APPENDIX B – ENVIRONMENTAL ASSESSMENTS

ECOLOGICAL, BUSHFIRE & CULTURAL HERITAGE

- *Naturecall Environmental* Statutory Ecological Assessment 2014 and addendum 2015
- *Bolwarra Environmental Services* Kempsey Comprehensive Koala Plan of Management Compliance Assessment February 2017
- *Midcoast Building and Environmental* Bushfire Hazard Assessment (September 2015)
- *The archaeological investigation for sites of indigenous cultural significance, Lot 1 DP 196559, Beranghi Rd, Crescent Head, Mid North Coast NSW.* By Mr John Appleton, July 2002.

Mar | 14

DARKHEART
Eco-Consultancy

STATUTORY ECOLOGICAL IMPACT ASSESSMENT:

Proposed 3 Lot Subdivision on Lot 1 DP 196559, Beranghi Road, Beranghi.

Prepared For: **Mr M.L. Corbett**

39 Lake Ridge Drive Kew NSW 2439
Phone/Fax: (02) 65 59 00 75 ♦ Mobile: 0409 833 968
darkhearteco@gmail.com

Notice To Users

This report is presented on an objective basis to fulfil the stated legislative obligations, considerations and requirements in order to satisfy the client's instructions to undertake the appropriate studies and assessments. It is not directly intended to advocate the proponent's ambitions or interests, but is to provide information required in the determination of development consent by the decision-making authority for the subject proposal.

To the best of our knowledge, the proposal described in this assessment accurately represents the proponent's intentions when the report was completed and submitted. However, it is recognised and all users must acknowledge that conditions of approval at time of consent, post development application modification of the proposal's design, and the influence of unanticipated future events may modify the outcomes described in this document. Completion of this report has depended on information and documents such as surveys, plans, etc provided by the proponent. While checks were made to ensure such information was current at the time, this consultant did not independently verify the accuracy or completeness of these information sources.

The ecological information contained within this report has been gathered from field survey, literature review and assessment based on recognised scientific principles, techniques and recommendations, in a proper and scientific manner to ensure thoroughness and representativeness. The opinions expressed and conclusions drawn from this report are intended to be objective, based on the survey results and this consultant's knowledge, supported with justification from collated scientific information, references/citations or specialist advice.

Furthermore, it is clarified that all information and conclusions presented in this report apply to the subject land at the time of the assessment, and the subject proposal *only*.

This report recognises the fact, and intended users must acknowledge also, that all ecological assessments are subject to limitations such as:

- Information deficits (eg lack of scientific research into some species and availability of information)
- Influences on fauna detectability eg season in which survey is undertaken
- Influences on species occurrence eg stage of lifecycle, migratory, etc
- Time, resource and financial constraints.

All users should take into account the above information when making decisions on the basis of the findings and conclusions of this report.

For and on behalf of Darkheart Eco-Consultancy,

Jason Berrigan
B. Nat. Res. (Hons, Grad. Cert. (Fish.).
MECANSW, MRZSNSW, MAPCN, MABS, MAHS, MRBIA
Senior Ecologist, DEC.

DOCUMENT STATUS	DETAILS/DISTRIBUTION	DATE	AUTHORISED BY

NOTE: This document is not authorised for non-client distribution unless signed authorisation provided above by DEC senior ecologist.

SUMMARY

This report presents the results of a statutory ecological assessment of the land identified as Lot 1 DP 196559, Beranghi Rd, Beranghi. This report is an updated version of an assessment prepared for the original development design in 2002, which was a traditional eleven 40ha block rural subdivision, and later a community title proposal in 2004. The report uses the previous survey results as a basis for assessment, with new records in the locality and also new listings under the TSC Act 1995 and EPBC Act 1999 also considered.

The proposed development is to establish a 3 Lot rural subdivision on the site with two lots of 150ha and one 162ha lot. Development envelopes 2ha in size have been identified in the east of each Lot fronting Beranghi Road where dwellings and Asset Protection Zones (APZs) will be located. These will be zoned 'E3' Environmental Management and the remainder of the Lots are designated as 'E2' Environmental Conservation areas under the Kempsey Shire Council Local Environmental Plan (LEP).

On each Lot, about 0.5ha of vegetation in each 2ha development envelope will be allowed to be largely cleared for the establishment of a building envelope which is to encompass buildings and on-site sewage treatment systems, with the required APZ allowed to extend into the residual of the 2ha development envelope. These structures and all infrastructure is to be located to avoid/retain all hollow-bearing trees and Koala food trees within the 2ha development envelope. Hence at most about 6ha of habitat may cleared/modified by the proposal (about 1.3% of the property).

Ten distinct vegetation communities were identified according to structural form and dominant canopy species. These were derived from edaphic (eg slope, moisture, soil type, drainage and aspect) and landuse/disturbance factors. No threatened flora species were detected, and none were considered likely potential occurrences.

Portions of the property fall under the 1:100 ARI and are mapped as having alluvial soils. The supported vegetation was considered to qualify as the Coastal Floodplain EECs – *Swamp Sclerophyll Forest* (parts of the east and west) and *River-flat Eucalypt Forest* (adjacent to Maria River).

A comprehensive ecological survey recorded the following threatened species on site:

- ***Koala***: A single Koala was observed on one occasion in the northwest paperbark swamp, and scats were found at a low frequency in various locations over the site. Previous survey by Kendall and Kendall also recorded Koala scats.
- ***Glossy Black Cockatoo***: Several birds were observed on the site, and numerous locations of chewed cones were found. The extent of the site incorporating a significant extent of potential forage and suitable hollow bearing trees suggested it could possibly support breeding of at least one pair of birds.
- ***Powerful Owl***: A Powerful Owl responded to call playback on and adjacent to the site during the survey. The extent of the site and available prey suggests the site would form part of a territory of a pair of birds, and with an extraordinary number of very large senescent trees, offered good potential to support breeding.
- ***Yellow-bellied Glider***: This survey recorded this species by call and spotlighting on site (in the dry sclerophyll forest and swamp forest communities) and adjacent to the west and south of the site, indicating the area is important to the Yellow Bellied Glider. Numerous sap incised trees were

observed on the site, and the abundance of hollows provided excellent habitat for this species. The site was considered to support at least one colony that would interact with adjacent colonies.

- ***Brushtailed Phascogale***: An individual of this species was recorded in dry sclerophyll forest in the eastern end of the site. The extent of habitat on and adjacent to the site suggests it could readily support a population of this species.
- ***Green-thighed Frog***: An individual of this species was recorded on top of the central ridgeline in dry sclerophyll forest amongst rather sparse groundcover. With dams and drainage lines, and areas of dry sclerophyll with dense, matted groundcover, the site has potential to support breeding of at least one population of this species.
- ***Yellow-bellied Sheathtail Bat****:* This species was *possibly* recorded via call detection in a brief pass over a hole in the canopy.
- ***Little Bent-wing Bat***: This species was *probably* recorded foraging along the tracks on the site.

Another 22 were considered potential occurrences due to a combination of factors such as local records, sufficient connectivity on site and in the locality, and suitable potential habitat.

Previous survey determined the property contained Core Koala Habitat, but a Koala Plan of Management approved for a previous development is no longer proceeding. Hence the proposal was assessed under the Core Koala Habitat development provisions of the Kempsey Shire Council Koala Plan of Management, and deemed to be able to comply.

It is acknowledged that the proposed development will have the generic negative effect of removal and fragmentation of some potential and known habitat and possibly some modification of a small part of the eastern extent of the *Swamp Sclerophyll Forest* EEC, and some indirect impacts eg edge effects. A number of mitigation measures are proposed in addition to controls provided by the Kempsey Shire Council Koala Plan of Management and the E2 zoning.

Overall, in context of the ecology of known/potentially occurring threatened species, extent of the EECs, and the extent of habitat to be removed relative to that remaining on site: the proposal is not considered likely to have an impact of sufficient order of magnitude to place a local population or local EEC occurrence at likely risk of extinction. Hence no referral to DoE or a Species Impact Statement is considered required.

TABLE OF CONTENTS

FIGURES, TABLES AND PHOTOS

INTRODUCTION

This firm has been requested to undertake a statutory ecological impact assessment on the land identified as Lot 1 DP 196559, Beranghi Rd, Beranghi. The development proposal is to establish a 3 Lot rural subdivision on the 459ha property.

This report is an updated version of a report prepared for the original development design in 2002 (Berrigan 2002b) and 2004 (Darkheart 2004). The report uses the previous survey results as a basis for assessment, with new records in the locality and also new listings under the TSC Act 1995 and EPBC Act 1999 also considered.

The statutory ecological assessment for this development proposal was undertaken in accordance with the *Environmental Planning and Assessment Act 1979*, as amended by the *Threatened Species Conservation* (TSCA) *Act 1995* which in turn has been amended by the *Threatened Species Conservation Legislation Amendments Act 2002* (Seven Part Test for Significance); and the Commonwealth *Environment Protection and Biodiversity Conservation* (EPBCA) *Act 1999* - Matters of National Environmental Significance.

An assessment of the Kempsey Shire Council *Comprehensive Koala Plan of Management* (KSC 2011) was also undertaken to determine the land classification and compliance obligations.

The survey and assessment was performed in consideration of the draft *Threatened Species Survey and Assessment – Guidelines for Developments and Activities* (DEC 2004), and the *Threatened Species Assessment Guidelines – Assessment of Significance* (DECC 2007). The assessment has also been undertaken in accordance with the Ecological Consultants Association of NSW – Code of Ethics (2002) available at www.ecansw.org.au.

1.0 BACKGROUND INFORMATION

1.1 SITE LOCATION AND ACCESS

Beranghi Rd is located about 15km east from Kempsey, along the Crescent Head Rd. The site is located about 7km along Beranghi Rd. Access to the property is via a gravel road.

The local position of the site in shown in Figure 1.

1.2 KEY DEFINITIONS

The **study site** is defined as the total holding currently owned by the proponent ie. Lot 1 DP196559 (also referred to as the 'property'). The **study area** consisted of the site and the adjacent land within 100m of the site. The **locality** is defined as land within a 10km radius of the study site.

These definitions are in line with DECC (2007).

1.3 PROPOSED DEVELOPMENT

The proposed development is to establish a 3 Lot rural subdivision on the site with two lots of 150ha and one 162ha lot. Development envelopes 2ha in size have been identified in the east of each Lot fronting Beranghi Road where dwellings and Asset Protection Zones (APZs) will be located. These will be zoned 'E3' Environmental Management and the remainder of the Lots are designated as 'E2' Environmental Conservation areas under the Kempsey Shire Council Local Environmental Plan (LEP). The proposed subdivision layout is shown in Figure 2.

On each Lot, about 0.5ha of vegetation in each 2ha development envelope will be allowed to be cleared for the establishment of a building envelope which is to encompass buildings and on-site sewage treatment systems, with the required APZ allowed to extend into the residual of the 2ha development envelope. These structures and all infrastructure is to be located to avoid/retain all hollow-bearing trees and Koala food trees within the 2ha development envelope.

Sewage treatment will be via on-site systems (to be established within building envelopes) conforming to Council's licensing standards, set back from any dam or watercourse to avoid water quality impacts.

1.5 CLIMATE AND WEATHER

1.5.1 Climate of the Bioregion

The climate of the north coast of the North Coast Bioregion from just north of Newcastle to the Queensland border is generally warm temperate. The main influence is the latitudinal position of subtropical anticyclone centres which move easterly across Australia.

In summer, warm moisture-laden east to south east winds prevail, sometimes bringing rain, with the heaviest in the form of thunderstorms or depressions from subtropical cyclones moving south. In winter, the northern movement of the anticyclones leads to a dominance of usually dry west to south winds, often leading to fine sunny days and cool nights. Rainfall is usually associated with cold fronts and the coldest temperatures.

Rainfall tends to be distributed more in summer in the north of the region, to relatively evenly distributed in the south. Annual rainfall is most influenced by distance from the coast and topographic position, with a general decrease from east to west. Annual rainfall in the Kempsey area (nearest station) is approximately 1213mm pa (Bureau of Meteorology 2010), falling predominantly in summer and autumn.

Temperature over the region primarily varies with altitude, decreasing about 5^{o} per 300m rise, and about 2-3^{o}C from north to south in areas of similar altitude. The average annual temperature on the coast is typically 16-20^{o}C, while the annual range is 18-22^{o}C (Australian Bureau of Meteorology, cited in Hager and Benson 1994).

Figure 1: Location of subject land

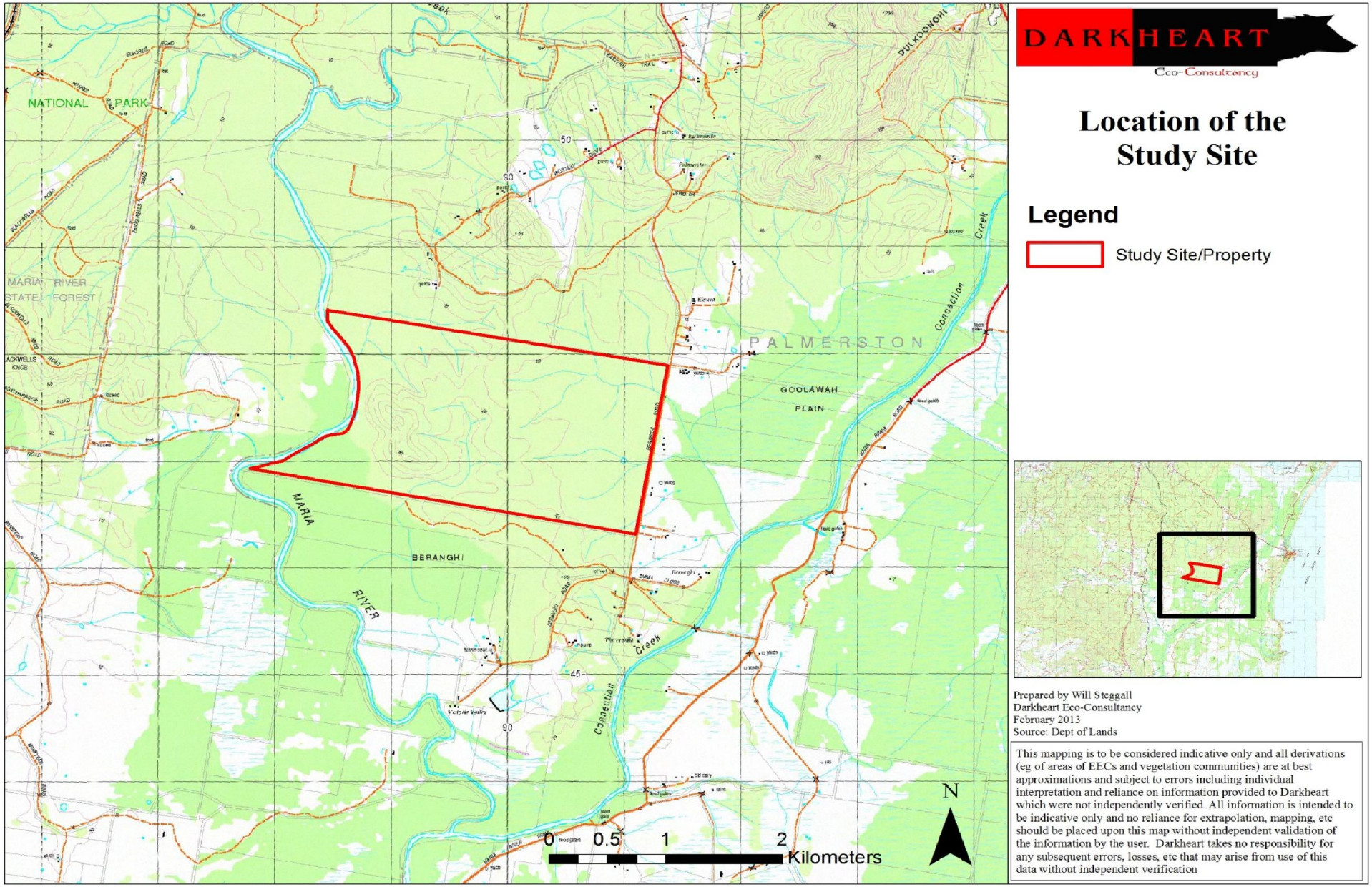
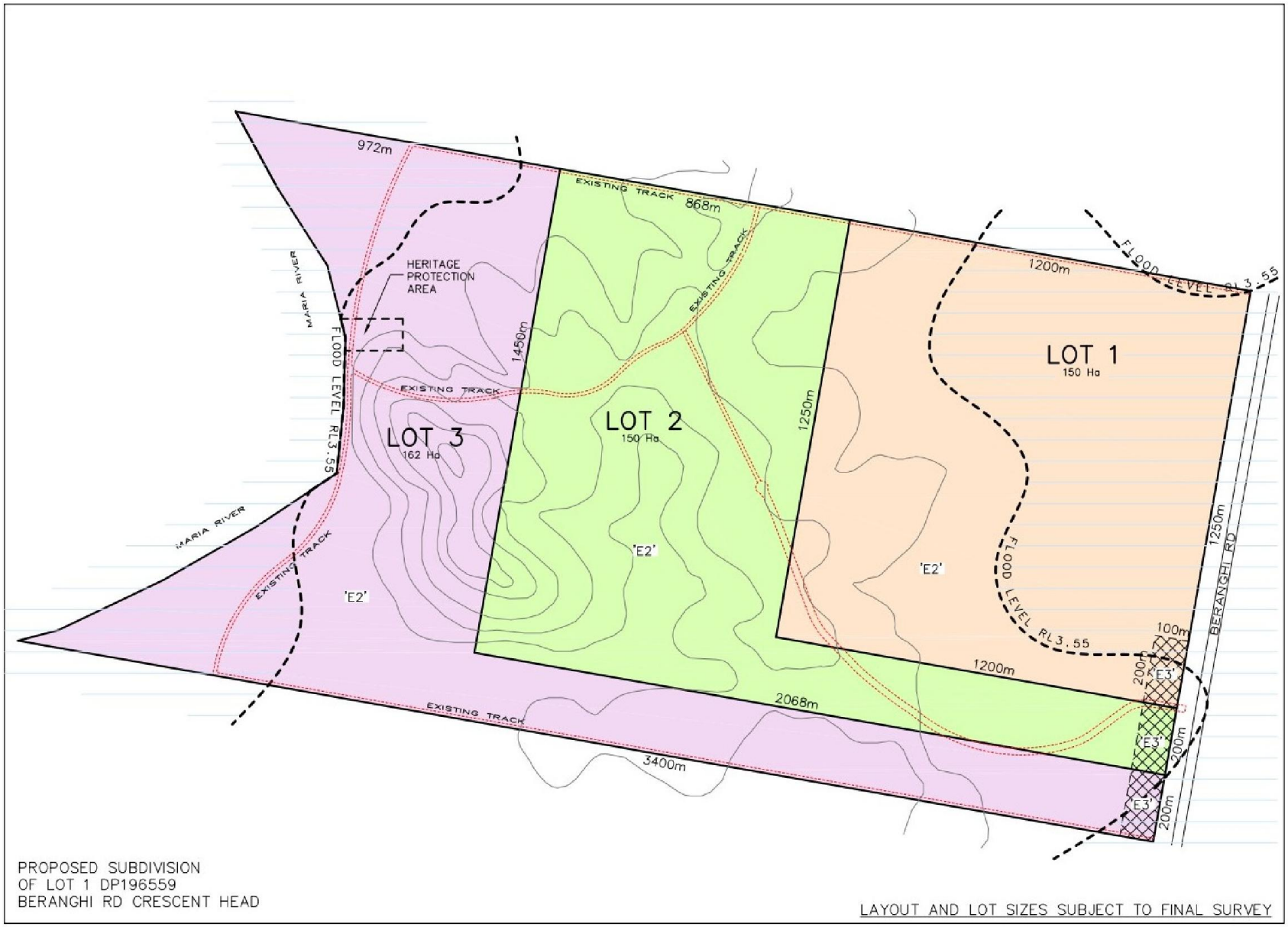


Figure 2: Proposed Subdivision Layout



1.5.2 Weather Conditions During Survey

The original survey was conducted over four weeks from 13/8/02 - 13/9/02. The Mid North Coast region was mostly declared in a state of drought at the time of the survey, with little rain occurring in the preceding months. About 30mm of rain (the most significant for months) fell on the site from 22nd – 27th August. Some other light rain (a few mm) also fell on the 15-16th August. However, the remainder of the survey period was dry, with days been warm to hot (24-30^{o}C) and nights being cool to mild (12-17^{o}C).

Winds varied over the survey period. In general, wind was from the north to east, often moderate in the afternoon. A number of southerly changes came through for a few days, bring milder conditions. These winds were strong.

1.6 TOPOGRAPHY AND SOILS

1.6.1 Topography

Refer to topographical map in Figure 1.

The topography of the site varies considerably from east to west. In the east, relatively flat land declines to a number of drainage lines, which drain east to Connection Creek. The land rises in the west to a low hill about 55m AHD, and then falls sharply to the Maria River; which forms the western boundary. This section of the Maria River is about 15-20 wide, and probably over 2-3 deep. Water quality is likely to be brackish, with salt wedges pushing up with summer tides.

Though there are several drainage lines, there are no true permanent watercourses on the site (only ephemeral flows). A number of dams have been constructed, and several deeper sections of the eastern drainage lines hold water in billabongs/minor scours.

1.6.2 Soils and Geology

Low elevation areas in the west of the site adjacent to Maria River consist of various alluvial deposits. These are mapped by Troedson & Hashimoto (2008) as floodplain, levee and alluvial and colluvial fan formations. Similarly in the low elevation areas in the east of the site, alluvial formations associated with Connection Creek further east occur. These are mapped as valley fill, alluvial and colluvial fan and backswamp. Figure 2 defines the RL 3.55 flood level on the site and land falling within it generally corresponds with the alluvial formations described above.

Bedrock of the Kempsey Beds formation comprising interbedded sandstone and siltstone covers the remainder of the site.

Site observations noted that the soil varies with location due to edaphic factors. On the hill, the soil is a shallow grey clay, with the parent material often emerging as rocks 10-30cm diameter on the surface. This deepens to a very fine, hardsetting grey clay which grades to orange-brown clay B horizon.

The soil adjacent to the river, especially in the swamp forest, consists of a mixture of alluvium and clay; stained a dark brown, which grades to a heavy grey clay with some iron mottling. This area is believed to be mapped as potential Acid Sulphate Soils (ASS) on the DLWC 1:25000 Telegraph Point ASS Risk Maps.

1.7 LANDUSE AND DISTURBANCE HISTORY

1.7.1 Past Uses

The property has been used predominantly for timber collection and cattle grazing.

Preferred tree species (most likely Tallowwood, Ironbark, Blackbutt, Thick-Leaved Mahogany and some Spotted Gum) appear to have logged over a number of rotations over the last 100 years or so. Judging by age distribution, logging intensity varied with the rotation period and density of preferred species, ie some areas show minimal signs, while others, especially the hill and western slopes, were once virtually cleared but for a few seed trees.

Cattle have been kept on the site at times grazing on native grasses, though at a low stocking rate due to the low carrying capacity of the soil and vegetation.

1.7.2 Fire

Fire has occurred periodically on the site, as indicated by charcoal on trunks, but appears from the nature of some areas to have not been especially intensive or widespread at least in recent years. No area has been left unburnt for any longer than perhaps 10-20years.

The last fire occurred in the summer 2001-02. Fire has burnt part of the eastern third of the site adjacent to Beranghi Rd. Fuel loads in other areas were moderate due to substantial groundcover and undergrowth consisting of highly flammable species eg Allocasuarinas.

1.7.3 Weed Invasion

Weeds are not common. Most are limited to the fringes of the road, and consist of a range of commonly species encountered species eg *Bidens pilosa*.

Lantana is common only in patches of the sclerophyll forest on the western face of the hill, and in some drainage lines.

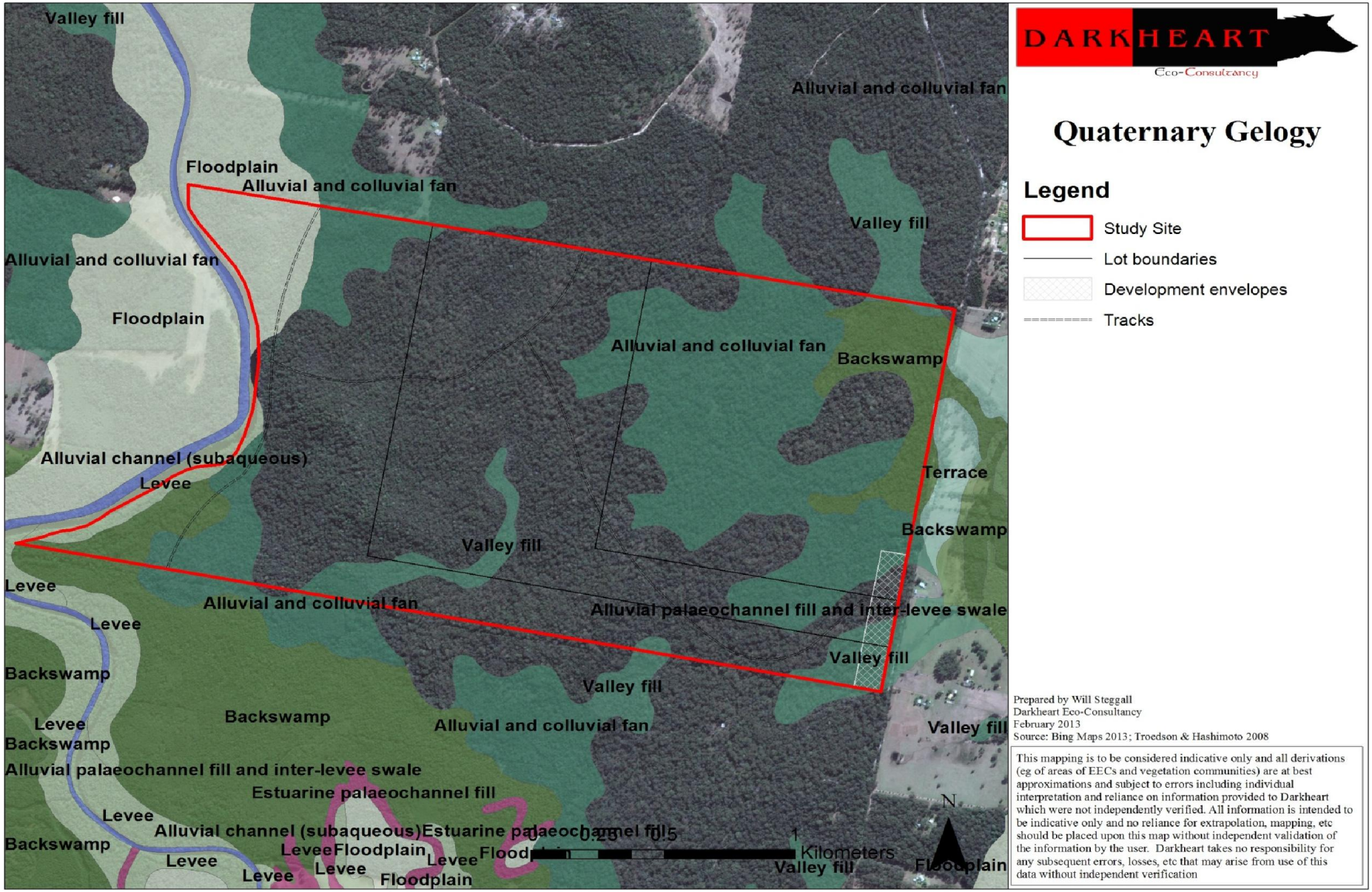
1.7.4 Non-Aboriginal Heritage

Ruins exist of a former convict detention dwelling on the western slope of the hill. The ruins consists of the remains of a number of stone walls that reportedly once formed part of a nightly “lock-up” for convict workers (Mr Robert Pitt, Kempsey Shire Council, pers. comm.).

1.8 ADJACENT DEVELOPMENTS AND ACTIVITIES

The general Beranghi area is a rural to rural residential area, with dwellings situated on large rural holdings, often vegetated with native forest. Two dwellings lie opposite the site. A tea tree oil plantation also lays opposite (east) the site.

Figure 3: Quaternary geology of the site



Maria National Park lies about 5-6km north and northwest of the site. A portion of Maria State Forest lies within about 3km west.

1.9 PREVIOUS STUDIES

1.9.1 Kendall and Kendall 1994

Kendall and Kendall Ecological Consultants (1994) were commissioned to conduct a preliminary Koala study of the subject land pursuant to a rezoning application to allow rural development. The study was only "preliminary" as survey methods and effort were limited, and the survey was conducted only using the boundaries as transects (Kendall and Kendall 1994). Surveying consisted of two days of scat searches under known browse species, and one night of spotlighting along the boundaries/transects.

Scats were found, but no Koalas were observed. The consultants concluded on the basis of this limited surveying effort, that "Koala numbers were not great" (Kendall and Kendall 1994).

1.9.2 Standing 1990

Standing (1990) in "*A Study of Koalas in the Macleay Valley*" conducted a review of Koala reports and habitat in the Beranghi-Crescent Head area. Apart from considering the Crescent Head/Beranghi/Maria River area as "containing one of the most significant populations of Koalas in the Macleay Valley"; she also notes "*this area abounds with wildlife including Swamp Wallabies, Red-Necked Wallabies, Eastern Grey Kangaroos, Brushtail Possums, Ringtail Possums, Sugar Gliders and Spotted-Tail Quolls*" (Standing 1990).

PART A: FLORA AND FAUNA SURVEY

2.0 SURVEY METHODS

2.1 GENERAL INFORMATION

The subject land was initially inspected on the 3/4/02 to determine the threatened species potentially occurring and the appropriate survey techniques. The original survey was conducted over four weeks from 13/8/02-13/9/02.

For this update, the available relevant literature and the current OEH Bionet/Atlas of Wildlife (OEH 2014a) were consulted for threatened species records within a 10km radius of the site.

2.2 FLORA

2.2.1 Local Threatened Flora Records

A search of the available literature and OEH Bionet database (OEH 2014a, Berrigan 2003d) found records of the following threatened species within 10km of the site.

Table 1: Locally recorded threatened flora species

Name	Legal Status	Distance From Study Site/General Location
Dwarf Heath Casuarina *(Allocasuarina defungens)*	E-TSCA, E-EPBCA	Limeburners Creek Nature Reserve
Hairy Joint-Grass *(Arthraxon hispidus)*	V-TSCA, V-EPBCA	Kundabung
Sand Spurge *(Chamaesyce psammogeton)*	E-TSCA	Goolawah Reserve
White-Flowered Wax Plant *(Cynanchum elegans)*	E-TSCA E-EPBCA	Delicate Nobby
Maundia triglochinoides	V-TSCA	Goolawah Reserve, North of Crescent Head Rd
Milky Silkpod *(Parsonsia dorrigoensis)*	V-TSCA, E-EPBCA	Limeburners Creek Nature Reserve
Austral Toadflax *(Thesium australe)*	V-TSCA, V-EPBCA	Crescent Head

E-TSCA = listed as endangered under the *Threatened Species Conservation Act 1995*
V-TSCA = listed as vulnerable under the *Threatened Species Conservation Act 1995*
E-EPBCA = listed as endangered under the *Environmental Protection and Biodiversity Conservation Act 1999*
V-EPBCA = listed as vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999*

2.2.2 Survey and Occurrence Prediction Methods

2.2.2.1 General

The flora survey routinely consisted of 2 main components:

- Identification, description and mapping of the major vegetation communities on the property, and any Endangered Ecological Communities/Endangered Populations listed under the *Threatened Species Conservation Act 1995* (TSCA), and/or *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA).
- Searches for and (if found) mapping of threatened species listed under the *Threatened Species Conservation Act 1995* (TSCA), and *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA).

Information derived from the above was also used to predict the likelihood of occurrence of threatened species recorded in the locality, Local Government Area (LGA) and North Coast Bioregion (see section 3.2.1.1 and Appendix 1).

2.2.2.2 Vegetation Community Survey Methodologies

Random walking transects in a zigzag pattern were used as opposed to plot sampling to survey the vegetation communities and search for threatened species. The sampling methodology utilised was considered suitable for the assessment for the following reasons (Forest Fauna Surveys *et al* 1997, DEC 2004, Cropper 1993):

- Provide the most amount of information for a given input.
- Provide an effective and highly accurate means to sample vegetation boundaries.
- Provide an efficient and effective means for assessing floristic diversity and possible presence of threatened species.

The vegetation communities were described from data collected during transect studies. Classification was based on the *Forest Types Classification Research Note 17* (1989) with sub-formation names for vegetation types adapted from the classification proposed by Beadle and Costin (1952) and Keith (2004) eg '*Dry Sclerophyll Forest'* to assist the fauna habitat evaluation, and the structural classification used by Walker and Hopkins (1990). Crown cover classes are defined by the following:

- **Closed or dense**: crowns touching to overlapping (crown separation ratio <0).
- **Mid-dense:** crowns touching or slightly separated (crown separation ratio 0– 0.25).
- **Sparse** : crowns clearly separated (crown separation 0.25–1).
- **Very Sparse:** crowns well separated (crown separation 1–20).
- **Isolated plants:** trees greater than 100 m apart, shrubs about 25m apart (crown separation >20).
- **Isolated clumps**: clump of two to five woody plants 200 metres apart (crown separation >20)

Species identification was made with the assistance of GTCC (2007), Bale (1993), Beadle (1982), Harden (1990, 91, 92, 93, 2000), Williams and Harden (1984), Williams and Harden (1980), Williams and Harden (unknown), Robinson (1994), and Brooker and Kleinig (1999). Plant species were identified to species or subspecies level and nomenclature conforms to that currently recognized by the Royal Botanic Gardens and follows Harden and PlantNET for changes since Harden (1990-1992, 2000).

2.2.2.2.2 Conservation Status Assessment

The conservation significance of vegetation communities was determined by comparing equivalent phytosociological associations and their conservation significance on the North Coast of NSW (eg Keith 2004, Keith and Scott 2005, NSWSC 2004a, 2004b, 2004c, 2004d, 2004e, 2005f, etc).

Identification of possible Threatened Ecological Communities (TECs) was based on the data collected by the survey and review of the relevant listings on the OEH website (www.environment.nsw.gov.au).

2.2.2.3 Threatened Flora Species Searches and Occurrence Assessment

2.2.2.3.1 Searches

Searches for the above locally recorded threatened flora recorded in the LGA and regionally in similar habitats to those occurring on the property (see Appendix 1), were carried out over the survey period in August-September 2002.

This involved intensive targeted searches over most of the whole site, with specific random meander over potential habitat for species either recorded within a 10km radius of the site, or in similar habitats in the region.

2.2.2.3.2 Potential Occurrence Assessment

Potential occurrence assessment of threatened flora species is provided in Appendix 1. This section assesses all considered threatened species listed under the TSCA and EPBCA for their potential to occur on site based on the following factors (DEC 2004, Forest Fauna Surveys 1997, DECC 2007):

- Presence/absence of suitable habitat.
- Condition and disturbance history of habitat.

- Local and regional records.
- Location of site within known distribution of the species.
- Connectivity with habitat where species is known to occur.

2.3 FAUNA

2.3.1 Local Threatened Fauna Records

The following table lists the significant fauna species that have been recorded or reported to occur within 10km of the study site (OEH Bionet 2014a, Standing 1990; Kendall and Kendall 1999; Redpath 2002; Darkheart 2004d, 2004f, Berrigan 2002h, 2003e, 1998e, 1998f, 1998g, 1999b, 2000d, Bill Larkin pers. comm., personal observations). Those in bold are dually listed under the EPBCA 1999.

The following species (excluding marine mammals, birds and reptiles as no suitable habitat is affected by the development) are considered likely to occur in the locality due to suitable habitat and regional records (some have been recorded within 20km) (OEH 2014a, DotE 2014a, personal observations). Those with an asterisk are listed under the EPBCA 1999:

1. ***Mammals*:** Parma Wallaby, Rufous Bettong, Eastern Pygmy Possum, Dwyer's Bat, Beccari's Freetail Bat, Hoary Bat, *New Holland Mouse

2. ***Birds*:** Grass Owl, Barking Owl, Little Eagle, *Red Goshawk, Spotted Harrier, Superb Fruit-Dove, Flame Robin, Scarlet Robin, Diamond Firetail, Hooded Robin, Bush Stone Curlew, Grey-Crowned Babbler, Speckled Warbler, White-Eared Monarch, Ground Parrot, Freckled Duck, *Painted Snipe, *Australasian Bittern.

3. ***Reptiles**:* Three-Toed Snake-Tooth Skink, Pale-Headed Snake.

4. ***Frogs*:** *Giant Barred Frog, *Olongburra Tree/Wallum Sedge Frog.

5. ***Insects***: Giant Dragonfly, Laced Fritillary.

Table 2: Locally recorded threatned fauna

Group	Common name	Species	Legal status	Distance from study site/general location
MAMMALS	Koala	*Phascolarctos cinereus*	V-TSCA	Recorded on site, numerous records along Beranghi Rd, Dulconghi Hill, Goolawah Plain, Maria River Sate Forest/National Park, Maria River State Forest/Kumbatine National Forest, Maria River National Park, Kalateenee State Forest, Kundabung, Mingaletta, Wharf Rd, Old Coast Rd, Maria River area, Crescent Head Rd area, Wharf Rd, Ballengarra State Forest; Big Hill, Crescent Head, Smiths Creek
	Spotted-Tailed Quoll	*Dasyurus maculatus*	V-TSCA, E-EPBCA	Crescent Head, Big Hill, Mingaletta, Kumbatine National Park, Maria River Sate Forest/National Park
	Brushtailed Phascogale	*Phascogale tapoatafa*	V-TSCA	Recorded on site, Maria River State Forest/National Park, Beranghi, Big Hill, Settlers Way, Dulconghi Hill, Ballengarra State Forest, 2km south of site
	Common Planigale	*Planigale maculata*	V-TSCA	Maria River State Forest/National Park
	Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	V-TSCA	South of Crescent Head
	Long-Nosed Potoroo	*Potorous tridactylus*	V-TSCA, V-EPBCA	Limeburners Creek Nature Reserve
	Squirrel Glider	*Petaurus norfolcensis*	V-TSCA	Maria River State Forest/National Park, Big Hill, Limeburners Creek Nature Reserve, Racecourse area
	Yellow-bellied Glider	*Petaurus australis*	V-TSCA	Maria River State Forest/National Park
	Little Bent-wing Bat	*Miniopterus australis*	V-TSCA	Goolawah Reserve, Racecourse Headland, Big Hill, Old Coast Rd, Maria River State Forest/National Park, Dulconghi Hill, Crescent Head
	Eastern Bent-wing Bat	*M. orianae oceanensis*	V-TSCA	Big Hill, Old Coast Rd, possible detection at Central Waste Depot, Crescent Head, Goolawah Reserve
	Eastern Cave Bat	*Vespadelus troughtoni*	V-TSCA	Near Racecourse Head
	Greater Broad-nosed Bat	*Scoteanax rueppellii*	V-TSCA	Big Hill, Goolawah Reserve, Dulconghi Hill
	Golden Tipped Bat	*Kerivoula papuensis*	V-TSCA	Maria River Sate Forest/National Park, Ballengarra State Forest
	Southern Myotis	*Myotis macropus*	V-TSCA	Big Hill area
	East Coast Freetail Bat	*Mormopterus norfolkensis*	V-TSCA	possible recording near Racecourse Headland
	Yellow-bellied Sheathtail-Bat	*Saccolaimus flaviventris*	V-TSCA	Dulconghi Hill
	Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V-TSCA	Ballengarra State Forest, Dulconghi Hill
	Eastern Long-Eared Bat	*Nyctophilus bifax*	V-TSCA	Goolawah Reserve
	Eastern Blossom Bat	*Syconycteris australis*	V-TSCA	Goolawah Reserve, Racecourse Headland area, near Big Hill
	Grey-headed Flying Fox	*Pteropus poliocephalus*	V-TSCA, V-EPBCA	Ballengarra State Forest, Racecourse area, Maria River Sate Forest/National Park, Crescent Head, Goolawah Reserve, Old Coast Rd, Crescent Head Rd area, Central Waste Depot, Dulconghi Hill
BIRDS	Glossy Black-Cockatoo	*Calyptorhynchus lathamii*	V-TSCA	Recorded on site, Maria River Sate Forest/National Park, Ballengarra State Forest, Kundabung, Maria River Sate Forest/Kumbatine National Park,

Group	Common name	Species	Legal status	Distance from study site/general location
	Square-Tailed Kite	*Lophoictinia isura*	V-TSCA	Kalateenee State Forest, Dulconghi Hill, Crescent Head , Crescent Head Rd area; Wharf Rd, Smiths Creek, Goolawah Reserve Mingaletta
	Powerful Owl	*Ninox strenua*	V-TSCA	Recorded on site, Old Coast Rd/Pipers Creek, Big Hill, Maria River Sate Forest/National Park, Dulconghi Hill, Limeburners Creek Nature Reserve
	Masked Owl	*Tyto novaehollandiae*	V-TSCA	Dulconghi Hill, Maria River National Park
	Sooty Owl	*Tyto tenebricosa*	V-TSCA	Old Coast Rd/Pipers Creek, Ballengarra State Forest
	Swift Parrot	*Lathamus discolor*	E-TSCA, E-EPBCA	Outskirts of Crescent Head
	Little Lorikeet	*Glossopsitta pusilla*	V-TSCA	Crescent Head area, Maria National Park
	Rose Crowned Fruit Dove	*Ptilinopus regina*	V-TSCA	Goolawah Reserve
	Barred Cuckoo-Shrike	*Coracina lineata*	V-TSCA	Big Hill
	Wompoo Fruit Dove	*Ptilinopus magnificus*	V-TSCA	Dulconghi Hill, Goolawah Reserve
	Varied Sittella	*Daphoenositta chrysoptera*	V-TSCA	Crescent Head area, Big Hill, Maria National Park
	White-Eared Monarch	*Carterornis leucotis*	V-TSCA	Crescent Head
	Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V-TSCA	Big Hill
	Painted Honeyeater	*Grantiella picta*	V-TSCA	Maria River State Forest
	Regent Honeyeater	*Anthochaera phrygia*	E-TSCA, E-EPBCA	Limeburners Creek Nature Reserve
	Olive Whistler	*Pachycephala olivacea*	V-TSCA	Limeburners Creek Nature Reserve
	Osprey	*Pandion haliaetus*	V-TSCA, EPBCA-Migratory	east of Dulconghi Hill, Crescent Head, Big Hill, Maria River, Mingaletta
	Blue-Billed Duck	*Oxyura australis*	V-TSCA	West of Big Hill
	Australasian Bittern	*Botaurus poiciloptilus*	V-TSCA, E-EPBCA	Limeburners Creek Nature Reserve, Maria River
	Black Bittern	*Ixobrychus flavicollis*	V-TSCA	Crescent Head area
	Jabiru/Black Necked Stork	*Ephippiorhynchus asiaticus*	E-TSCA	Crescent Head, Maria River Road, Rancho Relaxo, Goolawah Plain
	Comb-Crested Jacana	*Irediparra gallinacean*	V-TSCA	Goolawah Reserve, Maria River
FROGS	Green and Golden Bell Frog	*Litoria aurea*	E-TSCA, V-TSCA	Crescent Head, near Maria River Rd
	Green-thighed Frog	*Litoria brevipalmata*	V-TSCA	Recorded on site, Kundabung, Maria River State Forest
	Wallum Froglet	*Crinia tinnula*	V-TSCA	Big Hill
REPTILES	Stephens Banded Snake	*Hoplocephalus stephensii*	V-TSCA	Beranghi Rd

2.3.2 Fauna Survey Methodology

2.3.2.1 Habitat Evaluation

The site was initially inspected to determine the available potential habitats, and the support value of these habitats for threatened species. Habitats were defined according to parameters such as:

- structural and floristic characteristics of the vegetation eg understorey type and development, crown depth, groundcover density, etc.
- degree and extent of disturbance eg fire, logging, weed invasion, modification to structure and diversity, etc.
- soil type and suitability eg for digging and burrowing.
- presence of water in any form eg dams, creeks, drainage lines, soaks.
- size and abundance of hollows and fallen timber.
- availability of shelter eg rocks, logs, hollows, undergrowth.
- wildlife corridors, refuges and proximate habitat types.
- presence of mistletoe, nectar, gum, seed, sap, etc sources.

In consideration of the threatened species recorded in the locality, available habitats and potentially occurring species, the following survey methods were employed:

- trapping using 80 Elliott A traps, 20 Elliot B traps, 12 wire cage traps, and 20 pitfall traps per night.
- Hair tubing with 10 tubes of 15cm diameter, 10 tubes of 10cm diameter, and 20 of 2.5cm diameter.
- spotlighting by walking with a 100w hand-held spotlight through unroaded sections; and driving along trails with two observers using spotlights in the tray of a dual cab utility.
- scat, burrow and hollow inspections (where possible)
- call playback, detection and recording
- physical searches of habitat eg logs, leaf litter, etc.
- opportunistic sighting

All field surveying was conducted as per the conditions of the consultant's Animal Research Authority and Section 120 Scientific License.

2.3.2.2 Trapping and Hair Tubes

2.3.2.2.1 Elliot A trapping

Eighty Elliot A traps were set on 12 nights (960 trap nights) over portions of the site where there was dense groundcover or a local abundance of fallen logs. Traps were laid 10m apart along two transects in two different sections of the site. Traps were placed in dense groundcover, amongst rocks, near the base of trees and near fallen timber/debris. Traps were baited with a mixture of rolled oats, peanut butter and honey.

2.3.2.2.2 Elliot B (Arboreal) Trapping

Twenty Elliot B traps were mounted on platforms to trees with potential hollows, and Pink Bloodwoods (*Corymbia intermedia*) that were exuding sap (thus potential forage trees); or on trees adjacent to several of the latter. The traps were baited with honey soaked rolled oats and peanut butter. The target species were the Squirrel Glider and Brush-Tailed Phascogale. All traps were mounted on platforms so as to drain out the entrance. A total of 400 trap nights were performed.

The base and trunk of Elliot trap trees, and tree trunks within a 20m radius of each trap were sprayed with a honey-water solution from a pressure sprayer as an attractant.

The Long-Nosed Potoroo was not targeted due to lack of potential habitat.

2.3.2.2.3 Pitfall trapping

For detection of small terrestrial mammals, frogs and reptiles and snakes: five lines of pitfall traps were set-up. These consisted of steel buckets 50cm deep and 25cm wide buried in the ground, with a 20cm diameter piece of foam for flotation, and leaf litter for shelter. These traps were aligned with a 5m long 50cm high mesh barrier fence so that a trap lay at each end. Traps were closed with a steel lid if rain was a substantial risk. A total of 400 pit trap nights were performed.

Pitfall traps were concentrated in the swamp forest communities, due to the greater potential for the Common Planigale to occur, which was the main target species of this method.

2.3.2.2.4 Cage Trapping

Five wire cage traps were placed in transects 50m apart over the property, for 20 nights. These were baited with a piece of apple mixed with honey-soaked rolled oats and honey. All traps were mounted over 6m up the trunk, targeting the Yellow-bellied Glider.

Seven wire cages traps were placed in an even distribution over the property to maximise the potential for detecting the Spotted Tail Quoll. Traps were baited with meat, and linked with a scent trail. Traps were mounted on very large trees (>1.5m diameter) with large hollows, log piles, and near the base of trees with burrows.

2.3.2.2.5 Hair Tubes/Funnels

The large hair tubes (15cm diameter) were baited with either honey-soaked rolled oats or meat, and mounted to trees to target the Yellow-bellied Glider and Spotted-Tail Quoll.

The middle-sized hair tubes were baited with honey soaked rolled oats and peanut butter, and mounted to hollow-bearing trees, sap-exuding Pink Bloodwoods, or fallen logs. Target species were Squirrel Gliders and Brush-Tailed Phascogales.

The small tubes were baited with honey-soaked rolled oats and peanut butter mixture, and set on the ground (mainly in runways) within dense vegetation, especially of the swamp forest where saw sedge and Spikerush occurred.

All tubes were set for three days at a time, with tapes being removed on the fourth day, and the tubes reset for another three days the following day. A total of 720 tube nights were performed. All hairs were sent to Barbara Triggs, a hair identification specialist, for identification.

2.3.2.3 Spotlighting and Torch Searches

Spotlighting was conducted on this site for at least 4hrs, due to the large size of the property. Spotlighting involved a mixture of walking with a hand held 100 watt spotlight over un-roaded sections, and spotlighting with two observers from the back of a slow moving vehicle driving along the tracks. A total of 40 hours was spent spotlighting.

Torch searches for frogs were also taken around the edge of the culverts on Beranghi Rd adjacent to the site; the edges of the dams and a minor waterhole near the stockyards; and along the edge of Maria River.

Spotlighting was conducted at various intervals between dusk and dawn. Conditions varied from overcast and nearly clear nights. Wind was gusty to placid. The moon ranged throughout its full cycle during the survey period.

2.3.2.4 Yangochiropteran Bat Call Detection

An Anabat II bat call detector was carried during spotlighting to opportunistically record bats. The detector was also left in various locations for 30 minute recording intervals. A total of 40 hours was spent on call detection of Yangochiropteran bats.

2.3.2.5 Call Playback

Recorded calls of the following species were played back on the site:

- Koala
- Bush-Stone Curlew
- Masked, Barking and Powerful Owls
- Yellow-bellied Glider and Squirrel Glider.
- Wallum Froglet
- *Mixophyes iteratus, M. balbus*
- Green and Golden Bell Frog

Sooty Owl calls were not played due to lack of suitable habitat. Calls were played through a CD player via a 30W PA system from the rear of a utility or via a megaphone walking through the forest or by drainage lines and dams (for frogs), at a level approximating natural intensities of the species. The methodology involved playback of the call, followed by 5-10 minutes of listening; 10-15 minutes spotlighting for owls attracted by the calls (but not responding vocally), within 100m radius of the playback point; and playback of the next call, etc. Calls of the birds were generally played at dusk and dawn, when such calls are normally heard, with the greater part being from dusk to 12am. In general, mammal calls were played at various periods during spotlighting, with occasional random calls of the birds, except for the Yellow-bellied Glider which was played about 45mins to 1hour after dusk, or an equivalent time just before dawn. At least 1.25 hours were spent on call playback per night over the 4 week survey period, with a total of 20 hours.

In addition to listening for responses by owls to the recorded calls, alarm calls of the Yellow-bellied Glider were listened for in response to Powerful Owl (a known predator) playbacks.

Calls of the Wallum Froglet were played near the swamp forests; calls of the Mixophyes frogs were made near the drainage lines; and Green and Golden Bell Frogs near dams and in the swamp forest. Playback was initiated after dusk, with calls played intermittently over a 3 hour period as part of the above.

2.3.2.6 Diurnal Bird Survey

Birds were generally surveyed by detecting calls and searching by binoculars at dawn and dusk, while walking around the entire site, and opportunistically during other activities.

This provided short-term seasonal data on bird occurrences in the area for the particular season (DEC 2004).

2.3.2.7 Reptile, Frog and Habitat Surveys and Secondary Evidence

For a period of 2-3 hours per day, physical habitat searches were undertaken. This involved lifting up of timber, rocks and debris, inspection of dense vegetation and leaf litter for frogs and reptiles, binocular inspection of hollows, observation of likely basking sites and searches for scats, tracks and scratches. This time was also devoted to searching under Oaks for chewed cones indicative of the occurrence of the Glossy Black Cockatoo; under preferred forage species for Koala scats; and opportunistically for owl regurgitation pellets. A total of 50 hours was spent on this activity.

Species identification was assisted by Simpson and Day (1996), Wilson and Knowles (1992), Strahan (1992), Briggs (1996), Robinson (1996), and Schode and Tideman (1990).

2.4 SURVEY LIMITATIONS

All surveys are limited in their ability to fully document all species of flora and fauna likely or actually occurring on a site. Surveys such as these are merely “snapshots” in time, and can only be expected to provide an indicative not absolutely comprehensive representation of a site’s species assemblage (DEC 2004, Forest Fauna Surveys 1997). To counter this limitation, this survey has employed methods recommended in literature and known from personal experience to best detect the target species under the site and weather conditions at the time, and conservatively considered likelihood of occurrence based on local and historical records, presence of suitable habitat on site/study area, and records in similar habitat in the bioregion (see Appendix 1).

2.4.1 Flora

Flora detection is limited by the lifecycle stage of the plant eg no conspicuous above-ground components of the plant or lack of flowers and leaves. Some plants may thus escape detection by camouflaging in dense vegetation or not being physically visible at the time of the survey.

Identification limitations for species possibly being of conservation significance are routinely dealt with by referring samples to other consultants, NPWS or the Royal Botanical Gardens Herbarium Identifications Service. Flora detectability was very high for the site due to the limited study area/extent of vegetation communities and relatively low diversity.

The extent of the property limited detectability of some species, especially due to the time limitations, however, this was compensated by thorough targeted searches of areas considered to have the best potential for such species.

2.4.2 Fauna

Fauna detectability is limited by seasonal, behavioural or lifecycle of each species, and even habitat variations (eg flowering periods), which can vary within a year, between years, decades, etc. Habitat evaluation is used to counter this limitation by assessing the potential occurrence of threatened species based on potentially suitable habitat in the study area and local records.

The original survey period fell in late winter-early spring, which is period of low activity for some fauna eg Yangochiropteran bats, thus detectability may be expected to be limited for such species. Detection of seasonal breeding frogs also would be limited for species breeding in winter, or year round. The region was also in a state of drought, which may have had a significant effect on the abundance/presence of some fauna eg frogs.

Physical extent and time limitations for the survey limited fauna survey effort and intensity. This was compensated by maximising the number of traps/hair tubes, locating transects in areas of best potential, and utilising a range of techniques, over a period of 4 weeks and various weather conditions.

Recent burning of some of the eastern sections of the property may have also affected presence and detectability of some fauna groups.

3.0 SURVEY RESULTS

3.1 VEGETATION COMMUNITIES

Refer to vegetation map in Figure 3, Appendix 3 for the species list, and site photos following descriptions.

Ten distinct vegetation communities were identified according to structural form and dominant canopy species. These were derived from edaphic (eg slope, moisture, soil type, drainage and aspect) and landuse/disturbance factors. These descriptions are broad.

3.1.1 Open Dry Sclerophyll Forest A – Grassy Scribbly Gum

Distribution: This community occurs in limited areas on the eastern two thirds of the site only. Edaphic factors seem to be the main determinant, with the community found on flat or low-lying areas only. This community grades upslope into Dry Sclerophyll Forest (DSF) B, and into wetter areas into DSF C.

Structure and Species Composition:

(a) Canopy:

Structure and species: Dominated almost exclusively by Scribbly Gum (*Eucalyptus signata*) with occasional Red Mahogany (*E. resinifera*), and in wetter areas, Narrow-Leaved Red Gum (*E. seeana*). Canopy height is 20-30m, with about 45-60% canopy cover. Trunk DBH varies from 0.2-1.8m (most 20-40cm). Age varies with previous

logging, with some areas containing patches about 0.5ha of very young trees (trunk DBH <15cm).

(b) Understorey:

Structure and Species: Generally poorly defined and open, though sometimes dense stands of young Scribbly Gums 10-18m with trunk DBH 10-20cm occur. Allocasuarinas such as Black Oak (*A. littoralis*) and Forest Oak (*A. torulosa*) were limited to the edges of drainage lines or ecotones with DSF B. Height of these species generally ranged from 5-10m, with most trees being barely mature.

(c) Shrub layer:

Structure: Variable, from well-developed to sparse - depending on light penetration and species, generally 0.5 to 8m high.

Species: Varies from very few small and scattered shrubs amongst open grassy areas (almost like parkland), to patches of Coast Tea Tree (*Leptospermum laevigatum*) 4-8m tall often in dense stands, or scattered *Melaleuca sieberi, Leptospermum juniperinum, L. polygalifolium,* and *Pultenaea retusa* <1.5m. Broad-Leaved Geebung (*Persoonia levis*), *Banksia spinulosa*, and *B. oblongifolia* were also occasional, as was Sweet Wattle (*Acacia suaveolens*). Allocasuarinas were generally confined to patches usually <2m tall along the ecotone with DSF B.

(d) Ground-layer:

Structure: Very dense and matted. Height ranging from 0.2-0.5m

Species: Dominated almost exclusively by Wiry Panic (*Entolasia marginata*) with occasional Spiny-Headed Matrush (*Lomandra longifolia*). *Dianella caerulea* is a common occurrence, and some patches of Bracken Fern (*Pteridium esculentum*) also occur. In some very poorly drained areas, saw sedge (*Gahnia clarkei*) form dense patches up to about 0.5ha.

(e) Climbers and Scramblers:

Climbers and scramblers were not common overall. *Hardenbergia violacea* was the main species observed.

Comments: This community appears to be a result of both edaphic factors (poor drainage) and to a lesser extent logging (latter suggested by some near pure stands of young Scribbly Gums). This aesthetically attractive community is easily defined by the sudden change to a dense grassy groundcover, and general openness.

3.1.2 Open Dry Sclerophyll Forest B – Scribbly Gum with *Xanthorrhoea*

Distribution: This community is generally the dominant vegetation on-site, especially the eastern ridges.

Structure and Species Composition:

(a) Canopy:

Structure and species: Overall dominated by Scribbly Gum (*Eucalyptus signata*), with occasional Pink Bloodwood (*Corymbia intermedia*). In the middle on the main ridge, and grading to the west, Blackbutt (*Eucalyptus pilularis*) and Thick-Leaved (*E. carnea*)

become increasingly common associates (sometimes locally dominant in small patches of 1-2ha). Tallowwood (*E. microcorys*) also occurs infrequently yet conspicuously on the lower slopes towards drainage lines. Canopy height is 20-30m, with about 50-80% canopy cover. Trunk DBH varies from 0.2-1.8m (most 30-60cm), with senescent trees patchily distributed amongst large patches of immature regrowth, with a slight concentration around the middle of the property.

Some areas appear to have been locally clearfelled, especially the mid-southern ridge which is only relatively recently (<20-30yrs) old, and is characterised by either dense pure stands of Scribbly Gum or Thick-Leaved with trunk DBH <25cm.

(b) Understorey:

Structure and Species: Intergrades in terms of height to some extent with canopy; generally open and some dense/closed patches, depending on past clearing and species. Dominated by eucalypt saplings, Black Oak (*Allocasuarina littoralis*) and Forest Oak (*A. torulosa*). The latter may form dense localised patches, especially in the southwest corner where logging appears to have been locally intense. Understorey height ranges from 5-18m, depending on floristics. Trunk DBH varies with species, ranging from <10-30cm, and canopy cover varies from 40-80%.

(c) Shrub layer:

Structure: Variable, from well-developed to sparse- depending on light penetration and species, generally 0.5 to 4m high.

Species: Dominated by young Allocasuarinas in general, with young eucalypts. Other common species include *Pultenaea retusa*, Broad-Leaved Geebung and Hopbush (*Dodonaea triquetra*). *Pultenaea retusa* especially is often very dense in this community.

(d) Ground-layer:

Structure: Sparse to very dense and matted. Height ranging from 0.2-0.5m

Species: Characteristically dominated by *Xanthorrhoea macronema* matted with Wiry Panic (*Entolasia marginata*). In some areas, especially the drier or specifically intensely logged (and probably frequently burnt) ridges, Bladey Grass (*Imperata cylindrica*) dominates with some Spiny-Headed Matrush (*Lomandra longifolia*). Common forbs also occur.

(e) Climbers and Scramblers:

Climbers and scramblers were not common, except for False Sarsaparilla (*Hardenbergia violacea*).

Comments: This community is defined by the different groundcover. It is likely to have been originally broken down into other associations, such as *E. carnea* or *E. pilularis*, however the long history of logging (including some obviously very intense rotations where over 85% of the canopy appears to have been removed) has resulted in an alteration of the structure and floristics eg allowing Scribbly Gum to become dominant. The present delineation is thus very broad.

3.1.3 Open Dry Sclerophyll Forest C – Scribbly Gum/*Melaleuca sieberi*

Distribution: This community occurs on the fringe of swamp forest communities, as a distinguishable yet variable ecotone.

Structure and Species Composition:

(a) Canopy:

Structure and species: Dominated by Scribbly Gum, sometimes associated with Red Mahogany (*E. resinifera*), or in wetter areas, some *Melaleuca quinquenervia,* and *M. linariifolia,* and a few Narrow-Leaved Red Gums (*E. seeana).* Canopy height is 20-25m, with about 40-60% canopy cover. Trunk DBH varies from 0.2-1.4m (most 30-60cm).

(b) Understorey:

Structure and Species: Poorly defined in some areas, and well developed in others. Usually consists of young Scribbly Gums and mature *M. sieberi*. Occasionally other Melaleucas and Cheese Tree. Understorey height ranges from 5-18m, depending on floristics. Trunk DBH varies with species, ranging from <10-30cm. Canopy cover can vary from 20% to 75%.

(c) Shrub layer:

Structure: Variable, from well-developed to sparse- depending on light penetration and species, generally 0.5 to 4m high.

Species: Notably dominated by *M. sieberi*. Occasional wattles, other Melaleucas including *M. nodosa* and young Cheese Trees may occur in patches or scattered throughout.

(d) Ground-layer:

Structure: Very dense and matted. Height ranging from 0.2-0.5m

Species: Generally dominated by Wiry Panic (*Entolasia marginata*) matted with and Spiny-Headed Matrush (*Lomandra longifolia*), or dense patches of saw sedge (*Gahnia clarkei*).

(e) Climbers and Scramblers:

Climbers and scramblers were not particularly common, though Monkey Rope (*Parsonsia straminea*) was notable, with some False Sarsaparilla (*Hardenbergia violacea*) and Scrambling Lily.

Comments: This community is floristically quite simple yet distinctive as an ecotone around gullies and swamp areas, especially grading into the *M. nodosa* swamp forest.

3.1.4 Dry Sclerophyll Forest D – Blackbutt

Distribution: This is the second largest community on the site. It mainly occurs on the slopes and ridges in the west, with a small patch near the corral/present entrance.

Structure and Species Composition:

(a) Canopy:

Structure and species: Overall dominated by Blackbutt. Other associates vary with logging history and location, thus very difficult to describe a true association.

On the southwestern footslopes and eastern slopes of the western hill, Blackbutt is associated with Pink Bloodwood and Scribbly Gum. On the western face of the hill, it is associated with Pink Bloodwood, Thick-Leaved and Grey Ironbark. In some patches it is also associated with the Stringybark (*E. globoidea*). The small patch near the corral is associated with Pink Bloodwood and Tallowwood.

Overall, canopy height is 20-30m, with about 30-70% canopy cover. Trunk DBH varies from 0.2-1.8m (varies with location, with the western areas generally 20-40cm due to intense logging). Age varies considerably with previous logging, with some areas containing very young trees only (DBH <30cm), and no senescent trees.

(b) Understorey:

Structure and Species: Overall, dominated by Allocasuarinas often forming a dominant component of the understorey, and young eucalypts, 6-20m high. On the southwestern footslope, Allocasuarinas often form a closed sub-canopy due to near total clearing in the past. Understorey is more open on the eastern mid to foot slopes of the west hill, and in the eastern patch. Brushbox (*Lophostemon confertus*) is also very common as small trees 6-10m especially on the western face of the hill.

(c) Shrub layer:

Structure and Species: Variable with fire and logging history. Allocasuarinas are overall most common, though Hopbush, Broad-Leaved Geebung, young eucalypts and *Pultenaea retusa* are also common. Brushbox seedlings are common especially on the western side.

(d) Ground-layer:

Structure: Sparse to very dense. Height ranging from 0.2-0.5m

Species: Generally upper slopes and drier areas dominated by Bladey Grass and Spiny Headed Matrush, and lower, more moister areas dominated by Wiry Panic and Bracken Fern (*Pteridium esculentum*). Common forbs also occur.

(e) Climbers and Scramblers:

Climbers and scramblers were not common, except for False Sarsaparilla (*Hardenbergia violacea*) and some Scrambling Lily (*Geitonoplesium cymosum*) and *Hibbertia scandens*.

Comments: This community actually gathers a number of similar associations grouped together by having Blackbutt as the overall dominant species, and Allocasuarinas dominating the undergrowth. In general, Scribbly Gum was a common associate as well (though varying from co-dominant to infrequent). As for the previous community, these areas have been intensively logged (at least 60% loss of canopy; mostly 80%), and possibly burnt, which has had a significant effect on floristic and structural characteristics. The western areas of this forest were considered generally immature, and may revert to a better semblance of their original character in the long term.

3.1.5 Dry Sclerophyll Forest E – Thick-Leaved Mahogany

Distribution: This community dominates the western hill from the midslope to the crest.

Structure and Species Composition:

(a) Canopy:

Structure and species: Dominated by Thick-Leaved Mahogany (*E. carnea*), with common associates Blackbutt and Pink Bloodwood. Canopy height is 20-25m, with about 60-80% canopy cover. Trunk DBH varies from 0.2-1.8m (most 20-40cm). Age varies with previous logging, with some areas containing only even aged trees, and others with 10-15% senescent trees.

(b) Understorey:

Structure and Species: Intergrades to some extent with canopy; generally dense due to relative even age of forest. Dominated by eucalypt saplings (mainly *E. carnea*), and an abundance of Black Oak (*Allocasuarina littoralis*) and Forest Oak (*A. torulosa*). Understorey height ranges from 5-18m, depending on floristics. Trunk DBH varies with species, ranging from <10-30cm.

(c) Shrub layer:

Structure: Generally well developed depending on light penetration and species, generally 0.5 to 4m high.

Species: Dominated by a plethora of young Brushbox (*Lophostemon confertus*) and Allocasuarinas in general, with young eucalypts.

(d) Ground-layer:

Structure: Sparse. Height ranging from 0.2-0.5m

Species: Generally dominated by Bladey Grass with sparse Wiry Panic with Spiny-Headed Matrush. Common forbs also occur eg *Dianella caerulea*.

(e) Climbers and Scramblers:

Climbers and scramblers were not common. False Sarsaparilla (*Hardenbergia violacea*), *Hibbertia scandens* and Scrambling Lily were the most common.

Comments: This community has been completely cleared by logging but for a few remnant trees, and is still in a state of recovery.

Photo 1: Dry Sclerophyll Forest A

Photo 2: Dry Sclerophyll Forest B

Photo 3: Dry Sclerophyll Forest C

Photo 4: Dry Sclerophyll Forest D

Photo 5: Dry Sclerophyll Forest E

3.1.6 Moist Sclerophyll Forest A – Brushbox/Tallowwood

Distribution: This community occupies two minor drainage lines on the western slopes of the western hill.

Structure and Species Composition:

(a) Canopy:

Structure and species: Brushbox and some Tallowwood constitute the most common emergent species, with Pink Bloodwood also common, and occasional Blackbutt. Canopy height is 20-30m, with about 60-80% canopy cover. Trunk DBH varies from 0.2-1.4m (most 30-60cm).

(b) Understorey:

Structure and Species: Intergrades to some extent with canopy; generally dense and partly closed. Dominated by Forest Oak on higher area, with the gully line dominated by rainforest species in the gullies (eg Cheese Tree and *Acronychia oblongifolia*), and Weeping Bottlebrush (*Callistemon saligna*). Understorey height ranges from 5-18m, depending on floristics. Trunk DBH varies with species, ranging from <10-30cm.

(c) Shrub layer:

Structure: Variable, from well-developed to sparse- depending on light penetration, location and species, generally 0.5 to 4m high.

Species: Dominated by young Brushbox and Allocasuarinas in general. Gullies dominated by dense rainforest species (eg *Acronychia oblongifolia*). Some lantana also occurs in the gullies and by the lower edges of the forest.

(d) Ground-layer:

Structure: Sparse to dense. Height ranging from 0.2-0.5m

Species: Generally consists of Wiry Panic (*Entolasia marginata*) with some Spiny-Headed Matrush, or the grass, *Ottochloa gracillima* in more shaded areas. Rasp Fern (*Doodia aspera*) is very common, as is occasional False Bracken and Gristlefern (*Blechnum cartilagineum*). Tassel sedge (*Carex fascicularis*) and saw sedges (*G. clarkei* and some *G. aspera*) dominate wetter areas.

(e) Climbers, Scramblers, etc:

Twiners were common, and included species such as *Hibbertia scandens.* Scrambling Lily, Wombat Lily (*Eustrephus latifolius*), and Native Yam (*Dioscorea transversa*). *Parsonsia straminea* dominated some sections of the gullies.

Comments: This small community constitutes in total an area probably less than 2-3ha, and was probably once much more extensive prior to logging. Though not a true moist forest, it had enough elements to qualify, and may return to such a state if allowed to recover.

3.1.7 Moist Sclerophyll Forest B – Brushbox/Flooded Gum

Distribution: This community occurs as a patch less than 1ha on higher land in the southwest corner of the site, and extends south onto adjacent land.

Structure and Species Composition:

(a) Canopy:

Structure and species: Dominated by Brushbox and Flooded Gum (*E. grandis*), with occasional Grey Ironbark (*E. placita*). Canopy height is 20-35m, with about 60-80% canopy cover. Trunk DBH varies from 0.2-1.2m (most 30-60cm).

(b) Understorey:

Structure and Species: Well defined, from 6-20m, with canopy cover 60-100%. Dominated by rainforest species (eg Cheese Tree and *Acronychia oblongifolia*), and Weeping Bottlebrush (*Callistemon saligna*). Trunk DBH varies with species, ranging from <10-30cm.

(c) Shrub layer:

Structure: Very sparse, depending on light penetration, location and species, generally 0.5 to 4m high.

Species: Dominated by young Brushbox, *Callistemon saligna*, Cheese Tree, Hard Quandong (*Elaeocarpus obovatus*), Native Cascarilla (*Croton verreauxii*), Orange Thorn (*Citriobatus pauciflorus*) and *Acronychia oblongifolia*.

(d) Ground-layer:

Structure: Sparse to dense. Height ranging from 0.2-0.5m

Species: Generally consists of some Spiny-Headed Matrush, and the grasses, *Ottochloa gracillima* and *Oplismenus aemulus*. Some Rasp Fern (*Doodia aspera*), False Bracken and Gristlefern (*Blechnum cartilagineum*) occur. Tassel sedge (*Carex fascicularis*) and saw sedges (*G. clarkei* and some *G. aspera*) dominate wetter areas.

(e) Climbers, Scramblers, Epiphytes etc:

Twiners were very common, and included species such as Scrambling Lily, Wombat Lily (*Eustrephus latifolius*), Native Yam and *Morinda jasminoides*. *Hibbertia scandens* was relatively common. *Parsonsia straminea* was a very common liana.

Elkhorns were occasional on some trees.

Comments: This small community was <1ha on the site, and evidenced little evidence of logging.

Photo 6: Moist Sclerophyll Forest A

Photo 7: Moist Sclerophyll Forest B

3.1.8 Paperbark Swamp Forest A – *M. nodosa*

Distribution: This community occurs mainly in the northwest as a transition from the dry sclerophyll (Scribbly Gum and *M. sieberi*) to the true swamp forest dominated by *M. linariifolia* and Swamp Mahogany on the lowest portions of the site. It also occurs as a discontinuous ribbon in the southwest corner around the *Melaleuca quinquenervia-M. linariifolia-E. robusta* swamp forest.

Structure and Species Composition:

(a) Canopy:

Structure and species: Consists of emergent stratum of various eucalypts ie Scribbly Gum, Narrow-Leaved Red Gum, Pink Bloodwood and Red Mahogany. Canopy height is about 20-25m, with about 30% canopy cover. Trunk DBH varies from 0.2-1.5m.

(b) Understorey and Shrub Layer:

Structure and Species: Dominated almost exclusively by *Melaleuca nodosa* 0.5-12m high, forming an open to semi-closed canopy under the emergent eucalypts. Some sections on the western edges also had a high component of Black Oak, and sometimes *M. sieberi* and *M. linariifolia*. Some sections of shrub layer were almost impenetrable. A few Cheese Trees, *Callistemon saligna* and occasional eucalypts also occurred.

(c) Ground-layer:

Structure and Species: Moderately dense. Height ranging from 0.2-0.5m. Generally a mix of *Chorizandra cymbaria*, *Gahnia clarkei*, Wiry Panic and Spiny Headed Matrush. Forbs such as *Dampiera stricta*, also occurred.

(d) Climbers and Scramblers:

Monkey Rope was common, with occasional Scrambling Lily and Wombat Berry.

Comments: This community is essentially another ecotone with edaphic factors. In the northwest, it is especially well developed, which appears to be due to some intense logging for selected species.

3.1.9 Paperbark Swamp Forest B – *M. linariifolia/M. quinquenervia/*Swamp Mahogany

Distribution: This community is best defined as in the northwest and southwest corners where the land is very low-lying, and surface water may lie for extensive periods. A mix of this community and the dry sclerophyll forest communities occurs in the eastern drainage lines.

Structure and Species Composition:

(a) Canopy:

Structure and species: Consists of an emergent layer of Swamp Mahogany, 20-30m high with only about 10-30% canopy cover. Trunk DBH varies from 0.20-1.5m.

In eastern gullies, may also include Scribbly Gum, Blackbutt, Red Mahogany, *Melaleuca quinquenervia*, Pink Bloodwood or Tallowwood.

(b) Understorey:

Structure and species: Generally consists of *M. linariifolia* forming a canopy 10-12m high, often closed. Other Melaleuca species also occur in some areas eg. *M. quinquenervia* and *M. styphelioides.*

In eastern gullies, may also or either constitute a mix of Black Oak, *M. styphelioides*, and/or Cheese Trees.

(c) Shrub layer:

Structure and Species: Poorly defined – consists of scattered young Melaleucas, Swamp Mahogany and wattles 0.5 to 4m high.

In eastern gullies, may consist of a dense to sparse layer of Melaleucas (eg *M. sieberi, M. nodosa,* or *M. linariifolia*), and/or Cheese Trees, mixed with wattles, *Banksia spinulosa*, and/or a dense layer of *Leptospermum polygalifolium* and *Leucopogon lanceolatus*.

(d) Ground-layer:

Structure and Species: Tall and generally dense. Height ranging from 0.2-1.5m. Generally dominated by *Gahnia clarkei*, *Chorizandra cymbaria* and Swamp Fern (*Blechnum indicum),* grading to wetter areas where Common Spikerush (*Eleocharis acuta*) dominates. In deeper patches, Common Reed (*Phragmites australis*) or Giant Spikerush (*E. sphacelata*) dominate.

In the eastern gullies, the groundcover may be similar, or consist of a mix of Wiry Panic, *Gahnia clarkei* and *Chorizandra cymbaria*, or Tassel Sedge and *Ottochloa gracillima*.

(d) Climbers and Scramblers:

Monkey Rope was generally common, with some Scrambling Lily and Wombat Lily.

Comments: This community is typical of the site edaphic factors.

3.1.10 Paperbark Swamp Forest C – Swamp Mahogany/Swamp Oak/M. quinquenervia

Distribution: This community occurs as a narrow strip in the riparian zone along Maria River, where the banks are higher than land further in, due to alluvial deposits.

Structure and Species Composition:

(a) Canopy:

Structure and species: Dominated by varying mix of Broad-Leaved Paperbark (*Melaleuca quinquenervia*), Swamp Mahogany and Swamp Oak (*Casuarina glauca*). A few scattered Flooded Gum (*E. grandis*) also occur. Canopy height ranges from 20-35m, with about 50-70% canopy cover. Trunk DBH varies from 0.15-1.5m.

(b) Understorey:

Structure and Species: Dominated by *M. quinquenervia, M. styphelioides, M. linariifolia*, Swamp Oak and *Callistemon saligna*. Wattles are also common. Rainforest species became more common in the southern end. Height ranges 5-15m, with trunk DBH 0.05-30cm.

(b) Shrub layer:

Structure and Species: Consists of juvenile Melaleucas and wattles scattered through the forest, 0.5 to 4m high. In the southern end, rainforest species (mainly *Acronychia oblongifolia*) formed a dense tall shrub-lower understorey layer.

(c) Ground-layer:

Structure and Species: Very dense. Height ranging from 0.2-1.5m. Generally dominated by *Gahnia clarkei*, Swamp Fern and Spiny-Headed Matrush, grading to River Lily (*Crinum pedunculatum*), *Juncus* spp, Giant Spikerush and Common Reed along the river edge.

(d) Climbers and Scramblers:

Climbers and scramblers were not common. Monkey Rope and Scrambling Lily were the only species observed.

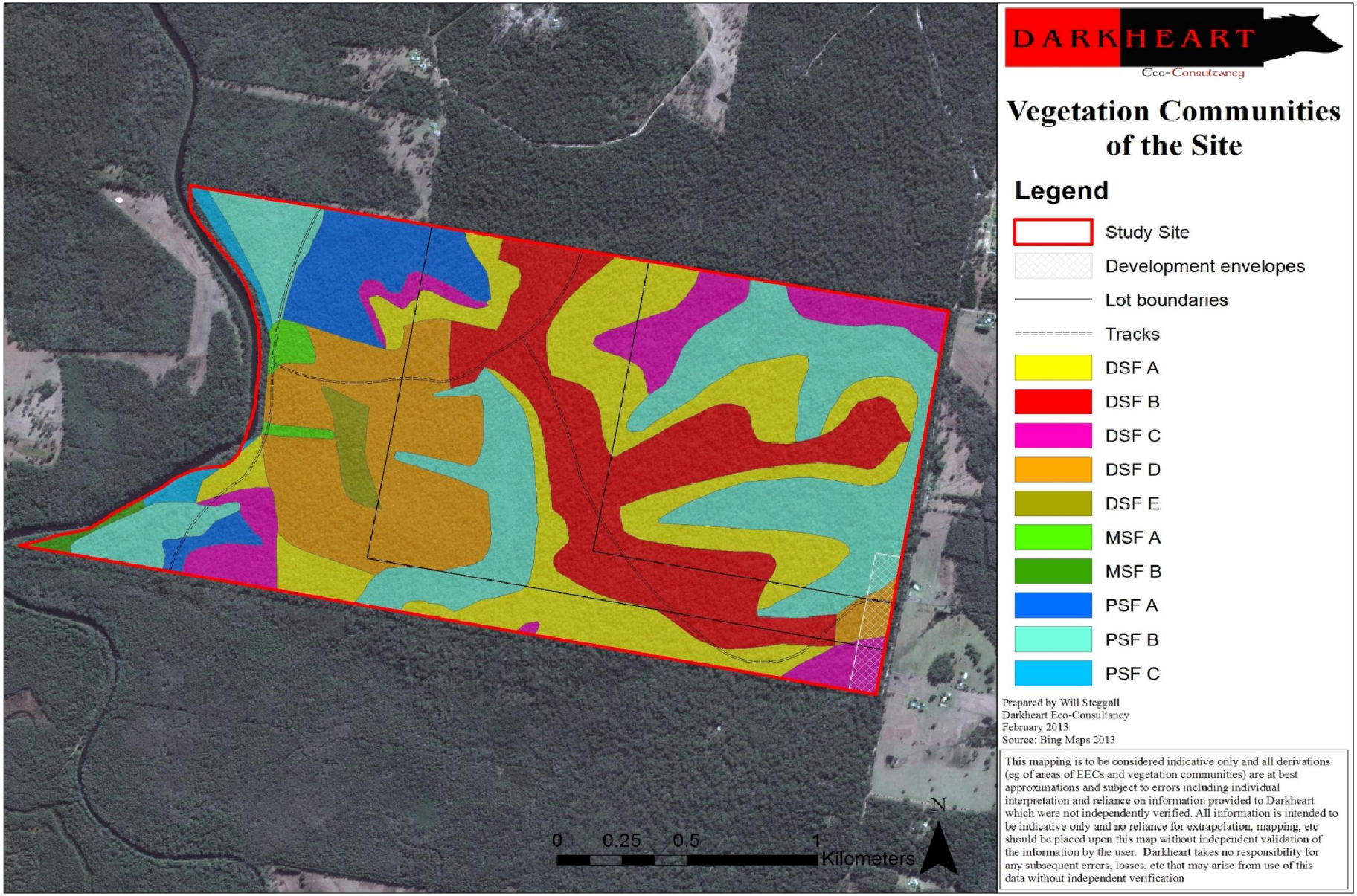
Comments: Some sections of this community were logged for the Flooded Gum, especially the southern end, which has a former track heavily overgrown with young rainforest species. The northern section was in a fairly natural state.

Photo 8: Paperbark Swamp Forest A

Photo 9: Paperbark Swamp Forest B

Photo 10: Paperbark Swamp Forest C

Figure 4: Vegetation communities on the study site



3.2 FLORA OF CONSERVATION SIGNIFICANCE

3.2.1 State/National Significance

3.2.1.1 Threatened Species

3.2.1.1.1 Targeted Searches Results

No threatened flora species were recorded in the development envelope/study area or property by the survey.

3.2.1.1.2 Assessment of Threatened Species Occurrence Probability

Section 2.2.1 lists 7 threatened flora species as recorded in the locality. Appendix 1 evaluates threatened flora species recorded in the locality and local bioregion for their potential to occur on the site and especially within the development envelope.

In regards to potential occurrence of these and most threatened flora, it should be noted that threatened plants often occur in habitats with a precise mix of essential ecological requirements, and not randomly in the landscape or a broad structural form of vegetation (eg dry sclerophyll forest). Such essential requirements may be a complex nexus of position, soil type (which affects fertility, acidity, etc) and climate, but may also include specific (sometimes symbiotic) association with fungi and bacteria (eg Proteaceae), dispersal vectors (eg bats) and disturbance regimes eg *Acacia aprica* will not recruit without a suitable fire regime (Vallee *et al* 2004, Bennet *et al* 2000, Brown *et al* 2003). Absence of such essential habitat variables or their modification (eg by disturbance such as frequent fire) can thus reduce or negate a site's potential for such plants to occur. These often poorly understood ecological factors are also a major contributor in the reason that many translocations of threatened plants and bushland restoration projects fail (Vallee *et al* 2004, Bennet *et al* 2000, Brown *et al* 2003).

3.2.1.1.2 Conclusions of Potential Occurrence Assessment

Appendix 1 evaluates threatened flora species recorded in the locality and local bioregion for their potential to occur on the property and especially within the development envelope.

The site has had a range of disturbances, in various intensities, from intense logging to extensive cattle grazing, for over 100 years. Additionally the fire regime has been varied eg a mix of prescription burning and wildfires. These threatening processes over time may have reduced the suitability of the property to support threatened species, or resulted in their elimination. In this regards, the site is considered to have minimal potential to possess a threatened flora species.

3.2.2 Threatened Ecological Communities

3.2.2.1 *Threatened Species Conservation Act 1995*

As seen in Figure 3, portions in the west and east of the site occur on various alluvial formations associated with Maria River and Connection Creek.

The floodplain, levee and backswamp formations are considered to readily meet the definition of a floodplain as described by the Scientific Committee's Final Determinations for Coastal Floodplain EECs,

while the others (valley fill, and alluvial and colluvial fan) may not be dominated by alluvial processes over their entire extent. The local relief and topographical setting of these suggest an intergrade of alluvial and colluvial processes eg runoff and sheet erosion rather than a dominance by fluvial deposition and overbank stream discharge (Troedson & Hashimoto 2008). The 'true' alluvial areas on site are generally more likely to fall within the RL 3.55 flood level (see Figure 2), as coastal floodplain geomorphological processes are most likely to be dominant here (Gales X).

Those areas falling on alluvial formations mapped at the 1:25,000 scale by Troedson & Hashimoto (2008) with vegetation which may floristically qualify as EECs are assessed below as these areas closely match the Final Determination's definition of coastal floodplains and fall below the 1:100 ARI. An indicative EEC map is provided as Figure 5.

3.2.2.1.1 Evaluation of *Swamp Sclerophyll Forest* EEC

3.2.2.1.1.1 Description

"*Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*" is a characteristic ecological community listed as Endangered under the TSC Act 2004. This EEC is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF) generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains. The structure of the community is typically open forest (but may be reduced to scattered trees via disturbance), and in some areas the tree stratum is low and dense ie a scrub. The community also includes some areas of fernland and tall reedland or sedgeland where trees are very sparse or absent. The most widespread and abundant dominant trees include *Eucalyptus robusta* and *Melaleuca quinquenervia*.

3.2.2.1.1.2 Site Evaluation

Swamp forest occurs on site in low lying areas in the west and east of the site, and along a drainage line running through the centre. Some of these areas (shown in Figure 5) coincide with alluvial formations below the 1:100 ARI mapped by Hashimoto and Troedson (2008). These areas are likely to best fit the Final Determination location, landform and habitat criteria.

Floristically, the swamp forest associations on site (Paperbark Swamp Forest A, B, C) broadly meet the Final Determination criteria for SSFCF EEC, being dominated by the indicator species - Swamp Mahogany and Broad-Leaved Paperbark (see floristic description in section 3.1). A significant number of other indicator species listed in the Final Determination for the EEC were also present (also see flora list in Appendix 2).

The site occurrence of this EEC would only represent a fraction of its local extent. It is likely to extend well beyond the site along the floodplain formations to the east and west, and in nearby Limeburner's Creek Nature Reserve.

3.2.2.1.2 Evaluation of *River-Flat Eucalypt Fo*rest EEC

3.2.2.1.2.1 Description

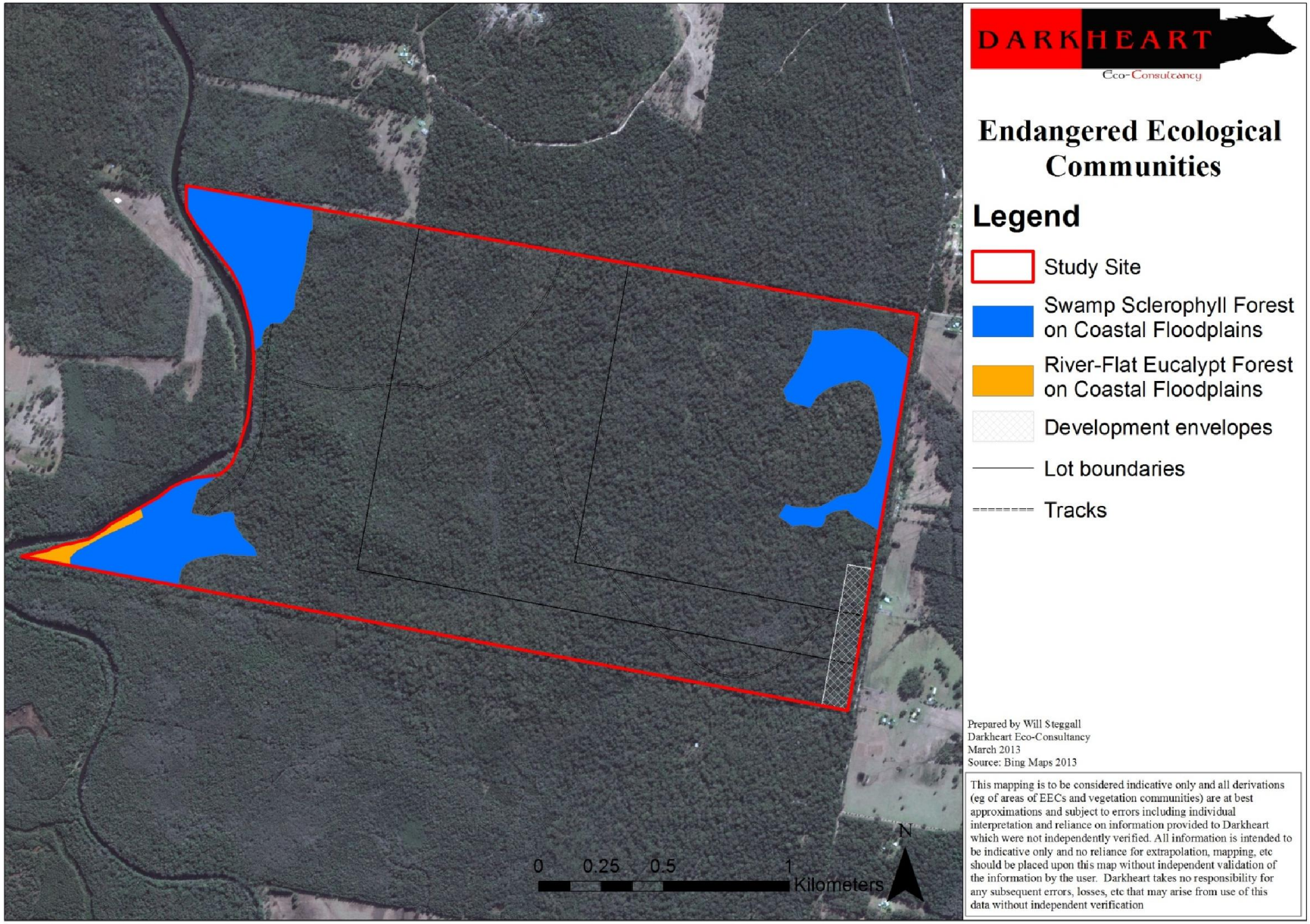
"*River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*" is an EEC associated with silts, clay-loams and sandy loams on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. *River-Flat Eucalypt Forest on Coastal Floodplains* (RFEF) generally occurs below 50m elevations, but may occur on localised river flats up to 250m above sea level. In the North Coast, the most widespread and abundant dominant trees include *Eucalyptus tereticornis, E. amplifolia, Angophora floribunda, A. subvelutina*, *E. saligna* and *E. grandis* (NSWSC 2004c).

3.2.2.1.2.2 Site Evaluation

The Flooded Gum and Brush Box dominated Wet Sclerophyll Forest B community mapped in the southwest of the site occurs on alluvial soils, and is considered to broadly meet the Final Determination criteria for RFEF EEC. While the floristic assemblages on site may not clearly match the typical canopy and understorey indicator species listed in the Final Determination for the southern occurrences, it states Flooded Gum may be a dominant canopy species north of Sydney. Hence the RFEF EEC is considered the closest match to the wet sclerophyll on site occurring on alluvial soils.

The site occurrence of this EEC is only likely to represent a fraction of its local extent given that only a small area occurs on site and high potential for it to occur elsewhere in the locality on the large floodplain systems.

Figure 5: Endangered Ecological Communities of the site



3.2.2.2 Other listed Threatened Ecological Communities and Populations

A summary of TECs and Endangered Populations listed under the TSC Act 1995 and EPBC Act 1999 which occur in the North Coast Bioregion (OEH 2014b, DotE 2013a) and their potential for occurrence in the study area, is provided in the following table.

Table 3: Review of TECs and Endangered Populations

Act	Endangered Ecological Community (EEC)	Occurrence Assessment
TSC Act	**"*Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions*"** is an EEC associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Swamp Oak Floodplain Forest (SOFF) generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. SOFF has a dense to sparse tree layer in which Swamp Oak (*Casuarina glauca)* is the dominant species. Other trees including *Acmena smithii*, *Glochidion* spp. and *Melaleuca* spp. may be present as subordinate species. The understorey is characterised by frequent occurrences of vines ie *Parsonsia straminea, Geitonoplesium cymosum* and *Stephania japonica* var. *discolor*, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.	Vegetation meeting the floristic criteria of this EEC does not occur on site or in the study area.
TSC Act	**"*Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*"** has been listed as an Endangered Ecological Community under the TSC Act 2004. This EEC is associated with periodic or semi-permanent inundation by freshwater, (including areas with minor saline influence). They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains ie habitats where flooding is periodic and standing fresh water persists for at least part of the year in most years. Freshwater Wetlands on Coastal Floodplains (FWCF) generally occur below 20m elevations, and the structure of the community varies from sedgelands and reedlands to herbfields. Woody species of plants are generally scarce. The structure and composition of the community varies both spatially and temporally depending on the water regime (Yen and Myerscough 1989, Boulton and Brock 1999).	Vegetation meeting the floristic criteria of this EEC does not occur on site or in the study area.
TSC Act	"***Lowland Rainforest on Floodplains on the NSW North Coast Bioregion***" generally occupies riverine corridors and alluvial flats with rich, moist silts often in sub-catchments dominated by basic volcanic substrates. Small, scattered remnants remain on the floodplains of the Tweed, Richmond, Clarence, Bellinger, Macleay, Hastings, Manning, and Hunter Rivers. In its natural state, this community supports a rich diversity of flora and fauna. Tree species often present include Figs, (*Ficus spp*.), Palms (*Archontophoenix cunninghamiana, Livistona australis*), Lilly Pilly's (*Syzygium spp.)* and vines (*Cissus spp., Pandorea pandorana, Flagellaria indica*).	Vegetation meeting the floristic criteria of this EEC does not occur on site or in the study area.
TSC Act	***"Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion***" has been listed as an Endangered Ecological Community since December 2006 on Schedule 1 – Part 3 of the TSC Act 1995. Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes, give the canopy an irregular appearance (Floyd 1990). The trees are taxonomically diverse at the genus and family levels, and some may have buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. Scattered eucalypt emergents may occasionally be present. In disturbed stands the canopy continuity may be broken, or the canopy may be smothered by exotic vines.	Vegetation meeting the floristic and geomorphological criteria of this EEC does not occur on site or in the study area.
EPBC Act	***"Lowland Rainforest of Subtropical Australia"*** is found from Maryborough to the Hunter. Predominantly occurs on basalt and alluvial soils, or enriched rhyolitic and metasediments. Generally occurs <300m above sea level but may occur >300m on	Vegetation meeting the floristic and geomorphological criteria of this EEC

Act	Endangered Ecological Community (EEC)	Occurrence Assessment
	north-facing slopes, and only in areas with annual rainfall >1300mm. May intergrade with ***Littoral Rainforest and Coastal Vine Thickets*** but usually occurs >2km from ocean. Typically tall (20-30m) closed forest often with multiple tree layers dominated by diversity of rainforest species with emergent non-rainforest species constituting <30%. Emergents are typically figs, Hoop Pine and Brushbox.	does not occur on site or in the study area.
TSC Act	***"Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions"*** is typically a closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. The plant species of this community are predominantly rainforest species while emergent Eucalypts or Lophostemons are present in some stands. This community grows only in coastal areas within maritime influence on sand dunes and soil derived from underlying rocks.	Vegetation meeting the floristic and geomorphological criteria of this EEC does not occur on site or in the study area.
EPBC Act	***"Littoral Rainforest and Coastal Vine Thickets of Eastern Australia"*** is a Critically Endangered Ecological Community listed under the EPBC Act 1999, which is generally identical to the TSC Act listing.	Vegetation meeting the floristic and geomorphological criteria of this EEC does not occur on site or in the study area.
TSC Act	A localised population of a distinctive variation of ***Glycine clandestina***, identified as *Glycine* sp. "Scotts Head", has been listed as an Endangered Population. This population is restricted to part of the headland complex at Scotts Head.	The site is well beyond the range of this population.
TSC Act	*"**Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregion**"* has been listed as an Endangered Ecological Community under the TSC Act 1995. Coastal Saltmarsh is the ecological community occurring in the intertidal zone on the shores of estuaries and lagoons along the NSW coast. Characteristic species include: *Baumea juncea, Juncus kraussii, Sarcocornia quinqueflora, Sporobolus virginicus, Triglochin striata, Isolepis nodosa, Samolus repens, Selliera radicans, Suaeda australis, Zoysia macrantha.*	Vegetation meeting the floristic and geomorphological criteria of this EEC does not occur on site or in the study area.
TSC Act	"***White Box Yellow Box Blakely's Red Gum Woodland***" is an EEC predicted to occur in Macksville, Dorrigo, Grafton, Kempsey, Korogoro Part, Nambucca, Coffs Harbour and Bare Part Atlas of Wildlife databases. This community is generally restricted to the tablelands and western slopes.	The site does not meet the floristic requirements of this EEC, hence it does not occur.
TSC Act	***"Hunter Lowland Red Gum Forest in the Sydney Basin and North Coast Bioregions***" is an EEC found on gentle slopes arising from depressions and drainage flats on Permian sediments of the Hunter Valley floor in the Sydney Basin and NSW North Coast Bioregions.	The site does not meet the floristic requirements of this EEC, hence it does not occur.
TSC Act	The "***Population of Eucalyptus seeana in the Greater Taree Local Government Area***" has been listed as an Endangered Population.	The site is beyond the specified distribution of this Endangered Population.
TSC Act	"***White Gum Moist Forest in the NSW North Coast Bioregion***" is an ECC characteristically dominated by White Gum (*Eucalyptus dunnii*) either in pure stands or with *E. saligna, E. microcorys* and/or *Lophostemon confertus* (NSWSC 2008a).White Gum Moist Forest typically occurs on the escarpment slopes and foothills of the north-east NSW, most commonly between 400 and 650 m elevation, where mean annual rainfall exceeds approximately 1000 mm and has a summer maximum (DECC 2007) on fertile soils. It is currently known from the local government areas of Clarence Valley, Coffs Harbour, Kyogle and Tenterfield.	White Gum does not occur on the site, thus the EEC does not occur.
TSC Act	"***Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions***" is a Critically Endangered Ecological Community (CEEC). This CEEC occurs on Carboniferous sediments (often on limestone) mainly on rocky slopes. The community typically forms a low closed forest dominated by low trees, shrubs and vines. The canopy is dominated by both varieties of *Elaeodendron australe* (Red Olive Plum), *Geijera parviflora* (Wilga), *Notelaea microcarpa* var. *microcarpa*	This community does not occur on the site which is located outside the prescribed range, thus the EEC does not occur.

Act	Endangered Ecological Community (EEC)	Occurrence Assessment
	(Native olive), and *Alectryon oleifolius subsp. elongatus* (Western Rosewood). Emergent eucalypts are common and include *Eucalyptus albens* (White Box), *E. dawsonii* (Slaty Box), and *E. crebra* (Narrow-leaved Ironbark). Hunter Valley Vine Thicket has been recorded from the local government areas of Muswellbrook, Singleton, and Upper Hunter (NSWSC 2007b).	
TSC Act	"***Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions***" is an EEC which occurs on Carboniferous sediments of the Barrington footslopes along the northern rim of the Hunter Valley Floor, where it occupies gullies and steep hill slopes with south facing aspects. The community usually forms a closed forest 15-20m high with emergent trees 20-30m high. Vines are abundant and there is a dense shrub and ground layer (NSWSC 2007c).	This community does not occur on the site which is located outside the prescribed range, thus the EEC does not occur.
TSC Act	***"Themeda* grassland on seacliffs and coastal headlands in the NSW North Coast, etc"** is an that belongs to the Maritime Grasslands vegetation class of Keith (2004) and its structure is typically closed tussock grassland, but may be open shrubland or open heath with a grassy matrix between the shrubs.	Vegetation meeting the floristic and geomorphological criteria of this EEC does not occur on site or in the study area.
TSC Act	***"Carex Sedgelands of the New England Tableland, Nandewar, Brigalow Belt South and NSW North Coast Bioregions***" is a preliminarily listed EEC in marshy regions dominated by sedges, grasses and semi-aquatic herbs. The species dominants are *Carex appressa, Stellaria angustifolia, Scirpus polystachyus, Carex gaudichaudiana, Carex sp. Bendemeer, Carex tereticaulis and Isachne globosa,* either as single species or in combinations. Other common species include *Geranium solanderi var. solanderi, Haloragis heterophylla, Lythrum salicaria, Epilobium billardierianum subsp. hydrophilum and Persicaria hydropiper* (Hunter and Bell 2009).	Vegetation meeting the floristic and location criteria of this EEC does not occur on site or in the study area.
TSC Act	'***Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions*'** is an EEC that generally occurs on floodplains and on floodplains and associated floodplain rises along the Hunter River and tributaries.	This community does not occur on the site or in the study area, which is located outside the prescribed range, thus the EEC does not occur.
TSC Act	**'*Coastal Cypress Pine Forest in the NSW North Coast Bioregion*'** is a distinctive vegetation community dominated by Coastal Cypress Pine (*Callitris columellaris*) and is typically found on coastal sand plains, north from the Angourie area on the far north coast of NSW.	The site/study area is far beyond the known range of this EEC and the Coastal Pine does not occur, thus the EEC does not occur.

3.3 FAUNA HABITAT EVALUATION

3.3.1 Aquatic Habitat

Aquatic habitat exists in the form of the dams; a small waterhole dug near the stockyards; Maria River; scours and small billabongs in drainage lines; and the paperbark forests.

(a) **Dams and Waterholes**:

Four dams occur on the site.

Two dams are located in the east-northeast end of Lot 2. These are spaced about 50m apart. The larger dam upstream is a permanent, deep dam about 40 x 20m, and about 2m deep. Most of its area is dominated by dense Giant Spikerush, and some water lilies also occurred in the small patch of open water. Water quality appeared to be high (no bacterial surface scum) though the water was tannin stained. This dam contained Plague Minnow (a Key Threatening Process) were observed in this dam, which limited its ability to support threatened frogs. This dam was not considered suitable for any threatened waterfowl or the Southern Myotis, due to its small size and limited foraging potential.

A smaller more ephemeral dam located east is about 20m wide, and when full, about 1m deep. At the time of the survey, it was almost dry with only a shallow pool (about 2m diameter) with water <25cm deep. The water was quite clear and appeared to be of good quality. A few Giant Spikerush constituted the only aquatic vegetation in the centre. Plague Minnow (a Key Threatening Process) were observed in this dam, which limited its ability to support frogs. This dam was not considered suitable for any threatened waterfowl or the Southern Myotis, due to its small size, limited foraging potential and lack of permanency.

The third dam is located higher up the larger drainage line in the northeast. This dam is about 15m in diameter, and completely overgrown with Giant Spikerush. Depth was indiscernible, but estimated to be at least 1m. Water quality appeared lesser than the other dam (possibly due to higher organic loading). This dam was considered to be very good frog habitat, due to the dense aquatic vegetation, and enclosure by dense groundcover in the adjacent forest. Due to its small size and limited foraging potential, it was not considered likely to have any value to threatened waterfowl or the Southern Myotis.

The fourth dam was located on the southern footslope of the western hill. This dam was about 15m in diameter, and at least 1.5m deep. Water appeared to be permanent. Water quality was overall good, though the water being very tannin stained. There was no aquatic vegetation, with the edges lined with saw sedge and other groundcovers on one side only – the other side was bare. Absence of Plague Minnow increased the potential for frog breeding in this dam, but it was considered of no significance to the Southern Myotis or any threatened waterfowl due its small size and lack of foraging potential/capacity.

A small waterhole (about 3m wide and about 40cm deep) has been dug near the stockyards to water stock during mustering. This waterhole held very dark, tannin-stained water, free of Plague Minnow, but absent of any aquatic vegetation. This waterhole was considered only to offer potential breeding habitat for common frogs such as *Litoria peronii* and *Limnodynastes peronii,* which have been personally observed in similar habitats in the area.

(b) **Drainage Lines**

There are four main branching drainage lines on the property, with the section of another in the southeast corner.

Semi-permanent waterholes were only found in the large northeast drainage line, and the central channel of the mid-southern drainage line. These occurred in either deep scours 1-2m wide and 1m deep, or in small pools 2-4m wide x 2-6m long (one in the northeast had possibly been enlarged by excavation). Water contained within these pools was similar to the dams, and almost all contained Plague Minnow (only pools in the uppermost sections were free). These pools and the drainage lines in general would provide important frog breeding habitat. The adjacent riparian vegetation, grassy forest and/or swamp forest would provide key foraging habitat.

These drainage lines were considered very unlikely to be suitable to the threatened *Mixophyes* frogs, which usually habituate moist forest near running water (Robertson 1993, Anstis 2002). However, they may offer potential breeding sites for the threatened Green-thighed Frog (*Litoria brevipalmata*).

(c) **Swamp Forest/Billabongs**

The swamp forest in the northwest, southeast and southwest corners provide generally good potential habitat for frogs. In these areas, especially the deeper and more extensive swamps on the western side, the groundcover is generally very dense, providing excellent refuge. During wetter periods, much of these areas would at least waterlogged, if not bearing some surface water. In the western swamps, shallow billabongs occur along the drainage lines. These were dry at the time of the survey (as they are barely 30cm deep), but could provide potential seasoning breeding habitat for a range of frogs, including the Wallum Froglet (*Crinia tinnula*).

The northwestern swamp contained the larger billabong, indicated by Common Reed and Giant Spikerush. This billabong has some limited potential for the Jabiru/Black-Necked Stork, and the Australasian and Black Bitterns.

(d) **Maria River**

The section of Maria River forming the western boundary is about 20m wide, and at least 2m deep in the channel centre. Water quality is known to vary from fresh to brackish (salt wedges push up from the Hastings in summer), and can be subject to acidified water from Acid Sulphate Soils in the catchment. A variety of fish typical of mid-north Coast NSW coastal rivers is known to occur (personal observations).

The river and riparian vegetation offers ideal habitat for birds such as the Osprey, Black Bittern and Australasian Bittern. The density of the riverside vegetation is likely to preclude occurrence of the Jabiru.

Overhanging trees are likely to be used as roosts and potentially nesting sites by a variety of waterfowl, including migratory species listed under the EPBC Act eg Cattle Egret and Great Egret.

The river is not suitable for any frogs, but is highly suitable for foraging by the Southern Myotis.

3.3.2 Terrestrial Habitat (logs, Undergrowth, Rocks, etc)

(a) **Logs:**

Due to past logging and some windfall, logs are relatively common on-site. Log size ranges from the remnants of tree crowns 10-30cm in diameter, to full-length trees 40-120cm in diameter. These provide multifunction potential habitat features ie:

- *Refuge*: Some logs had hollows in their base, or in the stems/trunks, which provided potential refuge for reptiles, mammals (including the Spotted-Tail Quoll), frogs and invertebrates.
- *Foraging substrate*: Many of the larger logs were old and in an advanced state of decay. Rotting timber provides a source of invertebrates eaten by vertebrates. Many showed signs of digging.

Logs were only common in the dry sclerophyll forest communities. They were rare or absent in other communities.

(c) **Groundcover:**

Groundcover varies with location and vegetation type as follows:

(i) *Dry Sclerophyll Forest*: Variable species affects density. In areas where Wiry Panic is dominant, the groundcover is usually dense and often matted, providing a good substrate for macropods, and smaller vertebrates feeding on invertebrates and fungi within the rotting organic matter. In other areas where Bladey Grass or *Xanthorrhoea* predominates, the groundcover is sparser, and provides limited grazing potential for macropods or cover for small terrestrial species.

(ii) *Drainage Lines*: Usually very dense, tall and matted. This provides both a substrate and refuge for invertebrates and small vertebrates. These areas contain some of the best groundcover outside the swamps.

(iii) *Melaleuca Forests*: Generally extremely dense groundcover dominated by dense saw sedge tussocks or Cyperaceace species. Provides excellent cover for wide range of birds, mammals, reptiles, frogs and invertebrates.

(d) **Leaf litter and Soil**

Leaf litter is generally well developed in the dry sclerophyll communities. In these communities, it forms a shallow and dry layer, providing substrate for fungi and invertebrates, and foraging habitat for vertebrates. Leaf litter is less obvious in the swamps and drainage lines, due to the dense groundcover, however, a layer of decaying vegetative matter (often at least a little moist) occurred in these areas, and provided a very good foraging substrate.

The A horizon of the clay soil was prone to hardsetting during drying. After a prolonged dry period, it appears to be easy to dig, though extremely fine. It would support burrowing.

(e) Undergrowth/Shrub Layer:

The component varied with vegetation community, logging history and fire frequency, as follows:

(i) *Dry and Moist Sclerophyll Forests*: Generally consisted of young Allocasuarinas and eucalypts. These offered only roosts, refuge and foraging substrate for birds. Wattles were occasionally common. These are significant as when flowering, provide forage for birds and insects. Some Banksia shrubs and Leptospermums occurred occasionally, providing similar potential as the wattles. These banksias, wattles and Leptospermums would be of no use to arboreal mammals (eg possums and gliders) due to the plant's small habit and inability to physically support the body weight of these mammals.

(ii) *Melaleuca Forests/Drainage Lines*: Generally densest where canopy was not closed. Mostly consisted of *M. nodosa* or *M. sieberi*, or Leptospermums and Banksias in eastern areas. These offered a foraging substrate for insects, and when flowering, a profuse nectar and pollen source for birds and insects. Again, due to their small size, would be of no direct use to arboreal mammals.

3.3.3 Understorey Habitat

3.3.3.1 Allocasuarinas

Black Oaks and Forest Oaks are generally very common overall on the site. These are restricted generally to the eucalypt forests, and are densest in areas disturbed by logging. Mature Allocasuarinas are particularly well developed in the Blackbutt, Thick-Leaved and Brushbox communities. In general, they are also well developed along drainage lines in the sclerophyll forests. In many parts of the Scribbly Gum forest, they dominate the shrub layer as juveniles <2m tall.

Generally, these Oaks provide good nesting material for birds, and good quantities of leaf litter, but their greatest value is to the Glossy Black Cockatoo, whose diet in this region is primarily based on Black Oak and Forest Oak. Overall, the property is considered to have significant foraging potential for the Glossy Black Cockatoo due to the abundance of forage species, and with an abundance of tree hollows, may support local breeding**.**

3.3.3.2 Wattles

Wattles overall are a common feature in almost all the vegetation communities on-site. Most are shrubs, but some of the western and eastern margins have a reasonable component of White Sally, which comprises part of the lower understorey (about 4-8m). As mentioned previously, wattles are prolific but seasonal flowerers, and thus a potential nectar and gum source for insects, birds and also Sugar and Squirrel Gliders. Wattles are also gum-producing, and some species are specifically used by the Sugar and Squirrel Gliders. Gum was not noted to be exuding from any individual trees.

3.3.3.3 Melaleucas

In the swamp forests and along most of the drainage lines, Melaleucas (*M. quinquenervia*, *M. linariifolia*, *M. sieberi, M. nodosa* and *M. styphelioides*) dominate the understorey. As shown in Table 2, these tend to flower in autumn to early winter (*M. quinquenervia*) or late spring-early summer. This provides a reasonable range and flow of nectar and pollen sources, and associated abundances of insects and birds.

3.3.3.4 Rainforest Species

Rainforest species occur in the understorey mainly on the lower western slope of the hill within the Brushbox forests, and the riparian vegetation. The most common fruiting species overall are Cheese Tree and *Acronychia oblongifolia*. These species ranges from juvenile plants <1m tall to small trees 12m high (average 5-8m). These produce an edible fruit. *Acronychia oblongifolia* is preferred by threatened frugivores such as the Wompoo Fruit Dove and Rose-Crowned Fruit-Dove. The potential for these species to utilise these resources on-site was considered marginal due to the limited extent and poor development of these resources.

3.3.4 Arboreal Habitat

(a) **Hollows**

Overall, the property has a very good range and abundance of hollows, due to the wide range in age of the forest, from old growth trees to recent regrowth. Hollow opening/aperture diameter ranges from 2cm to 50cm. Most fall in between 5-20cm. Trees over 1m trunk DBH often have more than one hollow. The most common hollow-bearing species was Scribbly Gum, probably due it being left as an undesirable species for timber harvest, and general dominance on the site.

Hollow abundance varies with location due to disturbance history and vegetation type as follows:

(i) *Dry Sclerophyll Forest*: The dry sclerophyll forest bore the highest density of hollow bearing trees, and these were most concentrated in the middle of the property. Hollow trees were randomly distributed from clumps to scattered trees. In some areas, hollow-bearing trees would number over 10-15/ha, while in others where the forest has once almost been clearfelled, less than a quarter of this may be found. On average, hollow bearing trees were not considered a limiting habitat component on the site.

Hollow-bearing trees were least abundant on the western slopes of the hill and mid-southwest due to the intensity of logging.

(ii) *Swamp Forest and Drainage Lines*: Hollows were less abundant in these communities due to the lower number of mature and large trees. Hollows were most frequently observed in Swamp Mahogany and Scribbly Gums. Hollows were uncommon in Melaleucas due to their smaller tree size. Most hollows were smaller (2-15cm aperture diameter). Average density was <1/ha in the swamp forests, but more common in the drainage lines (at least 2-3/ha).

(iii) *Wet Sclerophyll*: Hollows were uncommon in these communities due to their small size, and for the Brushbox-Tallowwood, extreme level of disturbance. Hollows were generally small (aperture <15cm diameter).

Arboreal termite nests were relatively common, especially in the swamp forests on Swamp Mahogany. Some had holes probably made by birds such as Forest Kingfisher, parrots, rosellas or lorikeets.

Many trees, particularly senescent Scribbly Gums in the Scribbly Gum dry sclerophyll, had their bases and trunks partially burnt or rotted out (which also predisposed them to a high risk of tree-fall by wind or subsequent fires). Only a couple had hollow chimneys with potential to provide roosts for

Yangochiropteran bats, with some showing some evidence of use (via scats – as detailed in later sections). Many old trees (mainly Scribbly Gums) with massive almost swollen bases (>1.5m) had hollows/holes with openings of various sizes (2-30cm), which provided potential dens for the Spotted-Tail Quoll, Bandicoots, snakes, cats and foxes.

(b) **Roosts**

Blackbutt, Flooded Gum and Scribbly Gum held some decorticating bark, which offered both a foraging substrate for insect prey for arboreal mammals, and some limited potential as roosts for Yangochiropteran bats.

Roosts for raptors are provided generally by taller emergent trees in the dry sclerophyll. Some taller trees on the western slopes would offer good vantage points. The best roosts were along Maria River and the emergent eucalypts in the swamp forests and drainage lines.

(c) **Nectar and Pollen Sources**

Table 4: Flowering period of canopy and understorey species

Species	Community	Frequency	Flowering Season
Corymbia intermedia	All but swamp forest	very common	late summer
C. maculata	TLM DSF	very rare	winter
Lophostemon confertus	Bbx WSF	common	early summer
Syncarpia glomulifera	Bbx WSF, BB-SG DSF	uncommon to few	spring-summer
E. pilularis	SG DSF, BB-SG DSF	very common	summer
E. signata	all	dominant species	Mainly spring
E. grandis	SM-SO-BLP SF	few	late summer
E. carnea	DSF D, DFS B	very common	early summer
E. carnea	DSF E	common	summer
E. siderophloia	TLM DSF, BBx-FO WSF	very rare	winter-mid summer
E. microcorys	All but swamp forest	common	winter-early summer
E. seeana	Swamp forest	few	early summer
E. robusta	Swamp forest	common	spring-early summer
E. resinifera	Swamp forest and drainage lines	occasional	summer
Melaleuca linariifolia	All but TLM DSF	abundant	spring-early summer
M. quinquenervia	Swamp forests and drainage lines	locally common to few	Mid-summer-winter
M. stypheloides	All but TLM DSF	common	summer
M. nodosa	Swamp forests	common to locally abundant	spring-early summer
M. sieberi	Swamp forests	common	summer
Callistemon salignus	All but TLM DSF	common	spring-summer

Winter flowering species are particularly critical for arboreals, due to the shortage of food resources in this period. As shown in the table, most of the site's flowering tree species are spring-summer flowerers. It may be expected that there could be a temporary increase in fauna (arboreal mammals, fruit bats and honeyeaters) on the property during spring-summer, but in mid-winter, fauna may be forced to utilise other resources (eg sap and gum) or forage in another part of their range for nectar and pollen. At the time of the survey, only a few Tallowwoods were flowering.

Pink Bloodwood, Flooded Gum, Spotted Gum, Narrow-Leaved Red Gums, Scribbly Gum and Blackbutt are potential sap sources for the Yellow-bellied Glider. Squirrel Glider and the common Sugar Glider also tap eucalypts for sap, with Grey Ironbark and Pink Bloodwood observed to be a very significant sap source at Crotty's Lane, Kempsey (Berrigan 1999a), and Pink Bloodwood and some use of Scribbly Gum at Arakoon (Berrigan 2000a, 2000b, 2000c, 2002f).

Blackbutt, Flooded Gum, Spotted Gum, Narrow-Leaved Red Gum and Scribbly Gum shed their bark in ribbons and/or patches. These may provide potential substrate for invertebrates and thus potential forage for small and larger mammals eg Antechinuses, gliders and possums. Substantial piles of bark and litter were noted to collect at the bottom of these trees.

Tallowwood, Swamp Mahogany and Scribbly Gums are Primary Preferred Koala Food Species as listed in Schedule 2 of SEPP 44. Blackbutt, Narrow-Leaved Red Gums, Red Mahogany, Forest Oak and Broad-Leaved Paperbark are secondary Koala browse species in some areas.

3.3.5 Bats

3.3.5.1 Yinpterochiroptera (frugivores and nectarivores)

3.3.5.1.1 Foraging Opportunities

The main species likely to occur on-site is the Grey-Headed Flying Fox (*Pteropus poliocephalus*), which is listed as Vulnerable under the TSC Act 1995 and the EPBC Act 1999.

The Grey-headed Flying Fox has been frequently recorded in the locality, and personally observed foraging on Pink Bloodwood, *Melaleuca quinquenervia*, Grey Ironbark, Scribbly Gum, Turpentine, Blackbutt and Tallowwood. It is considered highly likely to occur during flowering periods given the local records, and presence of preferred forage species. Winter-flowering tree species are particularly significant (Eby 2000a), hence *Melaleuca quinquenervia*, Spotted Gum, Tallowwood and Grey Ironbark would be the most significant potential forage species on site in this season.

The Queensland/Eastern/Common Blossom Bat (*Syconycteris australis*) is listed as Vulnerable under the TSC Act. Potential foraging resources on the site constitute Melaleucas, Pink Bloodwood, Swamp Mahogany and possibly Blackbutt. The species has a preference for heath and swamp forest, thus the best potential habitat is in the western swamps where such habitat is most extensive. Lack of year reliable and year round flowering species would qualify the site (as for the Grey-Headed Flying Fox) as potential seasonal foraging habitat, as part of a wider range which would be focussed on heathland and Banksia scrub along the nearby coastal margin.

3.3.5.1.2 Roosting Opportunities

Grey-headed Flying Foxes tend to roost according to life cycle period and food availability (Eby 2000a). In poorer periods, the species may roost temporarily close to the food source, or range wide from a larger colonial roost (mainly within a 20km radius). In normal periods, they tend to aggregate in roosts with a long history of usage, and such areas are generally well known (eg a large colonial roost reportedly occurs near Bowraville, while another well known maternity roost occurs near Grafton). The characteristics that determine choice of roost site are unknown, though in NSW, most are located near water (rivers or creeks), with dominant vegetation being subtropical rainforest, wet sclerophyll forest, Melaleucas, Casuarinas or Mangroves (Eby 2000a).

There is no historical or landowner accounts to evidence that the site has ever been a colonial roost. Colonial roosts are known to occur along Crescent Head Rd and somewhere near Crescent Head (Eby 2002). The riparian vegetation and forest adjacent to the Maria River has good potential as a seasonal roost at least for a small number of individuals moving throughout their seasonal range.

The Queensland Blossom Bat requires wet sclerophyll or rainforest to roost within flying range of foraging areas (Richards 1991). No rainforest occurs on the site, and the poorly developed wet sclerophyll is not considered likely to be suitable, unless roosting were to occur during warmer periods. It is not known if suitable roosting habitat occurs within range of the site, but it is a possibility.

3.3.5.2 Yangochiroptera (insectivores)

3.3.5.2.1 Foraging Opportunities

The property overall, is covered by forest with limited breaks in the canopy. The variable height and structure of the canopy (eg emergent trees over a lower closed canopy in the swamp forest), and provision of flyways along tracks, provides a range of foraging opportunities as follows:

(i) <u>*Supra canopy zone*</u>: The extent of relatively continuous canopy over the study site is ideal for aerial intercept species flying over the canopy. Threatened species that could forage in this stratum are: Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*), Common Bent-wing Bat (*Miniopterus schreibersii*), Little Bent-wing Bat (*M. australis*) and East Coast Freetail Bat (*M. norfolkensis*).

(ii) <u>*Sub-canopy zone*</u>: Some patches of more open forest (mainly the Scribbly Gum dry sclerophyll forest), and tracks provide potential foraging habitat for more manoeuvrable species or those that prefer more open habitats eg Hoary Bat (*Chalinobus nigrogriseus*), Common Bent-wing Bat, Little Bent-wing Bat, East Coast Freetail Bat and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

(iii) <u>*Forest interface*</u>: Portions of the southern and northern boundary abut partially cleared land or fire trails. The main drainage line in the northwestern swamp is largely devoid of obstructions. The general vicinity of the present access is also quite open. This provides suitable structure for species that forage on the interface between forest and open areas, or hovering/gleaning species, such as the East Coast Freetail Bat, Greater Broad-nosed Bat, Common Bent-wing Bat, Little Bent-wing Bat and Hoary Bat.

In addition, as detailed previously, the section of Maria River adjacent to the site is suitable for the Southern Myotis. Other bats may also forage along the river-vegetation interface eg Greater Broad-nosed Bat.

3.3.5.2.2 Roosting Opportunities

There are no abandoned dwellings, caves, cliffs, or overhangs on or directly adjacent to the site, which precludes species depending on such resources to breed or roost in, unless they are known to forage widely from such habitat components, or utilise alternative roosts (eg tree hollows) during non-breeding stages (and hence not depending on key maternity sites eg the Bent-wing Bats). The convict ruins are not suitable (they consist only of small walls or rubble piles <1m high).

The plethora of tree hollows and some trees with burnt out trunks/bases provide ample opportunities for roosts for species known to use such resources.

3.4 WILDLIFE CORRIDORS AND KEY HABITATS

3.4.1 OEH Wildlife Corridors and Key Habitats

3.4.1.1 Regional Corridors

Regional corridors are typically >500m wide and provide a link between major and/or significant areas of habitat in the region. Ideally they are of sufficient size to provide habitat in their own right and at least twice the width of the average home range area of fauna species identified as likely to use the corridor (OEH 2014c, Scotts 2003).

No regional corridors were mapped in close proximity to the site.

3.4.1.2 Sub-Regional Corridors

Sub-regional corridors connect larger landscaped features and are of sufficient width to allow movement and dispersal (generally >300m), but may not provide substantial species habitat (DEC 2004b, Scotts 2002).

As seen in Figure 6, the Maria River subregional corridor passes diagonally through the middle of the site. This links Ballengarra-Limeburner's regional corridor to Maria National Park and adjoining State Forest north of the site.

The site forms an important part of this corridor due to it being entirely vegetated, and because it contains high quality habitat (e.g. abundance of hollows, structurally intact/low weed invasion) in a range of vegetation types including dry and moist sclerophyll forest and swamp forest.

According to the OEH model (Scotts 2003), a number of threatened species could potentially utilise this corridor including Rufous Bettong, Brushtailed Phascogale (detected on site) and the Koala (detected on site) (Scotts 2002, OEH 2014c).

3.4.1.3 Key Habitats

Key Habitats are areas of predicted high conservation value for forest faunal assemblages, endemic forest vertebrates or endemic invertebrates; spatially depicted as a merging of mapped assemblage hubs, assemblage hot spots and centres of endemism (OEH 2014c, Scotts 2002).

Approximately 70% of the site is mapped as Key Habitat. As discussed in section 3.3, the high habitat quality (e.g. abundance of hollows, structurally intact/limited disturbances such as weed invasion) generically qualifies this property as Key Habitat. A number of threatened fauna species depend on these habitats, and was confirmed by the detection of threatened arboreal marsupials (e.g. Brushtailed Phascogale and Koala) during survey. This key habitat continues northwest to Maria National Park (Figure 6).

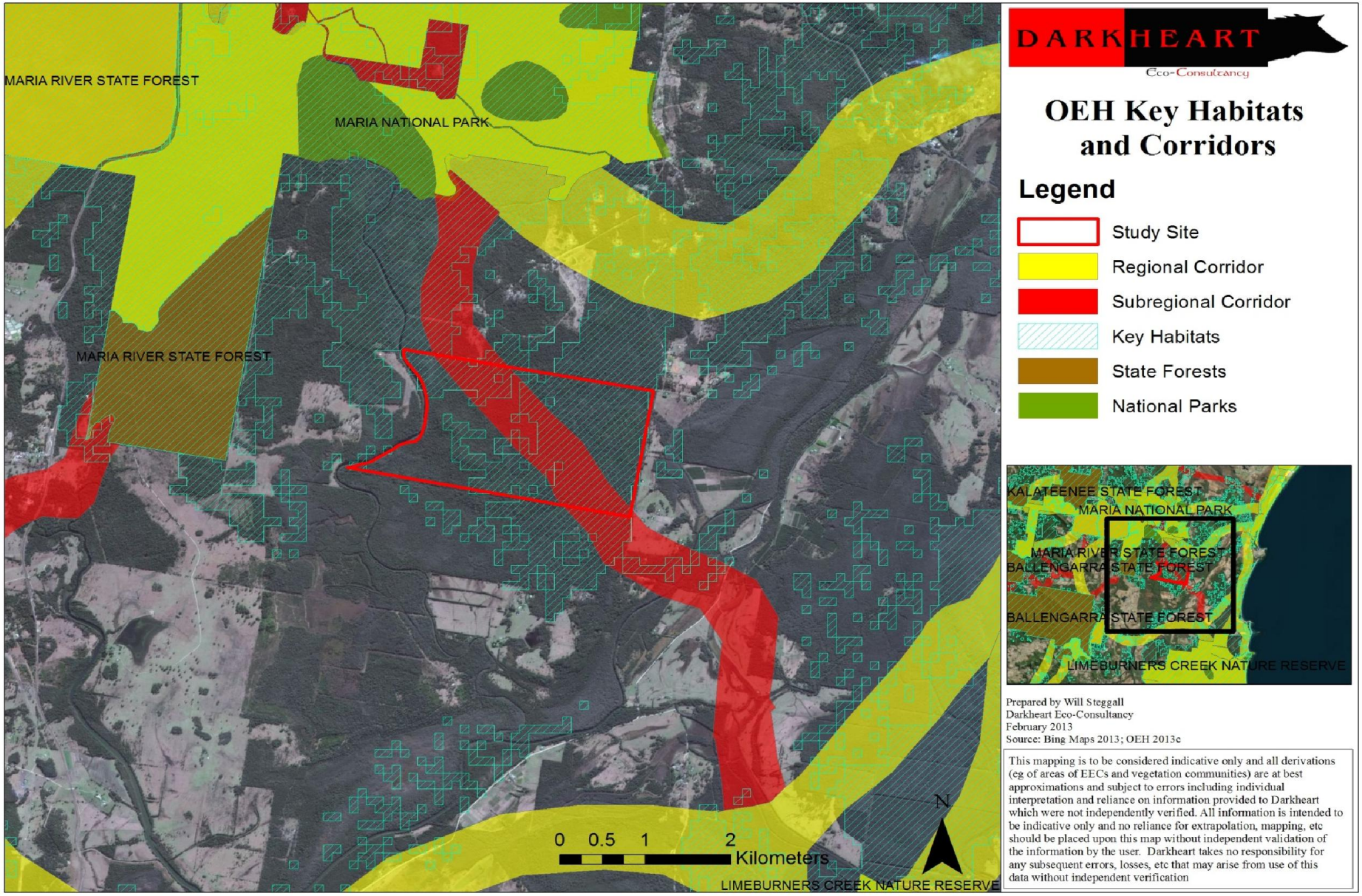
3.4.2 LOCAL CORRIDORS AND HABITAT LINKS

Habitat links are evaluated in this report as links from habitat on-site directly to similar habitat on adjacent land. These would be used by fauna, which depend solely or at least partially on the site and adjacent habitats for all of their lifecycle requirements (eg a colony of Brushtailed Phascogale), and/or dispersal (eg Koalas). Local corridors are larger habitat links or an aggregation of links which provide connections between remnant patches of habitat and landscape features, and are used for larger scale movement of genes and/or animals eg dispersal, colonisation, nomadic seasonal movements, etc. Due to their relatively small area and width (they may be <50m), these corridors and links are vulnerable to edge effects (Scott 2003, Lindenmayer and Fisher 2007).

As shown in Figure 6, the site's forest communities adjoin forest to the north and south, but links to the east are hampered by cleared agricultural land and by Maria River to the west. Fauna not able to cross agricultural pasture, or water barriers thus would not be able to move in these latter directions.

Firebreaks run along the northern and southern boundaries, though are poorly defined (overgrown tracks). These may provide some limited impedance to species dependant on dense groundcover and limited mobility (eg Common Planigale).

Figure 6: OEH Key Habitats and Corridors



3.5 FAUNA SURVEY RESULTS

3.5.1 Call Playback, Detection and Recording

3.5.1.1 Birds

Playback of calls of the Bush-Stone Curlew, Sooty, Masked, Powerful and Barking Owl failed to gather any response from either of these birds. A White Throated Nightjar (*Caprimulgus mystacalis*) was heard calling on numerous occasions.

Responses by arboreal mammals to Powerful Owl and Masked Owl call playback suggested possible experience with these predators (see 3.6.2.3.1), and potential indication of occurrence in the area (unless the response is from another source eg species instinct). This was confirmed in the last week of the survey when a Powerful Owl was recorded calling on the site. This bird responded to call playback by going silent, and could not be attracted to the consultant. The bird appeared to be calling from the western face of the hill, and later moved to adjacent land south of the site.

3.5.1.2 Frogs

Due to lack of rain, frog calling was extremely limited. No response was made to call playback.

The following species were heard from the dams:

- Common Eastern Froglet (*Crinia signifera*).
- Striped Marsh Frog (*Limnodynastes peronii*)
- Dwarf Tree Frog (*Litoria fallax*)

3.5.1.3 Mammals

3.5.1.3.1 Arboreal Mammals

Yellow-bellied Gliders readily responded to both recorded Yellow-bellied Glider territorial calls, and playback of the Powerful Owl calls. These were mainly recorded in the northwestern swamp on-site, and later in the survey (after the full moon), over the mid to mid-southern portions of the site. At least 5 individuals were recorded on several occasions foraging during the survey.

Another two individuals responded to these calls from adjacent forest across the river. Given the presence of tall trees close to the river, and the gliding distance the Yellow-bellied Glider can make (about 150m (NPWS 2002b), it is possible that the species may move across the river. Some individuals located to the mid-south of the site on adjacent land containing identical habitat (Scribbly Gum dry sclerophyll forest) were also recorded responding to calls from individuals on the study site.

A significant number of Sugar Gliders responded with alarm calls to the Masked Owl playback. These were recorded in all the dry sclerophyll communities, and the Brushbox-Tallowwood Oak community.

No response was made to male Koala call playback on the site.

3.5.1.3.2 Bats

Yangochiropteran bats were generally not commonly observed by this survey, despite the large extent of potential habitat, though it was noted that insect abundance was minimal (perhaps due to the drought). Bats were mainly visually observed along the access track that ran parallel to the river, and into the northwest swamp forest, and also along the main access track that ran through the dry sclerophyll forest. A rather large Yangochiropteran bat was once observed flying over the canopy at a medium speed, but only a brief call could be recorded.

Ultrasonic Yangochiropteran bat calls recorded during the survey were sent to Mr Glen Hoye (*Fly By Night Bat Surveys*) for identification. The results are shown below in table 5. The location of observed bat foraging routes is shown in figure 6.

Table 5: Identification of Yangochiropteran bat call recordings.

Species	S. fl	T.au	M.sp2	C. go	C. mo	M.au	N.sp	V.pu	V. vu
Identification Confidence	Po	P	P	P	Po	P	C	Po	P

Key:

C.go	Gould's Wattled Bat (*Chalinolobus gouldii*)
C.mo	Chocolate Wattled Bat (*C. morio*)
V.vu	a Forest Bat (*Vespadelus vulturnus*)
V.pu	a Forest Bat (*V. pumilus*)
T.au	White-Striped Freetail Bat *(Tadarida australis*)
M.au	**Little Bent-wing Bat (*Miniopterus australis*)***
M.sp.2	an undescribed Freetail Bat (*Mormopterus* sp. 2)
N.sp	an undescribed long-eared Bat (*Nyctophilus sp.*)
S. fl	**Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) ***
C	Confident identification
P	Probable identification
Po	Possible identification
*	Threatened Species

Those species listed as "*confident*" and "*probable*" are most likely to be the species occurring on the site. As shown above, two threatened Yangochiropteran bat species appear to occur on site: the Little Bent-wing Bat and the Yellow-bellied Sheathtail Bat. The latter is considered to be the bat briefly seen flying over the canopy on one occasion, hence the limited identification confidence.

3.5.2 Trapping Results

3.5.2.1 Wire Cages

A single Lace Monitor and a Bush Rat were captured in wire cage traps. Several others were activated, with no captures recorded. These were attributed to Laced Monitors or possibly dogs/foxes.

3.5.2.2 Elliot B Traps

Elliot B traps resulted in the capture of 20 Sugar Gliders, 14 Brown Antechinuses, and a single Brush-Tailed Phascogale. The Phascogale was recorded on a senescent Tallowwood in the Blackbutt-Scribbly Gum dry sclerophyll forest about 50m west of the corral, on the eastern side of the property.

3.5.2.3 Elliot A Traps and Pitfalls

Table 6 lists the species and number and location of Elliot and pitfall trappings.

Table 6: Elliot and Pitfall captures

Common Name	Species	Number	Trap Method
Bush Rat	*Rattus fuscipes*	17	A and Pitfall
Swamp Rat	*R. lutreolus*	4	A
Dusky Antechinus	*Antechinus swainsonii*	1	A
Brown Antechinus	*A. stuartii*	42	A and B
Striped Marsh Frog	*Limnodynastes peronii*	2	pitfall

The Swamp Rat and Dusky Antechinus were recorded only in the northwest swamp. The Striped Marsh Frogs were recorded in pitfalls located along Maria River. The Bush Rats and Brown Antechinuses were found all over the site, with highest abundance in or near the swamp forests.

3.5.2.4 Hair Tubes

A number of scats and miscellaneous hair samples (eg from barb-wire fences) were collected and sent with samples obtained from hair tubes, for identification by Barbara Triggs (recognised hair specialist), according to techniques developed by Brunner and Coman (1974). The results are shown in table 5.

Table 7: Hair tube results

Hair Source	Definite Species	Possible Species
Tubes	Sugar Glider	-
Tubes	Brown Antechinus	-
Tubes	Bush Rat	-
Dog scat	*Macropus* spp	Red-Necked Wallaby (*M. rufogriseus*)
Fox scat and miscellaneous hair sample	Northern Brown Bandicoot (*Isoodon macrourus*)	-
Fox scat	Unidentifiable bird feathers	-
Animal remains	Water Rat (*Hydromys chrysogaster*)	-

3.5.3 Spotlighting, Secondary Evidence, and Opportunistic Observations

3.5.3.1 Spotlighting and Torch Searches

Spotlighting was generally rather very unproductive as a fauna survey technique. The only species observed by spotlighting were: several Sugar Gliders, several Eastern Grey Kangaroos, two Brush-Tail Possums, two Tawny Frogmouth Owls, a Boobook and several sleeping birds.

In general, torch searches for frogs were similarly generally unproductive. A few *Litoria fallax* and *Limnodynastes peronii* were observed.

During call playback and spotlighting for mammals and forest owls, a Green-thighed Frog (*Litoria brevipalmata*) was incidentally found on the main access track. This species is listed as Vulnerable under the TSC Act 1995. A single individual was found on the top of a ridge in the Scribbly Gum dry sclerophyll, several hundred metres from the nearest drainage line or moist vegetation, in an area with groundcover consisting of Bladey Grass and Wiry Panic.

3.5.3.2 Secondary Evidence

3.5.3.2.1 Scratches

Examination of tree trunks showed variable levels of arboreal activity depending on species and location.

Scratches were generally minimal on the Scribbly Gums, and in dry sclerophyll forest in general, except for hollow bearing trees that bore scratches of small to large arboreal mammals (including Koalas) and Laced Monitors. Tallowwoods were the most commonly scratched tree, with heaviest use in forest on the western slopes of the hill.

Scratches were most common on Swamp Mahogany in the swamp forest communities, and on a number of Melaleucas (*M. quinquenervia*, *M. nodosa* and *M. linariifolia*). Some of these could be attributed to Koalas due to scats found at the tree base.

3.5.3.2.2 Scats and Tracks

Scats of the Red-Necked Wallaby and Eastern Grey Kangaroo were frequently encountered near the base of trees; along tracks, and in "lays" (pushed down grass).

As mentioned previously, wild dog and fox scats and also tracks were found. Residents report wild dogs in the area (Bill Larkin, pers. comm.). Baiting programmes are reported to have been carried out for these pests, which may have had a negative impact on some native species eg Spotted Tail Quoll.

As mentioned previously, Koala scats were found. These were distributed generally all over the property, with a slight concentration west of the hill. Locations are shown in figure 7.

Some Yangochiropteran bat scats were found on the ground below hollow chimneys in the base of senescent trees on the site. Due to their condition, these could not be confidently identified to a species.

3.5.3.2.3 Feeding Signs

(i) ***Digging and Burrowing***

Diggings were not abundant. Most were observed in the drainage lines, and under dense copses of Allocasuarinas. These were attributed to bandicoots.

(ii) ***Chewed Allocasuarina Cones***:

Chewed Allocasuarina cones were found on numerous occasions under Oaks on the site. These were found in all areas with mature trees, particularly the denser clumps, and the western slope of the hill.

(iii) ***Sap Sucking - Arboreal Mammals***

Incisions made into tree trunks for sap sucking were common overall in all but the swamp forest and wet sclerophyll communities. Pink Bloodwood and Scribbly Gums bore incisions. Most of these were only small cuts 2-10cm long, in a ring of 3-5 around a tree, with 1-4 rings per tree. However, many trees, predominantly Scribbly Gums, bore rings of larger incisions, often excised patches 10-20cm long and 5cm wide. Some older, healed incisions were noted on some Narrow-Leaved Red Gums. These were large (about 10-15 long) and L or V shaped.

"L" or "V" shaped incisions and rectangular excisions of patches of bark are often typical of the Yellow-bellied Glider, which characteristically makes bigger incisions than the Squirrel or Sugar Glider. Some trees are sampled for their sap-exuding properties, and not used again (NPWS 2002). Key trees used by Yellow-bellied Gliders are habitually used (trees often bear many incisions evident of various ages), which when found, may usually be surveyed with high probability of detection of this species. The smaller incisions were attributed to the Sugar Glider. The nature of the larger incisions, and detection of the Yellow-bellied Glider on-site (including sighting an individual in a tree with large incisions) confirm the species resides on the property.

3.5.3.3 Opportunistic Observations

3.5.3.3.1 General

Table 8 lists all the species detected by this survey on the subject land by spotlighting, call detection, opportunistic sighting and habitat inspections.

3.5.3.3.2 Birds

Six Glossy Black Cockatoos (listed as Vulnerable under the TSC Act) were observed feeding on Allocasuarinas during the survey period. The common Yellow-Tailed Cockatoo was also observed feeding in Cheese Trees and on the trunks of eucalypts on several occasions.

Passerine bird activity on the site was generally good, with morning and afternoon peaks. Thornbills were the most visual, and honeyeaters the most audible. Abundance and diversity was greatest around hill and the western slopes and swamps; and the drainage lines.

No raptors or waterfowl were observed on or near the site during the survey.

3.5.3.3.3 Reptiles

Reptile activity and diversity was rather average, perhaps due to the time of year (early spring). Numerous Garden Skinks and several Red-Belly Black Snakes were observed, as well as a few Laced Monitors. A Red belly Black Snake skin was found in the Scribbly Gum dry sclerophyll. A couple of Water Dragons were observed in the eastern drainage lines and along Maria River.

A local resident along Beranghi Rd reported the sighting of a individual Stephens Banded Snake about 3km north of the site, in generally similar habitat to that on the site. This species is listed as Vulnerable under the TSC Act 1995.

3.5.3.3.4 Mammals

A single Koala was observed once during the survey, in the northwest swamp forest. Several Eastern Grey Kangaroos and Red-Necked Wallabies were observed during survey activities.

3.5.3.3.5 Frogs

Frogs were heard calling during other survey activities, as listed previously.

Table 8: Vertebrate fauna recorded on the property

bold indicates threatened species under the TSCA; # indicated threatened species under the EBPCA; * indicates introduced species.

Group	Common Name	Scientific Name
BIRDS	**Glossy Black Cockatoo**	***Calyptorhynchus lathamii***
	Yellow-Tailed Black Cockatoo	*C. funereus*
	Eastern Rosella	*Platycercus eximius*
	Laughing Kookaburra	*Dacelo novaeguineae*
	Eastern Whipbird	*Psophodes olivaceus*
	Black-faced Cuckoo Shrike	*Coracina novaehollandiae*
	Grey Fantail	*Rhipidura fuliginosa*
	Golden Whistler	*Pachycephala pectoralis*
	Red-Browed Finch	*Neochmia temporalis*
	Eastern Yellow Robin	*Eopsaltria australis*
	Silvereye	*Zosterops lateralis*
	Superb Fairy Wren	*Malurus cynaeus*
	White-browed Scrubwren	*Sericornis frontalis*
	Striated Pardalote	*Pardalotus striatus*
	Spotted Pardalote	*P. punctatus*
	Leaden Flycatcher	*Myiagra rubecula*
	Restless Flycatcher	*M. inquieta*
	Brown Flycatcher/Jacky winter	*Microeca flavigaster*
	Brown Thornbill	*Acanthiza pusilla*
	White-cheeked Honeyeater	*Phlidonyria nigra*
	Lewins Honeyeater	*Meliphaga lewinii*
	Australian Pipit/Richard's Pipit	*Anthus novaeseelandiae*
	White-Throated Treecreeper	*Cormobates leucopheus*
	Eastern Spinebill	*Acanthorhynchus tenuirostris*
	Spangled Drongo	*Dicrurus bracteatus*
	Brush Wattlebird	*A. chrysoptera*
	Noisy Miner	*Manorina melanocephala*
	White-throated Warbler/Gerygone	*Gerygone oliveacea*
	Dollarbird	*Eurystomus orientalis*
	Fantailed Cuckoo	*Cuculus flabelliformis*
	Pallid Cuckoo	*C. pallidus*
	Wonga Pigeon	*Leucosarcia melanoleuca*
	Crested Pigeon	*Geophaps lophotes*
	Peaceful Dove	*G. striata*
	White Headed Pigeon	*Columba leucomela*
	Australian Raven	*Corvus coronoides*
	Pied Currawong	*Strepera graculina*
	Magpie	*Gymnorhina tibicen*
	Magpie Lark	*Grallina cyanoleuca*
	Grey Butcherbird	*Cracticus torquatus*
	Forest Kingfisher	*T. macleayii*
	Masked Plover	*Vanellus miles*
	Pacific Black Duck	*Anas superciliosa*

Group	Common Name	Scientific Name
	Chestnut Teal	*A. castanea*
	Grey Teal	*A. gibberifrons*
	Dusky Moorhen	*Gallinula tenebrosa*
	Wood Duck	*Chenonetta jubata*
	Stubble Quail	*Coturnix pectoralis*
	Powerful Owl	***Ninox strenua***
	Southern Boobook	*N. boobook*
	Tawny Frogmouth	*Podargus strigoides*
	Owlet Nightjar	*Aegotheles cristatus*
MAMMALS	Sugar Glider	*Petaurus breviceps*
	Brush-tail Possum	*Trichosurus vulpecula*
	Yellow-bellied Glider	***Petaurus australis***
	Brushtailed Phascogale	***Phascogale tapoatafa***
	Koala	***Phascolarctos cinereus***
	Short-beaked Echidna	*Tachyglossus aculeatus*
	Red-necked Wallaby	*Macropus rufogriseus*
	Eastern Grey Kangaroo	*M. giganteus*
	Short-Beaked Echidna	*Tachyglossus aculeatus*
	Northern Brown Bandicoot	*Isoodon macrourus*
	Wild Dog	*Canis familiaris*
	Fox	*Vulpes vulpes*
	Brown Antechinus	*Antechinus stuartii*
	Dusky Antechinus	*A. swainsonii*
	Swamp Rat	*Rattus lutreolus*
	Bush Rat	*R. fuscipes*
REPTILES	Garden Skink	*Lampropholis guichenoti*
	Eastern Water Dragon	*Physignathus lesueurii lesueurii*
	Laced Monitor	*Varanus varius*
	Red-Bellied Black Snake	*Pseudechis porphyriacus*
FROGS	Common Eastern Froglet	*Crinia signifera*
	Striped Marsh Frog	*Limnodynastes peronii*
	Dwarf Tree Frog	*Litoria fallax*
	Green Thighed Frog	***L. brevipalmata***
	Laughing Tree frog	*L. peronii*
FISH	Mosquito Fish/Plague Minnow	*Gambusia holbrooki*

3.6 DISCUSSION OF FAUNA SURVEY FINDINGS

3.6.1 Success of Methodology and General Site Ecology

The survey results reflect the need to use a range of techniques to detect fauna. Trapping is highly successful for some species eg Sugar Gliders, but in this survey, failed to detect the Yellow-bellied Gliders. These results may be a reflection of the size of the study site and number of traps ie fauna may not have encountered traps due to the large extent of habitat.

Limited results for other survey methods eg Yangochiropteran bat call detection and frog call identification, may be due to the season (ie late winter), and drought.

Overall, the fauna assemblage detected is generally typical of the habitats sampled, including the recorded threatened species, although the Green Thighed Frog was unexpected. Some species groups were poorly represented. This is due either to lack of suitable habitat on-site (eg waterfowl), or season (eg winter,

migratory period, torpor, breeding, etc). Abundance and diversity were not considered exceptional given the range of habitats and availability of some critical resources eg tree hollows.

3.6.2 Detected Threatened Species

Six threatened species were confirmed to occur on-site: Koala, Yellow-bellied Glider, Glossy Black Cockatoo, Powerful Owl, Brush-Tailed Phascogale and Green Thighed Frog. At least two threatened Yangochiropteran Bats are considered likely due to call detection: Little Bent Wing Bat and Yellow-bellied Sheathtail Bat.

3.6.3 Potentially Occurring Threatened Species

From Appendix 1, the following other threatened species (those in bold listed under the EPBCA 1999) are considered potential occurrences (with varying levels of probability) on the property, possibly only in localised areas:

Table 9: Threatened species potentially occurring on the property.

Species	Potential Habitat/ Occurrence Type	Occurrence Likelihood Unlikely = 0 Moderate = 3 High = 5
Osprey	Maria River adjacent to site is known habitat with potential nest trees along bank. Water bodies on site too small for foraging.	Moderate chance of occurrence along Maria River or site fly over.
Square-Tailed Kite	Entire site offers generic potential to form portion of large area of potential foraging territory, with generic potential nesting trees.	>Fair chance of occurrence utilising site as small part of a wider foraging range.
Little Eagle	Entire site offers generic potential to form portion of large area of potential foraging territory, with generic potential nesting trees.	Fair chance of occurrence utilising site as small part of a wider foraging range.
Masked Owl	Potential prey species common on site, and likely to be similarly common in local forest. Property would form small portion of large foraging territory with a handful of suitable nest trees on property.	Considered fair to good chance as part of wider foraging range.
Little Lorikeet	Preferred nectar species and potential breeding hollows present. Site may at most comprise small portion of foraging and breeding habitat falling within a wider foraging range.	Fair to good chance of occurrence with presence and abundance varying on flowering instances.
Swift Parrot	Property, especially swamp forest has potential for foraging.	Very low to low chance of occurrence as opportunistic forager.
Varied Sittella	Forest offers generic foraging and breeding habitat as part of wider local range.	At least fair as resident family of birds
Black Bittern	Good quality potential habitat along Maria River with more marginal habitat in swamp forest on site.	High chance of occurrence along Maria River and low to fair in northwest swamp.
Australasian Bittern	Potential habitat in northwest swamp forest and possibly river margins.	Low to fair chance of occurrence utilising swamp forest as small part of a wider foraging range.
Eastern Chestnut Mouse	Swamp forest offers generic potential habitat, with dry sclerophyll more marginal.	Low as few local records, and very sparse distribution.
Common Planigale	Potential foraging and breeding habitat predominantly in swamp forest where groundcover is dense.	Considered very low to fair chance of occurrence on site.

Species	Potential Habitat/ Occurrence Type	Occurrence Likelihood Unlikely = 0 Moderate = 3 High = 5
Spotted-Tail Quoll	Generic potential foraging habitat, forming minor portion of large foraging territory. Potential dens such as hollow logs, basal and arboreal tree hollows present.	Considered moderate chance of occurrence on site as part of local range movements and opportunistic foraging.
Grey-Headed Flying Fox	Good range of nectar species. Entire property offers potential foraging habitat as small part of wider foraging range. No known roosts on site.	High chance of seasonal occurrence on site.
Little Bent-wing Bat	Site has suitable foraging potential and non-breeding roosts.	*Probable* detection on site via Anabat analysis.
Eastern Bent-wing Bat	Site has suitable foraging potential and non-breeding roosts.	Fair to high, using site as part of wider foraging range.
Eastern Cave Bat	Site contains suitable foraging habitat.	Low chance of occurrence using site as small part of foraging range.
Yellow-bellied Sheathtail Bat	Site is suitable for foraging and roosting.	*Possible* recording on site via Anabat analysis.
Greater Broad-nosed Bat	Continuous forest vegetation, tracks and forest interface on site ideal for foraging. Potential breeding/roosting in tree hollows.	Low to fair potential occurrence on site.
East-Coast Freetail Bat	As for Greater Broad-nosed Bat	Low to fair potential occurrence on site.
Eastern False Pipistrelle	As for Greater Broad-nosed Bat	Low to fair potential occurrence on site.
Wallum Froglet	Best potential habitat in western swamp forest, other drainage lines on site marginal.	Low to fair
Stephens Banded Snake	Site has suitable structure and prey species with numerous hollows and logs. Past disturbances may have reduced potential to occur.	Low to good as recorded in locality
Pale-Headed Snake	As for Stephens Banded Snake	No local records, unlikely to fair chance of occurrence on site.

These species are subject to later statutory assessments.

PART B: EPBC ACT 1999

4.0 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

4.1 THREATENED AND PROTECTED FAUNA

A significant number of pelagic seabirds, marine turtles, fish and mammals listed as Threatened and/or Migratory under the EPBCA 1999 (some are also listed as threatened under the TSCA) are known or may occur on rare occasion within the locality. Suitable habitat for these species does not occur on or near the site. Consequently, these migratory/threatened marine fish, turtles, mammals and seabirds are not considered in the following assessment.

4.1.1 Vulnerable and Endangered Fauna Species

The Koala was the only EPBC Act listed threatened species detected on the site by the survey.

A search of the Department of the Environment's (DotE) - *Matters of National Environmental Significance* (MNES) website was taken to generate a list of threatened species potentially occurring in the locality of the site. These are shown in the following table, with other species previously recorded or considered by the consultant as potential occurrences in the locality due to suitable habitat. An evaluation of their likelihood of occurrence on the subject land is also provided from the evaluation table in Appendix 1.

Table 10: EPBCA threatened fauna species potential occurrence assessment

Note: Likelihood of occurrence derived from opinions of consultants in consideration of known ecology of each species (see Appendix 1); and quality of habitat on-site. * indicates listed on DSEWPC website search.

Group	Common Name	Scientific Name	Listing Status	Recorded In Locality	Suitable Habitat On-Site	Likelihood Of Occurrence On Site
BIRDS	*Australian Painted Snipe	*Rostratula australis*	V	N	Marginal	Unlikely due to lack of preferred habitat
	*Australasian Bittern	*Botaurus poiciloptilus*	E	Y	Good habitat along Maria River and swamp forest on site	Low to fair
	*Red Goshawk	*Erythrotriorchis radiatus*	V	N	Y	Unlikely to low - very few NSW records
	*Eastern Bristlebird	*Dasyornis brachypterus*		N	N	Unlikely
	*Swift Parrot	*Lathumus discolor*	E	N	Preferred foraging habitat in some parts of the site	Very low to fair depending on flowering periods
	*Regent Honeyeater	*Xanthomyza phrygia*	V	N	Marginal	Unlikely due to rarity and lack of preferred habitat
MAMMALS	*Long-nosed Potoroo	*Potorous tridactylus tridactylus*	V	N	Marginal to good in swamp forest	Unlikely – no local records and wild dogs present
	*New Holland Mouse	*Pseudomys novaehollandiae*	V	N	N	Unlikely
	*Spotted-tail Quoll	*Dasyurus maculatus maculatus*	V	Y	Y	Low to fair due to historical records and extent of potential habitat
	*Brush-tailed Rock Wallaby	*Petrogale penicillata*	V	N	N	Unlikely
	*Koala (combined populations of QLD, NSW and the ACT)	*Phascolarctos cinereus*	V	Y	Y	Recorded on site
	*Grey-headed Flying Fox	*Pteropus poliocephalus*	V	Y	Y	High – recorded near site
	*Dwyer's/Large Pied Bat	*Chalinobus dwyeri*	V	N	Structurally suitable but no roosts.	Unlikely to low – no records in Shire
FROGS	*Green and Golden Bell Frog	*Litoria aurea*	V	Y	Marginal in swamp, dams and drainage lines	Unlikely to low as Plague Minnow and no close records
	Wallum Sedge Frog	*L. olongburensis*	V	N	N	Unlikely – no records south of north Coffs Harbour
	*Stuttering Frog	*Mixophyes balbus*	E	N	N	Unlikely
	*Southern Barred Frog	*M. iteratus*	E	N	N	Unlikely

Group	Common Name	Scientific Name	Listing Status	Recorded In Locality	Suitable Habitat On-Site	Likelihood Of Occurrence On Site
REPTILES	Burrowing Skink/ Three-Toed Snake-Tooth Skink	*Coeranoscincus reticulatus*	V	N	N	Unlikely

4.1.2 Migratory Species

No migratory bird species were recorded on the site or the property by the survey.

A significant number of EPBCA listed migratory bird species are known (OEH 2014a) or considered at potential occurrences in the locality. A search of the MNES website and literature review (Readers Digest 1990, Priest *et al* 2002, Sandpiper 2004, Rogers *et al* 2006, Antos and Weston 2006, Antos 2005, WWF 2005, Nebel *et al* 2008, Shorebirds 2020 2008) also produced a list of likely occurrences. All of these species plus some considered by the consultant as potential occurrences in the LGA in similar habitat to that on the property are also shown in the following table, with an evaluation made on likelihood of occurrence based on cited ecology. Note this list excludes seabirds, etc as detailed above.

Table 11: EPBCA migratory fauna species potential occurrence assessment

* indicates listed in the Protected Matters report.

Common Name	Scientific Name	Predicted Type Of Occurrence	Recorded In Locality	Habitat On Study Site	Likely To Occur On Study Site
*White-Bellied Sea-Eagle	*Haliaeetus benghalensis*	Species and/or habitat likely to occur in area	Y	Y – in Maria River. Potential nest sites along river	Y
Osprey	*Pandion haliaetus*	-	Y	Y – in Maria River. Potential nest sites along river	Y
*Latham's Snipe	*Gallinago hardwickii*	Species and/or habitat likely to occur in area	N	N	N
*Painted Snipe	*Rostratula benghalensis*	Species and/or habitat likely to occur in area	N	N	N
*White-Throated Needletail	*Hirundapus caudacutus*	Species and/or habitat likely to occur in area	Y	Y	Y
*Cattle Egret	*Egretta ibis*	Species and/or habitat likely to occur in area	Y	N	N

Common Name	Scientific Name	Predicted Type Of Occurrence	Recorded In Locality	Habitat On Study Site	Likely To Occur On Study Site
Great Egret	*Egretta alba*	-	Y	Marginal around small dams – edge of river too dense	Low to fair
Swift Parrot	*Lathumus discolor*	Species and/or habitat likely to occur in area	N	Preferred foraging habitat in some parts of the site	Very low to fair depending on flowering periods
*Rufous Fantail	*Rhipidura rufifrons*	Breeding or breeding habitat likely to occur in area	Y	Y – mainly in gullies, wetland and wetter patches of dry sclerophyll	Y
*Satin Flycatcher	*Myiagra cyanoleuca*	Breeding or breeding habitat likely to occur in area	Y	Y – mainly in gullies, wetland and wetter patches of dry sclerophyll	Y – low
*Black Faced Monarch	*Monarcha melanopsis*	Breeding or breeding habitat likely to occur in area	Y	Y – mainly in gullies, wetland and wetter patches of dry sclerophyll	Y – low
Spectacled Monarch	*M. trivirgatus*	Breeding or breeding habitat likely to occur in area	N	Y – mainly in gullies, wetland and wetter patches of dry sclerophyll	Y – low
Oriental Cuckoo	*Cuculus saturatus*	-	Y	Y	Y
Regent Honeyeater	*Xanthomyza phrygia*	Species and/or habitat likely to occur in area	N	Marginal habitat on site and sparse records.	N
*Rainbow Bee-eater	*Merops ornatus*	Species and/or habitat likely to occur in area	Y	Y	Y - low
*Fork-Tailed Swift	*Hirundapus caudacutus*	Species and/or habitat likely to occur in area	Y	Y	Y

4.2 THREATENED FLORA

No EPBCA listed threatened plants were recorded during the survey.

The following table assesses the occurrence potential of species derived from the MNES search tool for the locality:

Table 12: EPBCA threatened flora species potential occurrence assessment
Note: Likelihood of occurrence derived from opinions of consultant in consideration of local records, known ecology of each species; and quality of habitat on-site. * indicates not recorded on ROTAP database in region as yet

Common Name	Scientific Name	Listing Status	Recorded In Locality	Suitable Habitat On-Site	Likelihood Of Occurrence On Site
Dwarf Heath Casuarina	*Allocasuarina defungens*	E	Y	N	Unlikely
Hairy-Joint Grass	*Arthraxon hispidus*	V	Y	N	Unlikely
Leafless Tongue Orchid	*Cryptostylis hunteriana*	V	N	N	Unlikely
White-Flowered Wax Vine	*Cynanchum elegans*	E	Y	N – no rainforest, and wet sclerophyll very marginal	Unlikely – not found despite targeted searches of marginal habitat on site
-	*Euphrasia arguta*	E	N	N	N
*Frogbit Fern	*Hydrocharis dubia*	V	N	N	Unlikely. Not found
Biconvex Paperbark	*Melaleuca biconvexa*	V	N	N	Unlikely
-	*Parsonsia dorrigoensis*	E	Y	As for *Cynanchum elegans*	As for *Cynanchum elegans*
Lesser Swamp Orchid	*Phaius australis*	E	N	N	Unlikely - not found despite targeted searches of marginal habitat on site
Siah's Backbone	*Streblus pendulinus*	E	N	N	Unlikely
Minute Orchid	*Taeniophyllum muelleri*	V	N	N	Unlikely
Austral Toadflax	*Thesium australe*	V	Y	Marginal at best	Unlikely given cattle grazing and logging history. Not found.

5.0 KEMPSEY SHIRE COUNCIL KOALA PLAN OF MANAGEMENT

5.1 Site Classification

The site is mapped under the Comprehensive Koala Plan of Management (CKPoM) as having an individual Koala Plan of Management (IKPoM).

This IKPoM accompanied the original report for the previous community title subdivision (Darkheart 2002). This KPoM however is no longer current as the previously approved development is no longer proceeding, and an assessment of the current proposal under the KSC CKPoM (KSC 2011, Biolink 2011) is required.

The site has been previously determined to contain Potential Koala Habitat, and qualifies as Core Koala Habitat due to the presence of suitable food trees, identification of Koala scats and recent and historical sightings of Koalas on site (Darkheart 2002). Thus the proposal is assessed under the provisions for land containing Core Koala Habitat.

5.2 PKH Compliance Assessment

As the proposal is for a rural subdivision and retention of all preferred Koala Food Trees (KFTs) is proposed, it is to be considered under provisions of section 4.8 (a). This requires application of the performance criteria in Section 4.11.

5.3 Performance Criteria Compliance Assessment

Section 4.11 of the CKPoM lists Performance Criteria for CKH. The proposal is assessed by these criteria to demonstrate compliance with the CKPoM in the following table:

Table 13: KSC CKPoM Compliance Assessment

Performance Criteria	Compliance Assessment
a) ensure there is no net loss of core koala habitat across the subject land;	All of the KFTs on site will be retained. Only a small area of vegetation in the southeast corner of the site will be affected (about 6ha), with the remainder to be protected (about 453ha) under E2 zoning.
b) minimise the removal of any identified preferred Koala food trees, where they occur across the subject land;	The proposal will not remove any KFTs on the site as all structures and infrastructure must avoid/retain KFTs.
c) ensure such trees will not be negatively impacted by subsequent development works including the construction of buildings, associated infrastructure and/or provision of public utilities;	KFTs occurring in proximity to the future dwellings, etc, and in the APZ are to be located pre-DA for these future dwellings; and flagged prior to the clearing/construction phase. Contractors to be instructed by proponent not to park under retained trees or store materials within the drip line.
d) ensure key linkages across the landscape are maintained, where they occur, to reduce the effects of habitat	Canopy retained across most of property, retaining linkage with similar vegetation to south and north on adjoining Lots.

Performance Criteria	Compliance Assessment
fragmentation;	
e) comply with the Habitat Compensation Measures where relevant as per Section 4.12 of this plan;	Not applicable
f) where Onsite PKFT Tree Replacement Measures have been applied, as per Section 4.9 of this plan, measures to ensure the retention of replacement trees over time, which may include but are not limited to restrictions on title; and	Not applicable
g) where Koala habitat and associated linkages are proposed to be retained on the development site to mitigate impacts, measures to ensure the protection of those areas in the long term, which may include but are not limited to restrictions on title;	Development envelopes will be zoned E3 Environmental Management and residual land on site will be zoned E2 Environmental Conservation. This zoning ensures long-term protection and prohibits clearing of vegetation and RAMAs.
h) appropriate measures (ie erection of exclusion fencing) are to be in place to ensue Koalas are protected during site construction works. Should Koalas be found on site during clearing, construction or site works then provisions (i) and (j) in Section 4.11 apply.	Specific recommendations are provided in this report to ensure Koalas are not impacted during construction works.
i) Clearing of vegetation i. If clearing of certain vegetation is to occur following consideration of Section 4.8 of this plan, clearing for development purposes must not proceed until the area has been inspected for the presence of koalas and approval given in writing by a suitably qualified and/or accredited koala specialist. ii. Approval to proceed with the clearing of vegetation in accordance with this section is only valid for the day on which the inspection has been undertaken. iii. The koala specialist referred to	CKPoM measures will form a part of the Conditions of Consent

Performance Criteria	Compliance Assessment
in (i) above must remain on site during clearing of vegetation.	
j) Protection of Koalas from undue disturbance	CKPoM measures will form a part of the Conditions of Consent
k) Swimming pools	CKPoM measures will form a part of the Conditions of Consent
l) Keeping of domestic dogs	CKPoM measures will form a part of the Conditions of Consent
m) Fencing	CKPoM measures will form a part of the Conditions of Consent
n) Road design standards	Not applicable – roads too short or limited maximum speed due to curvature and condition.
o) Rezoning	Development envelopes zoned E3; remainder zoned E2

PART C: IMPACT ASSESSMENT AND RECOMMENDATIONS

7.0 POTENTIAL IMPACTS OF THE DEVELOPMENT

Loss of habitat is the primary threat to threatened species, populations and EECs (Johnson *et al* 2007, Lindenmayer and Fisher 2006, NSWSC 2001d, 2004a, 2004b, 2004c, 2004d, 2004d, 2004e, 2004f, 2004g, Smith *et al* 1995, Gibbons and Lindenmayer 2002, NPWS 1999b, Watson *et al* 2003, Gilmore and Parnaby 1994, etc). As habitat requirements are species specific, habitat loss in turn has species specific impacts. Conversely, loss of native vegetation does not automatically equate to habitat loss as some species may be advantaged ie the extent of potential habitat may be increased as a result of vegetation loss (eg species which prefer woodland habitats over forest). However, habitat loss rarely occurs in isolation from other impacts such as habitat fragmentation, isolation, degradation, altered species interactions (eg predation), etc, hence impact assessment must consider the cumulative effect of all these impacts on individual threatened species (Johnson *et al* 2007, Lindenmayer and Fisher 2006).

This section gives a description of processes and impacts that may arise from the proposed development, with specific evaluation for threatened species recorded or considered to potentially occur on the property (as determined in Appendix 1) subsequently provided under the relevant statutory impact assessment sections of this report. Ameliorative measures and recommendations to mitigate or avoid these impacts are provided in section 8.

7.1 HABITAT LOSS/MODIFICATION

7.1.1 Establishment of the Subdivision

7.1.1.1 Description

The proposal as described previously in section 1.3 is essentially a 3 Lot rural subdivision, with dwellings to be located in the E3 areas, and the remainder zoned E2 to protect the biodiversity values of the residual.

As shown in Figure 2, development envelopes 2ha in area will be located in the east of each Lot and include the building envelopes and APZ. Only 0.5ha of vegetation on each development envelope (the 'building envelope' is recommended to be allowed to be completely cleared for the establishment of a building envelope (which encompasses buildings, on-site sewage treatment systems and inner APZ).

The building envelopes are to be located in an area on each development envelope which will allow for retention of preferred Koala Food Trees (Tallowwoods, White Stringybark and Swamp Mahogany), preferentially all hollow-bearing trees, and try to avoid dense patches of Allocasuarinas (detailed in section 8). Vegetation in the remainder of each development envelope may be further partially underscrubbed to increase bushfire protection as a compromise to protection of the E2 land, but aside from boundary fencing (which must also avoid KFTs and hollow-bearing trees), the canopy is expected to remain intact.

Access driveways to the building envelopes and any internal fences will require minor clearing and similarly must avoid Koala Food Trees, hollow-bearing trees and Allocasuarinas. For the purposes of this assessment, it is assumed that up to 6ha of vegetation will be modified (ie cleared in parts and underscrubbed).

The residual land in each Lot (which is about 453ha in total) is to be zoned E2 Environmental Conservation which prohibits clearing and agricultural activities.

7.1.1.2 General Impacts

Direct impacts from establishment of the subdivision will include:

- Loss/modification of up to 6ha of dry sclerophyll forest and swamp forest (about 1.3% of the property's vegetation).
- Potential loss of some hollow-bearing logs as well as Allocasuarinas and other potential forage and refuge sources.
- Loss/modification of known and potential habitat for a range of threatened species eg Yellow-bellied Glider, Koala and Brush-tailed Phascogale.
- Introduction of on-site effluent disposal, and potential impacts on soil characteristics (eg pH, fertility and drainage) and water quality (eg runoff into drainage lines, and groundwater eutrophication).

Indirect impacts may include:

- Introduction of anthropogenic impacts eg increased human presence, noise and artificial lighting.
- Introduction of domestic pets and exotic plants.
- Alteration to bushfire regimes.

7.2.3 Physical and Behavioural Barriers

7.2.3.1 Fencing

7.2.3.1.1 Literature Review

Fences can provide a physical barrier to fauna movement eg Koalas (Wilkes and Snowden 1998, AKF 2007, Connell Wagner 2000, Port Stephens Council 2001, Lunney *et al* 1999, DECC 2008), or a threat eg Yellow-bellied Gliders, Squirrel Gliders, Greater Gliders, Eastern Blossom Bats, owls, Koalas and Grey-headed Flying Foxes and a range of Yangochiropteran bats have been recorded being injured or entangled leading to death (via starvation, injury, predation, exposure, etc) (Gibbons and Lindenmayer 2002, Berrigan 2001h, Maclean 2007, www.batrescue.org.au, www.wildlifefriendlyfencing.com, Woodford 1999, The Owl Pages 2002).

Easements associated with fences may also open up currently closed vegetation eg dense ground cover undergrowth. This can not only expose small animals to an elevated predation risk (see section 7.4.7, and photos 3, 4 and 11), but may behaviourally impede fauna movement eg the Eastern Chestnut Mouse prefers runways under cover and is impacted by roading in its habitat (*Garrett v Freeman (No. 4) [2007] NSWLEC 389*).

7.2.3.1.2 Impact Assessment

The revised subdivision design restricts clearing/modification to the 2ha development envelopes in the east of each Lot. Only the boundaries of each of these envelopes thus may be fenced, and hence the extent of fragmentation over the property is substantially minimised, as is the length of fencing. Hence the site should retain much of its present continuity.

The clearing of vegetation for fence lines around the development envelopes will create some degree of fragmentation within a very small localised portion of the site. Combined with underscrubbing, this will reduce the habitability of the development envelopes for some sensitive or small home range species.

No significant fauna barrier effect physically by the fences themselves is considered likely. The gap created by the fence may provide a physical and behavioural barrier/inhibitor to small fauna species dependant on continuous groundcover, and thus inhibit movement of some species eg Common Planigale. Given the extent of tracks across the property however and the limited width, this barrier effect is not considered likely to be significant.

As noted previously, barbed wire is a notable risk of injury and mortality to gliders. Wire fences in general can sometimes cause fatal injury via entanglement (eg macropods) or death eg birds have been personally observed to break wings or necks via accidental collision, especially on dusk or at night (eg owls). Use of barbed wire is recommended to be prohibited, and in *lieu,* use of plain wire or post and rail is proposed.

7.2.3.2 Roads and Tracks

7.2.2.2.1 Literature Review

Wildlife and particularly Koala road kills and injuries predominantly occur on high volume, high speed (60-100km/hr) streets and roads with poor visibility through sight interference (eg crests and corners) or poor visibility (eg inadequate street lighting) (Wilkes and Snowden 1998, Connell Wagner 2000, Port Stephens Council 2001, Lunney *et al* 1999, DECC 2008, AKF 2007).

In general, road kills do not appear to have any major impact on the viability of populations of smaller species, but has been shown to be an adverse contributing factor to mortality of larger species (eg Koala and Spotted-Tail Quoll) with the following characteristics (Jones 2000):

- Fauna within small, isolated and possibly declining populations sensitive to elevated mortality levels.
- Fauna populations occurring in isolated or fragmented habitat.
- Fauna who come into regular contact with roads (eg scavenging other road kills) via their ecology (eg wide foraging range, dispersal, etc), or fragmentation of habitat via construction of a new road through formerly continuous habitat (eg bisection of home range).

Furthermore, habitat adjacent to black spots (road sections characterised by high wildlife mortality) may also act as "sinks" to surrounding populations ie constant loss of recruits replacing previously killed individuals (Jones 2000, Gibbons and Lindenmayer 2006, Lindenmayer and Fisher 2006, AKF 2007, DECC 2008b, Goldingay and Taylor 2005, Rhodes *et al* 2008).

7.2.3.2.2 Impact Assessment

An existing primary access road and associated tracks will be retained for bushfire management and access to the Maria River in the E2 zone. Only local residents and their guests will use these tracks, and perhaps the Rural Fire Service, hence vehicle strike risk is minimal.

Other new roads and tracks will be limited to short access driveways to future dwellings from Beranghi Road. These will only result in very minor localised fragmentation within the development envelopes. No road kill risk is likely as the driveways will be short and only allow low speed of vehicles.

7.3 SECONDARY IMPACTS

Secondary/indirect impacts typically associated with rural and rural-residential development are identified and assessed for significance below.

7.3.1 Noise

7.3.1.1 Construction Noise

7.3.1.1.1 Literature Review

Noise impacts on wildlife are poorly studied and understood in Australia, as noted by an impact study, review and Species Impact Statement for a proposed shooting range at Scotts Head which potentially affects known habitat of the Yellow-bellied Glider, Powerful Owl, Glossy Black Cockatoo, Long-Nosed Potoroo, Stuttering Frog, Wompoo Fruit-Dove and Common Bent-wing Bat (Clancy 2001, 2003,

Berrigan 2001). Some species show sensitivity especially at primary exposure, though evidence has been presented to demonstrate long term adaptation to noise eg photos of Eastern Grey Kangaroos lying on the range used by active skeet shooters, and statutory declarations reporting sightings of Glossy Black Cockatoos feeding at the end of an active shooting range (Berrigan 2001i, Clancy 2003). This consultant has also observed a Wompoo Fruit-Dove roosting in an isolated woodland tree adjacent to a busy road (Ocean Drive); Glossy Black Cockatoos foraging in a tree under which firewood was being chainsawed, in urban remnants and next to a landfill; Bitterns foraging on oyster leases adjacent to motorboats; and Jabiru foraging beside earthmoving machinery (at Greenmeadows, Port Macquarie) or under traffic bridges over estuaries (Lake Cathie and North Haven). Military training grounds have even proved to be *de facto* nature reserves for some species such as the Powerful Owl, Bush Stone Curlew, Squirrel Glider and Brushtailed Phascogale (Anon 1990, Anderson *et al* 2007); and studies have included jet flyovers over Osprey nests without significant adverse impact (Trimper *et al* 1998).

When the EIS for the Sydney's second airport location (Badgery's Creek) was exhibited, the EPA was asked to assess the impact of noise on wildlife within the Blue Mountains National Park. The review found that all major studies of noise impact on wildlife have been carried out in the USA, and very little Australian work had been done. The EPA's literature review found in summary (Paul Wilkes EPA, pers. comm. to Macksville SSAA) the following:

- Risk of hearing damage in wildlife is greatest from exposure to close or nearby blast noise rather than long-lasting exposure to continuous noise.
- Decreased responsiveness after repeated noise is frequently observed and usually attributed to habituation.
- Military and civilian blast noise (quarry and mine activity) had no unusual effects on wildlife.
- Peregrine Falcons indicate no sensitivity to blast noise, even rearing young near blast construction areas.
- An endangered mammal species, the Red Squirrel, showed no reaction to noise and blasting.
- When a new noise occurs in an area, animals initially turn towards the noise source, once determined that no harm associated with the sound, habituation occurs.
- Acoustic scaring methods such as gas guns lose their effect as target species habituate to them.
- Anecdotal accounts of terrestrial wildlife living with noise loud enough to cause pain in humans eg seabirds near airports and Ospreys near Defence Force testing areas.
- On shooting ranges, anecdotal observations of ground birds such as Plovers nesting on the ground directly near firing mounds, raptors hunting the grass areas for prey during shooting competitions, and Currawongs hunting insects on the ground during shooting.
- Raptors nesting and rearing young alongside airstrips and quarries that have blasting activity.

Furthermore, this consultant has undertaken inspections of two long established shooting ranges (Kempsey and Wingham). A population of Koalas was found at Wingham, and evidence of other arboreal fauna was found at both. Another survey of a range at Coffs Harbour recorded Sugar Gliders and the Powerful Owl. The Grey-headed Flying Fox was observed at all three foraging at night (Berrigan 2002e, 2002f, Clancy 2003).

7.3.1.1.2 Impact Assessment

Noise will be as typical of residences, and occasionally, noise may be higher than normal eg recreational motorbike riding. Noise effects on fauna in Australia are relatively poorly studied (Clancy 2000, 2003, Berrigan 2001d). Most evidence presented is anecdotal, but suggests most fauna have a fair degree of tolerance and adaptation at least to residential noise. For example, this consultant has observed Glossy Black Cockatoos foraging in a tree within 30m of a person chain-sawing firewood.

Given the extent of habitat on the remainder of the site, and that most threatened fauna detected on site are nocturnal; noise is not considered likely to be a significant issue or threat.

7.3.2 Potential Direct Mortality

Potential direct mortality of native fauna may occur during the construction stage via habitat removal and refuge destruction.

This potential impact is usually most relevant for fauna in tree cavities, dense undergrowth and log piles. This potential threat will affect any individual residing in a hollow-bearing tree that has to be removed for the building envelopes, access road, or bushfire provisions.

This will be a risk on site as hollow-bearing trees may require removal. This threat will be mitigated by specific recommendations (see section 8.1.2).

7.3.3 Artificial Lighting

Lighting may potentially discourage particularly nocturnal native species from foraging near areas of development, especially given light may travel significant distances and it can have a similar effect to a full moon on the hunting success of predators such as owls, or a behavioural avoidance impact by potential prey species (DEC 2004, Andrews 1990, Grayson and Calver 2004). This consultant has observed the Squirrel Glider being discouraged from existing hollows by external lighting shining on the hollow entrance, with the gliders only exiting hollows after the lighting was turned off (Darkheart 2005i). Artificial lighting also shown to affect Yangochiropteran bat assemblages positively and negatively (Scanlon and Petit 2008).

Conversely, the Squirrel Glider has also personally been observed foraging in urban areas where typical residential lighting (eg road lights, house lights etc) was present (Darkheart 2004n), as well as in caravan parks which contain an urban woodland adjacent to remnant habitat (Darkheart 2005a 2005d, 2007a). Other studies have also recorded this species in mosaics of urban remnants (Goldingay and Sharpe 2004, Goldingay *et al* 2006, Smith and Murray 2003, Smith 2002, 2000a, Melton 2007). This consultant has also recorded the Yellow-Belled Glider and Powerful Owl foraging in peri-urban remnants (Darkheart 2006c, 2006i), as have other studies (eg Ambrose 2006, Cooke *et al* 2000, Kavanagh 2004). Wallabies, kangaroos, Tawny Frogmouth Owls, Kookaburras, Magpies and possums have been noted foraging under artificial lighting in residential areas and service stations eg around Lake Innes, Port Macquarie and Kendall (personal observations). Artificial lighting may also be beneficial to Yangochiropteran bats by localised aggregation of insects, with these animals being observed foraging under streetlights, and even landing on lit footpaths in Horton St Port Macquarie to scamper for insects (personal observations).

Artificial lighting can also have the positive impact of increasing sight detection of fauna on roads, thus reducing risk of road kills eg Koalas (Wilkes and Snowden 1998, AKF 2007, Connell Wagner 2000, Port Stephens Council 2001, Lunney *et al* 1999, DECC 2006).

Artificial lighting will be provided as typical of residential dwelling, though it is recommended to be kept at the minimum required. Given only 3 dwellings on the eastern side will be established, artificial lighting should have minimal impacts to a localised area around the dwellings.

7.3.4 Alterations to Bush Fire Risk and Regimes

7.3.4.1 Literature Review

Fire is a natural ecological component of the flora and fauna occurring in the area (Gibbons and Lindenmayer 2002, Smith *et al* 2005, NPWS 2004, Catling 1991, Gill *et al* 1999), however, an inappropriate fire regime can have significant negative effects (NSWSC 2004a, 20004b, 2004c, 2004d, 2004e, 2004f, NPWS 2004, Catling 1991, Gill *et al* 1999), potentially including local extinction.

Bushfires, particularly intense, crown-burning fires, are a major threat to wildlife and threatened fauna such as Koalas (AKF 2007, Port Stephens Council 2001, Lunney *et al* 1999, DECC 2006). Extensive fires that burn out a large extent of habitat – particularly habitat that is isolated or fragmented, and thus limited in escape, refuge or re-colonisation potential, are particularly damaging if not catastrophic via direct mortality or indirectly (eg insufficient resources left to support the population) (AKF 2002, Lunney *et al* 2008).

Less intense fires may also cause secondary problems such as smoke-inhalation/breathing disorders, loss of food supply, stress and displacement (eg via complete burning of an individual's home range).

Altered fire frequency can also ultimately simplify or alter the character of vegetation communities by removing fire sensitive species (eg convert wet sclerophyll to dry, or eliminate Allocasuarinas), and even develop fire-prone communities (eg promote development of a grassy groundcover). It may also accelerate loss of hollow-bearing trees, particularly stags (Gibbons and Lindenmayer 2002). This has consequences for the fauna assemblage as well as species dependant on specific resources eg Glossy Black Cockatoo, Common Planigale and Three-Toed Snake Toothed Skink (Gibbons and Lindenmayer 2002, NSWSC 2000c, Recher *et al* 1985, Catling 1991, Gill *et al* 1991).

7.3.4.2 Impact Assessment

As detailed previously, the site has been classed as fire prone, and has a demonstrated fire history ie prescribed burns generally along the east.

The large extent of the site and lack of current human presence/low intensity management presently provides a significant fire risk. A well-prepared and managed fire plan could see reduction in potential to develop wildfire or intense fires, which would benefit fauna.

Statutory provisions under the *Rural Fires Act 1997* and *Native Vegetation Act 2003* limit the potential for fire to be used to degrade habitat, as will the E2 zoning. Allowing the development envelopes to be modified to increase bushfire protection to dwellings is also a compromise to reducing the pressure for frequent prescription burns of the E2 zone.

7.3.5 Disease

This threat is most relevant to Koalas. Most Koalas are naturally infected with *Chlamydia* pathogens (Sharp and Phillips 1999, Phillips 1997). This and other diseases may develop when Koalas are under stress, of which one cause is habitat disturbance.

Given that the key areas of habitat (swamp forest and drainage lines) are largely not affected, and that human-Koala contact is likely to be low (given extent of habitat), the risk of stress-induced disease to Koalas, or any other threatened species, is considered very low.

7.3.6 Power Line and Water Tank Mortality

Electricity supply to the site and perhaps dwellings will most likely be above ground. Threatened fauna such as Jabiru and Grey-headed Flying Foxes are occasionally killed via collision/contact with power lines (personal observations).

Subdivision of the site will introduce this threat to the Grey-headed Flying Fox. There appears to be no reported record of Masked Owls or Powerful Owls being killed by powerlines (Kavanagh 2000b).

Unsealed water tanks have been known to result in mortality of native species including frogs, birds, and the Brushtailed Phascogale (WWF 2002).

Leaf excluders should will be used on all tanks to ensure there is no risk of fauna drowning (see section 8.1.7).

7.3.7 Edge Effects

The fragmentation and/or isolation of currently intact vegetation via partial/mosaic clearing and establishment of pastures, buildings, trails, roads, etc, can have the following effects which are generally referred to as edge effects (Lindenmayer and Fisher 2006, Andrews 1990, Goosem 2002, May and Norton 1996, Catterall 2004, Dickman 1996, NPWS 2001, Kelly *et al* 2003, Cropper 1993, Downy 2003, Brown *et al* 2003):

- Increased ingress of feral species such as cats and dogs.
- Ingress of weeds into areas not previously found.
- Alterations to microclimate ie drying, altered humidity levels, increases light penetration, etc.
- Increased exposure to wind.
- Increased predation, competition and assemblage modifications.

7.3.7.1 Feral Fauna Species

7.3.7.1.1 Literature Review

Fragmentation, modification and disturbance of vegetation can allow invasion by or advantage (eg create a more suitable environment) the ingress of feral species (Lindenmayer and Fisher 2006, May 1997, Dickman 1996, NPWS 2001). For example, foxes prefer open woodland/pastoral ecosystems as opposed to closed forest (NPWS 2001); while the Indian Myna exploits urban and residential environments where

tree hollows have been retained in a parkland setting and nectar producing species have been planted with good intentions to provide foraging resources (Catterall 2004). Tracks and trails constructed within formerly intact forest have also been shown to advantage the ingress of foxes and cats (NPWS 2001, May and Norton 1996), and also providing a good ambush opportunity for fauna forced to cross the open ground. No exotic species were detected on site by this survey, which is surprisingly given the relative isolation of the remnant, and proximate landuses. However, such species may be still be present in specific areas (eg adjacent to the landfill) and/or in low density.

Exotic rodents are also advantaged by disturbances associated with human developments, and in turn can invade the adjacent forest edge, or support foxes and feral cats which in turn may supplement their diet with native species. Exotic rodent species potentially compete with native species (Catterall 2004, Dickman 1996, Lindenmayer and Fisher 2006) as well as prey on native invertebrates, hence can result in modifications of fauna and flora assemblages (Lindenmayer and Fisher 2006, May 1997, Dickman 1996, DEC 2007b), however they also provide food for native predators eg raptors (Wyong Shire Council 1999, Cooke *et al* 2000, Kavanagh 2004, 2000a, 2000b, pers. obs.).

Species such as House Sparrows, Starlings and Indian Mynas can be introduced to natural habitats by disturbance that leaves or creates vacant niches, and via establishment of landscaping that provides habitat in urbanised areas (Catterall 2004), hence these species could establish on site. The competition with native species for hollows by the Indian Myna and Starling is a particularly significant threat (Birds Australia 2010, Catterall 2004).

Foxes and feral cats are listed as Key Threatening Processes (NSWSC 2000a, 2000b, DSEWPC 2010b) indicating their significance to the decline of biodiversity. If the proposal were to advantage these species, this would introduce/increase competition and predation on native species in the adjacent forest. However, this is a current threat due to the current relative isolation of the remnant within a rural/pastoralised area adjacent to a developing industrial estate. Hence foxes are likely to be currently present (and potentially feral cats), and invasion by exotic rodents potentially from the industrial estate, or the existing landfill.

Pet cats and dogs are also significant threats to native wildlife (Patton 1990, Barratt 1997, Grayson and Calvert 2004, AKF 2007, DECC 2008b). Keeping of either or both by landowners will increase predation/injury risk (eg of Koalas), especially by cats of species such as Phascogales. Keeping of unsexed cats also increases the risk of establishment and recruitment of a feral population (Barratt 1997, NSWSC 2000a, Grayson and Calver 2004, Dickman 1996).

7.3.7.1.2 Impact Assessment

Rural subdivision is often associated with introduction of non-native species ie rodents, cats and dogs. The latter two may be kept as pets which could roam the bushland, or become feral (eg via dumping of unwanted offspring). Cats are significant predators of native species, and domestic dogs are significant threats to species such as the Koala. As pets will largely be limited to the vicinity of the dwellings or the development envelope, potential impacts should be largely localised if they occur.

As the site is Core Koala Habitat, the KSC CKPoM requires dogs to be banned.

Exotic rodent species such as the Black Rat and House Mouse can be introduced to natural habitats by disturbance that leaves or creates vacant niches. Neither species presently appears to occur on the site.

There is some potential that these species may enter the site via the subdivision. Alternatively, these may offer potential prey for native species eg Masked Owl.

Other feral species, such as foxes, either presently occur, or will be largely unaffected by the proposal (in terms of directly increasing abundance).

7.3.7.2 Weeds

7.3.7.2.1 Literature Review

Exotic plant impacts are relevant in terms of weed invasion most often on the edge of disturbed vegetation due to altered hydrological, nutrient and microclimate regimes at the disturbance interface (Kelly *et al* 2003, Cropper 1993, Downy 2003, Brown *et al* 2003, Lindenmayer and Fisher 2006). Weeds may generally enter or establish on a site (and also push into relatively undisturbed vegetation) via (Kelly *et al* 2003, Cropper 1993, Downy 2003, Brown *et al* 2003, Webb 1995):

- Flow of nutrients from on-site effluent treatment detrimentally affecting health of native plants adapted to low nutrient status soils, and advantaging weeds that prefer high nutrient soils.
- Introduction of plants which escape and become weeds eg ornamentals, lawn covers, etc.
- Disturbance providing colonising opportunities for weeds eg underscrubbing of APZs.
- Introduction of fill or earthmoving machinery containing weed propagules.

Establishment of weeds especially within narrow or small remnants of vegetation can lead to modification of the structure and floristics of the community, and modify its habitat potential eg dense lantana can prevent Koala access to food trees (AKF 2007, DECC 2008), and aquatic weeds such as Salvinia and Water Hyacinth can significantly degrade wetlands (DLWC 1998a, 1998b).

7.3.7.2.2 Impact Assessment

Lawns and gardens may be established eventually in the building envelopes, which will displace the present groundcover. It is possible that some plants introduced as garden ornamentals may escape and become weeds, though this may be curtailed by sensitivity to fire and low fertility soils, which is characteristic of the study area. Lawns with grasses will attract some fauna (eg macropods). Any planted fruit trees may also attract flying foxes.

7.3.8 Erosion and Sedimentation

Sedimentation and erosion impacts may occur at the construction of APZs via removal of vegetation and traffic eg during removal of vegetation to establish APZs (RFS 2006a).

The soils on the site are highly prone to erosion. The access road will have to be constructed to a sufficient standard by Council requirements to ensure erosion does not occur. Standard erosion mitigation measures will also be required for all construction, which Council should ensure are instituted and effective.

8.0 AMELIORATIVE MEASURES AND RECOMMENDATIONS

8.1 PRIMARY AMELIORATIVE MEASURES

The following ameliorative measures and major recommendations are primarily made to reduce or avoid potential impacts on threatened fauna either known or considered potential occurrences on the study site/property. These are integral to the basis of later assessment and conclusions as it is assumed these recommendations will largely be implemented in some form as part of the Development Consent.

8.1.1 Development Design Measures

8.1.1.1 Retention of Key Habitat Components Within Development Envelopes

The location of building envelopes within the 2ha development envelopes will be according to the following:

- At least 50m from any drainage line to provide a buffer zone for on-site sewage disposal.
- Be located in areas that will allow for retention of all KFTs, preferentially retains all hollow-bearing trees, and tries to avoid dense patches of Allocasuarinas.

The proposed location of the building envelopes and the nearest KFTs is to be determined by future owners, mapped on a registered plan and verified by a suitably qualified ecologist prior to DA approval and clearing to ensure compliance with the above requirements. This will be required as part of the Development Application for the future construction of proposed dwellings.

In the APZ, underscrubbing and thinning of the canopy (eg into a parkland style forest) must follow the following recommendations:

- Retain all hollow-bearing trees;
- Retain all KFTs (White Stringybark, Tallowwood and Swamp Mahogany); and
- Maximum retention of trees with sap incisions.

No further canopy removal is permitted on the remainder of the development envelope, other than for access driveways and fence lines, but extended APZs are acceptable to increase bushfire protection provided EECs and dense Allocasuarina stands are avoided.

8.1.2 Habitat Removal and Vegetation Clearing Management

8.1.2.1 General Measures

The following measures are recommended to manage clearing and protection of the retained habitat within the development envelopes in the construction phase:

- The extent of the building envelopes and APZs are to be clearly marked (e.g. via pegging/fencing/flagging) before clearing in order to prevent any inadvertent clearance beyond

what is required and has been assessed. This fencing/marking is to remain until all clearing and construction is completed.

- All Koala Food Trees (KFTs) over 25cm DBH around the building envelope and APZ are to be clearly marked for retention with flagging tape and spray paint. All other trees to be retained are to be clearly marked.
- Site induction is to specify that no clearing is to occur beyond the marked area. All vehicles are only to be parked in designated areas. Similarly, any materials associated with the development are to be stored outside the retained vegetation.

8.1.2.2 Clearing Monitoring

In addition to the hollow-bearing tree removal protocol (section 8.1.2.4), the following is recommended to be implemented to minimise impacts on native fauna:

- The area of clearing work is to be inspected for Koalas and other fauna by an ecologist immediately prior to commencement of any vegetation removal involving machinery and/or tree-felling.
- A pre-clearing survey must be undertaken and will include searches of habitat eg lifting and destruction of logs, searches for bird nests, and raking of leaf litter. Other than Koalas, any detected fauna is to be relocated off-site to suitable habitat on the remainder of the property. Any bird nest considered active is to be removed in a manner that allows retrieval of eggs/young, and these are to be taken into care by FAWNA/WIRES.
- If a Koala is present in the proposed clearing envelope, works are to be suspended until the Koala moves along on its own volition. If the Koala is located in a position that a 25m buffer may be established, works may proceed outside this buffer.
- The ecologist/animal welfare representative is to remain on site to supervise clearing to retrieve any fauna detected during works, undertake appropriate action (eg euthanize severely injured animals), and ensure Koalas do not enter the site during clearing works. A report detailing the results of the clearing monitoring is to be provided to KSC within 14 days of works completion.

8.1.2.3 Retained Tree Protection During Construction

The following general measures are to be implemented to ameliorate possible impacts on retained hollow bearing trees and KFTs within the APZs during clearing associated with construction:

- All habitat trees to be retained within the development envelope are to be clearly mapped on a plan lodged with Council, which will be provided to the construction contractor.
- All trees to be retained are to be clearly marked and fenced off (subject to any potential arborist's advice, fencing is to be a minimum area of the drip line/Tree Protection Zone of the subject tree/group of trees) on the site prior to commencement of works, and such fencing is to remain until construction is complete. Site induction is to clearly specify that no clearing is to occur beyond the designated area and is to only include designated trees.
- Prior to commencement of clearing, all trees identified for removal are to be inspected by Council or an approved ecologist to certify that the correct vegetation has been marked for removal/retention.

- Due care must be taken to ensure that all trees marked for retention are not damaged in any way (unless via unavoidable excavation for which other measures will apply as per any arborist's recommendations) i.e. no damage to crown, trunk and roots, unless specific arborist's recommendations are employed to mitigate damage. Compaction under the drip line of retained trees/vegetation is to be avoided (preferably via fencing) to prevent root damage or other injury to tree health (specific measures will be required to protect trees designated to be retained). Appropriate guards (preferably approved by an arborist) are to be installed to prevent physical damage to the trunk where setback via fencing is not practical/possible, and other additional measures (e.g. mulch placed over roots) are to be implemented to protect the health of the affected trees. Appropriate measures approved by an arborist are to be taken when roots must be trimmed or otherwise affected during any excavation works.
- Contract conditions with construction contractors are to provide for compliance mechanisms (e.g. financial penalties) for breeching of the above e.g. accidental tree removal (including replacement plantings), and compensatory measures (e.g. replacement plantings, nest boxes).

8.1.2.4 Hollow Bearing Tree Removal Protocol

If any hollow bearing trees unavoidably require removal as a result of the proposed development (though considered unlikely), their removal must be undertaken via a method that will minimise the risk of injury/mortality of any denning/roosting fauna (particularly the Yangochiropteran bats, Brushtailed Phascogale and Yellow-bellied Glider) within practical feasibility and limitations of Occupational Health and Safety (OH&S) obligations. Ideally, hollow-bearing tree felling would be undertaken outside the likely breeding and/or torpor season of hollow-obligate threatened species.

Felling of hollow-bearing trees is suggested to be achieved by the following general procedure:

- Initial hard bumping of tree to initiate evacuation of any residents (subject to OH&S restrictions). This is to be repeated at least 3 times at about one minute intervals over at least 5 minutes per tree (preferably longer). Caution will be required not to risk personal injury via falling branches as per OH&S obligations.
- The tree is to be removed via a method that does not require traditional tree felling methods ie a chainsaw "cut and clear drop" method is <u>not</u> to be utilised unless there is no other option. The use of crane or an excavator with an articulated pincer attachment that can hold the trunk while the tree base/limb/section is sawn, allowing the tree to be lowered gently to the ground, is the most preferred method. If this is not available, and with due OH&S considerations, an arborist can cut the limbs and gently lower each hollow-limb or tree section down one by one via ropes and pulleys or assistance with a crane.
- An ecologist with relevant experience or approved member of FAWNA/WIRES **must** be present during felling of the hollow bearing tree to monitor the process, capture any resident animals, and undertake appropriate emergency actions if required e.g. transport animal to veterinary treatment (care at proponent's cost) and/or see that they are taken into care by FAWNA/WIRES. Hollows are to be immediately once the tree is felled or section removed for animals, and appropriate measures undertaken. All rehabilitated animals are to be released in the retained habitat directly adjacent to the site.
- If a hollow cannot be cleared of fauna occupation (eg via use of an inspection camera), the following options are to be employed:

- The exit is to be blocked with porous material (to minimise risk of panicked animals being injured), and the limb/trunk carefully cut with a chainsaw, with progressive inspections until the hollow is cleared (required if the material must be windrowed or immediately chipped).
- If practical, the hollow-bearing section of tree/limb is to be carefully excised via chainsaw, and placed on the edge of the construction area with the hollow facing upwards, to allow passive escape after dusk of any fauna.

A written report is to be provided to Council within 14 days following the removal of hollow-bearing tree detailing all results and actions undertaken.

8.1.3 Clearing Restrictions

As previously mentioned, the development envelopes will be zoned E3 Environmental Management with the residual to be designated E2 Environmental Conservation. Under the new KSC Draft LEP, this zoning prohibits clearing exemptions under the NV Act ie. clearing of regrowth, clearing for Routine Agricultural Management Activities (RAMAs) as well as sustainable grazing. RAMAs include clearing for fencelines, boundaries, dams, firebreaks and stock yards.

Thus any further clearing or agricultural activities either in the development envelopes or residual land in the Lots are not permitted except with the consent of Council.

8.1.3 Bushfire Management

Burning is controlled by both the *Native Vegetation Act 2003* and *Rural Fires Act 1997*.

The NVA 2003 considers burning as clearing, hence excessive fire leading to changes in structure and floristics is a breach of the Act (DECC 2009). Consequently, future landowners are to be clearly advised that they are legally required to liaise with the NSW Rural Fire Service in regard to any proposed burning of the residual habitat, and to assist in control of any threatening bushfire. Specifically, they are to apply to the RFS for a Bush Fire Hazard Reduction Certificate (BFHRC) prior to undertaking any fuel reduction. A copy of this ecological assessment is to be provided to the RFS to fully inform their decisions eg to inform them of the presence of fire sensitive communities such as rainforest, from which fire must be excluded.

The extent and frequency of any fuel reduction burning will be subject to the *Bushfire Environmental Assessment Code* (RFS 2006b) and applicable provisions of the *Rural Fires Act 1997*. The Code specifies ecologically appropriate fire regimes and fuel reduction measures for vegetation communities and threatened species, and hence is expected to abided by for any required prescription burning.

8.1.4 Fences

If internal boundary fences are to be constructed in the development envelopes, it is recommended that either wire-post designs be used *only* with plain wire, or electric fences (preferably single strand) for wildlife safety. Barbed wire is <u>not</u> to be used due to the potential mortality threat, and is to be specified as a restriction on the title.

If physically and practically possible, boundary fences should not be constructed across drainage lines. Any private firebreak constructed along boundary fences should be limited to the width and designs specified in *Planning for Bushfire Protection* (NSW Rural Fire Service 2006). The latter measure is to prevent exorbitant and unnecessarily wide firebreaks and fragmentation of vegetation communities.

Boundary fences of the Lots are not permitted to be cleared under the E2 zoning.

8.1.6 Artificial Lighting

In general, lighting design and location must ensure lighting is directed to the ground within the site and not onto retained hollow-bearing trees or adjacent vegetation to minimise impacts on fauna potentially using this habitat.

Security lighting is preferred to be sensor-based to reduce energy consumption and contributions to Climate Change (NSWSC 2004d).

8.1.7 Drowning in Water Tanks

If any water tanks are used on site, the design must include measures to prevent access of any fauna (eg leaf excluders) to avoid the risk of accidental drowning.

8.1.8 Pollution and On-Site Effluent Controls

On-site sewage treatment is required to be licensed by Council. Council's on-site sewage treatment licensing provisions should be adequate to ensure there is no risk of contaminants (including excessive nutrients) entering watercourses or drainage lines, which may be potential breeding habitat for the Green-thighed Frog.

Ideally, any on-site sewage treatment system (especially the disposal area) should be located the maximum distance from the nearest watercourse, wetland or drainage line. As noted previously, a minimum of 100m is recommended.

8.1.9 Erosion and Sedimentation Control

Standard erosion and sedimentation controls are assumed to apply as per statutory provisions.

8.2 SECONDARY RECOMMENDATIONS

The following are provided for optional consideration by the determining authority. It is not assumed that these recommendations are adopted as conditions of consent or in the conclusions of this report, but it is highly desired that the proponent at least be advised to consider adopting them to assist in maintaining biodiversity as per the principles of Ecologically Sustainable Development.

8.2.1 Landscaping

Any landscaping proposed as part of the development should give due consideration to the establishment of native plants as ornamental species to maintain and/or increase biodiversity, provide replacement habitat, and maximise water efficiency.

Recommended species for planting should include locally indigenous Eucalypts, Angophoras, Grevilleas, Banksias, Melaleucas, Acacias, Allocasuarinas and Callistemons (especially winter-flowering species which are useful for the Little Lorikeet, gliders, honeyeaters and Grey- Headed Flying Fox eg *Banksia integrifolia);* and fruiting rainforest species such as Brush Cherry (*Syzygium australe*), figs, *Acronychia spp*, *Cryptocarya* spp, etc.

Where possible, plantings should preferably not be in parkland style or isolated trees as this minimises their effectiveness to provide habitat to all but common medium sized species (eg Currawongs and Indian Mynahs) and may become detrimental to the presence of other species (Catterall 2004). Rather, plantings should be planned to recreate a natural structure (ie layered). Such plantings thus would consist of at least one or two canopy trees, underlain by a few understorey trees, and finally a number of shrubby species. This multi-layered planting can provide effective aesthetics while supporting passerine birds (who depend on the lower stratums and structural complexity), Yangochiropteran bats, and canopy species such as birds, arboreal mammals and Yinpterochiropteran bats (Catterall 2004).

8.2.2 Predator Control

8.2.1.1 Domestic Cats

Cats are likely to be desired to be kept by landowners. Cats represent a threat to Phascogales, Quolls, Common Planigales and other small fauna that may become potential prey. Dogs can have a nuisance value (eg chasing fauna), but are a significant threat to Koalas.

If cats are to be kept by any resident, they must be confined to the building envelope or dwellings to avoid risk of predation on wildlife, or escape to establish feral populations.

8.2.1.2 Foxes and Wild Dogs

Foxes and wild dogs are present on the site, and most likely occur in adjoining lands. Feral cats may also be present but are considered a lower probability.

The new owners are recommended to periodically liaise with the Local Land Services and adjacent landowners, and participate in annual local fox/feral cat control programs. Any sightings are to be recorded and provided to the LLS with appropriate controls implemented in future programs.

8.2.3 Frog Habitat Enhancement

The following measures are recommended for new owners to consider in dam construction to enhance their potential for frog habitation, especially the Green-thighed Frog:

- Dams should be <1m deep (to allow for seasonal drying out and elimination of Plague Minnow) and have gentle sloping gradients from the edge to the floor, to allow establishment of emergent vegetation. Plantings of native aquatic vegetation eg water lilies (*Nymphae* spp) and Spikerush (*Eleocharis* spp and *Baumea* spp), is highly recommended.
- If possible, leave an island covered with vegetation, or with logs and rocks, in the centre as a refuge.
- Vegetation around the edges whether ornamental or native is encouraged.
- Pile rocks and/or logs around the dam edges for refuge.

- No fish (native or exotic) is to be introduced to any dam or watercourse. Not only do many fish eat frog eggs and tadpoles, this may contravene policy and legislation.
- Stormwater, grey water or any other contaminated water should not be allowed to enter the dam.

PART D: STATUTORY CONSIDERATIONS

9.0 EPBCA 1999 - MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE ASSESSMENT

9.1 GENERAL CONSIDERATION/SUMMARY

The provisions of the EPBCA require determination of whether the proposal has, will or is likely to have a significant impact on a "*matter of national environmental significance"*. These matters are listed and addressed as follows:

i) **World Heritage Properties**: The site is not listed as a World Heritage area nor does the proposal affect any such area.

ii) **Ramsar Wetlands of International Significance**: No Ramsar wetland occurs on the site, nor does the proposal affect a Ramsar Wetland.

iii) **EPBC Act listed Threatened Species and Communities**: The Koala is a known occurrence. The Grey-headed Flying Fox, Australasian Bittern, Spotted-tailed Quoll and Swift Parrot were considered potential occurrences on the site. None are likely to be significantly affected by the proposal (See section 9.2 and Table 13).

iv) **Migratory Species Protected under International Agreements**: No migratory species is likely to be significantly affected by the proposal (see section 9.3).

v) **Nuclear Actions**: The proposal is not a nuclear action.

vi) **The Commonwealth Marine Environment (CME)**: The site is not within the CME nor does it affect such.

vii) **The Great Barrier Reef Marine Park:** The proposal does not affect the Great Barrier Reef Marine Park.

viii) **Nuclear Actions:** The proposal is not a nuclear action.

vix) **A water resource, in relation to coal seam gas development and large coal mining development**: The proposal is not a gas or mining development.

The proposal thus is not considered to require referral to the DotE for approval.

9.2 EPBCA THREATENED SPECIES

9.2.1 Threatened Flora

No EPBC Act listed flora species were found on the study site, and are thus not considered further.

9.2.2 Threatened Fauna

9.2.2.1 General Consideration

The Grey-headed Flying Fox and Koala are listed as Vulnerable, and the Spotted Tail Quoll, Swift Parrot and Australasian Bittern are listed as Endangered under the EPBC Act. These species are considered at least fairly to highly likely to occur on site, given local records and an abundance of potential foraging habitat. These species are dealt with specifically in 9.2.2.2.

Regarding other fauna species, a number of species have been recorded in the locality, or are considered potential occurrences in the locality in terms of potentially suitable habitat. A significant number of others have also been recorded in the region. The following groups of species are not considered further as the proposal has no consequence upon them:

1. **Marine reptiles, fish and mammals** eg Grey Nurse Shark, Great White Shark, Southern Right Whale, Loggerhead Turtle, Green Turtle and Leatherback Turtle.
2. **Migratory/open ocean seabirds** eg Gould's Albatross, Southern Giant Petrel, Blue Petrel, Northern Giant Petrel, Sooty Albatross, Kermadec Petrel, Shy Albatross and Grey-Headed Albatross.

These species were considered likely to be unaffected by the development proposal due to:

- Lack of habitat affected eg Pelagic species
- Extremely rare probability of occurrence near site or in locality
- Nesting or foraging habitat not potentially or significantly affected
- No threats to be introduced or enhanced.

The following species listed under the EPBC Act are potential or known occurrences in the locality or Macleay Valley, and are considered for potential impacts, risk and significance in the evaluation table in Appendix 2. These species are generally dually listed under the NSW TSC Act 1995. Species considered are:

1. Birds: Regent Honeyeater, Painted Snipe and Red Goshawk.
2. Mammals: Long-Nosed Potoroo (considered as entire species), New Holland Mouse and Dwyer's Bat.
3. Frogs: *Litoria olongburensis, L. aurea, Mixophyes balbus* and *M. iteratus.*
4. Reptiles: Three-toed Snake-toothed Skink.

None of these species were considered likely to be significantly affected by the development proposal as:

- Potential habitat does not occur on or near the site.
- Potential habitat is not affected at all or significantly.

- Habitat loss represents negligible contraction of a marginally suitable fraction of a larger potential range.

9.2.2.2 Assessment

The following fauna species are deemed to require formal assessment:

- **Endangered:** Swift Parrot, Australasian Bittern, Spotted Tailed Quoll
- **Vulnerable**: Grey-Headed Flying Fox, Koala

9.2.2.2.1 Factors To Be Considered for Vulnerable and Endangered Species

The guidelines to assessment of significance to this Matter define an action as likely to have a significant impact on a Vulnerable and/or Endangered species, if it will:

a) Lead to a long-term decrease in the size of an important population (Vulnerable) or population (Endangered) of a species, or:
b) Reduce the area of occupancy of an important population (Vulnerable) or population (Endangered), or:
c) Fragment an existing important population (Vulnerable) or population (Endangered) into two or more populations, or:
d) Adversely affect habitat critical to the survival of a species, or:
e) Disrupt the breeding cycle of an important population (Vulnerable) or population (Endangered), or:
f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or:
g) Result in invasive species, that are harmful (by competition, modification of habitat, or predation) to a Vulnerable or Endangered species, becoming established in the Vulnerable and/or Endangered species' habitat, or:
h) Introduce disease that may cause a species to decline, or:
i) Interferes substantially with the recovery of the species.

An *important population* is one that is necessary for a species' long-term recovery. This includes such populations as:

- Key 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:

9.2.2.2.2 Assessment of Significance

This section addresses each of the previous points listed.

For the purposes of discussion, the "*important population*" of the Vulnerable species is defined as follows:

- **Grey-Headed Flying Fox**: Given the ecology of this species (Eby 2000a, 2000b, 2002, DotE 2013b, OEH 2014b), for the purposes of discussion, the "*important population*" of Grey-Headed Flying Foxes is defined as that population of the species likely to depend on colonial roosts in the Macleay Valley.

- **Koala:** The important population would be any Koalas within the locality due to the sparseness of local records and likely large home ranges (KSC 2011, Biolink 2009b, DECC 2008).

The 'population' of the Endangered species is defined as follows:

- **Spotted-Tailed Quoll:** Given the extent of forest along the eastern half of the Shire, it is considered the population is those Quolls that reside generally east of Kempsey (eg in Hat Head, Maria River and Kumbatine National Parks; Limeburners Creek Nature Reserve/Wilderness Area; Maria River, Kalateenee and Ballengarra State Forests; and forested private land); which form an interbreeding set of individuals.
- **Swift Parrot:** Given its large territory, a "*population*" for the purpose of the following assessment is defined as individuals which may use the site as a minute portion of their non-breeding foraging habitat from core habitat where their closest known breeding records occur.
- **Australasian Bittern:** The "*population*" is defined as that population of the species likely to use suitable wetlands in the locality eg Limeburners Creek National Park, Belmore River Floodplain.

a) Lead to a long-term decrease in the size of an important population (Vulnerable) or population (Endangered) of a species, or:

Grey-Headed Flying Fox

In the context of the species ecology, the development envelopes provide a relatively minor area of potential foraging habitat. The larger 459ha property offers a more important area of habitat in a local context, but is still relatively minute compared to the full lifecycle and seasonal requirements of this species (Eby 2000a, 2000b, 2002, DotE 2014b, OEH 2014b).

The development envelopes are not known nor considered suitable as roosting habitat for the species, thus no such areas are affected by the proposal. Potential roosting habitat does however occur on the site along Maria River.

The proposal will at most result in the loss/modification of approximately 6ha of forest vegetation which offers potential forage when flowering for this species, hence the proposed development will reduce the site's current foraging carrying capacity for the species.

Relative to the amount of habitat available on the remainder of the site (>450ha) and more so the locality over which the important population would have to forage to meet its lifecycle requirements, this is considered a relatively minute area of potential habitat. Given this, that the remainder of the site will be retained, and the ecology of the species; the habitat reduction is not considered capable of directly resulting in an inevitable long term decline of an important population. In addition, alternative known/potential habitat occurs extensively in the locality, and the species readily forages and roosts in human-modified environments e.g. the Sydney Royal Botanical Gardens (Parry-Jones 2006). Hence sufficient forage will remain within its local range to sustain the local population, and the proposal will thus not lead to a long-term decrease in the size of an important population.

Spotted-Tail Quoll

The proposal may require the removal/modification of at most 6ha of generic potential foraging habitat (generic potential for denning in tree hollows and log should all be retained), forming at most, a minute part of the wider foraging range of a local individual.

The loss of this habitat may have a minor impact on the occurrence/abundance of prey within the development envelopes via loss of habitat for small terrestrial animals, arboreal mammals, and passerine birds, as well as increase anthropogenic impacts (e.g. human presence, etc).

This is considered a negative impact on the Quoll and a contribution to the threatening processes affecting the species (OEH 2014b), however the proposal is highly unlikely to affect the viability of a potential local population. This is due to the fact that the development envelopes only form a small part of this species potential territory; that the vast majority of habitat on the site (including all potential den sites) will be retained and protected; and that the Quoll has been recorded moving through more disturbed habitats.

Swift Parrot

As for the Grey-Headed Flying Fox, the proposal will see the loss/modification of at most about 6ha of generic potential forage habitat. Clearing within the development envelopes will mostly affect summer-flowering species, which are not used by the Swift Parrot, hence the far majority of the best potential habitat will be retained and protected in the remainder of the Lots.

Although detrimental in terms of incremental and cumulative habitat loss in the locality, and thus contributing to the major threatening processes responsible for decline of this species (OEH 2014b, DotE 2013b); given that the site only forms a small part of the local extent of such habitat; that the vast majority of habitat on the site will be retained; and the ecology of the species (OEH 2014b, DotE 2013b, Oliver 1998, SPRT 2001): the impacts induced by the proposal are considered unlikely to significantly affect the viability of any population in the area.

Australasian Bittern

In very broad terms, swamp forest and riparian habitat on the western side of the site has generic potential to offer foraging habitat for this species, but is not known or likely to be breeding habitat (OEH 2014b, DotE 2013b) due to its limited extent and failure to detect on site. Despite this potential habitat, the Bittern is considered to have minimal likelihood of occurrence due to:

- Lack of local records.
- Documented national decline.
- Preference for large freshwater wetlands.

The proposal has no direct impact on potential habitat of this species as the development envelopes are located well away from suitable wetland habitats in the far west of the site, and any possible indirect impacts on a potential local population (eg. human presence, modification of wetlands via stormwater runoff) would be buffered by the residual habitat and/or can be effectively managed through the mitigation measures proposed.

Koala

The proposal is required to avoid removal of any KFTs. These can be retained within the development envelopes via selective location of dwellings and infrastructure. Furthermore, no new roads or changes to traffic volumes will occur. Dogs must be banned as per the CKPoM.

Hence it will not lead to a long term decrease of an important population.

b) *Reduce the area of occupancy of an important population (Vulnerable) or population (Endangered),* or:

Grey-Headed Flying Fox:

For the Grey-Headed Flying Fox, the proposal will not result in the loss of any roosting habitat, as the development envelopes are not known or considered suitable to be a roost site. Foraging habitat of this species is measured in terms of hundreds of thousands of hectares, hence the loss of the relatively small area (6ha) of habitat is minimal relative to the area of occupancy (OEH 2014b, DotE 2014b, Eby 2000a, 2000b, 2002). This species is expected to occur post-development regardless of indirect impacts.

Quoll:

For the Quoll, the loss/modification of at most 6ha of potential habitat is also only a minute fraction of a potential territory of a single animal, let alone an entire population (Belcher 2000, 1994, NPWS 1999a, WWF 2002, OEH 2014b, Claridge *et al* 2005, Kortner *et al* 2004), and as noted above, the overwhelming majority of the individual and population's area of occupancy will remain as is.

Swift Parrot:

The Swift Parrot is a migratory species that travels from its breeding habitat in Tasmania, to winter foraging habitat along the east coast to the inland slopes of the Great Dividing Range of the mainland, up to Duaringa. The Swift Parrot is predicted to occur over 860 000km^2 (medium confidence), with only about 4000km^2 occupied and decreasing (low confidence) (Garnett and Crowley 2000).

In this context, the transformation of about 6ha of marginal habitat on the site is relatively insignificant. Conversely, about 450ha containing potential habitat will be retained, resulting in preservation of some potential habitat within the area of occupancy of the species.

Australasian Bittern:

The proposal will not reduce the area of occupancy for the Australasian Bittern as no potential habitat will be affected by the proposal.

Koala:

The proposal is unlikely to affect the area of occupancy as no KFTs will be removed and post development the site would be expected to retain this species current potential to occur. Further, the best potential habitat for the Koala on the property will not be affected by the proposal.

c) *Fragment an existing important population (Vulnerable) or population (Endangered) into two or more populations*, or:

The Grey-headed Flying Fox, Swift Parrot and Australasian Bittern are highly mobile and known to be capable of crossing human-modified habitat. The proposal will offer no barrier to movement. Thus it will not fragment an existing important population.

The Quoll is highly mobile and known to be capable of crossing human-modified habitat including rural land and peri urban areas (Smith *et al* 1995). Given that current linkage within the study area will remain, the proposal will not result in the fragmentation an existing important population.

The Koala is also relatively mobile, able to cross clearings and roads, though is highly susceptible to other threats such as dog attack and vehicle strike. The proposal does not create any new barrier or nor impact current connectivity as dwellings will be located close to Beranghi Road to minimise fragmentation.

d) *Adversely affect habitat critical to the survival of a species*, or:

"*Critical habitat*" refers to areas critical to the survival of a species or ecological community may include areas that are necessary for/to:

- Activities such as foraging, breeding, roosting or dispersal.
- Succession.
- Maintain genetic diversity and long term evolutionary development, or
- Reintroduction of populations or recovery of the species/community.

Grey-headed Flying Fox:

As mentioned previously, the site, given its significant extent, offers good potential foraging habitat for Grey-headed Flying Fox, with habitat along Maria River offering some potential roosting habitat. Post-development, despite the loss/modification of up to about 6ha of potential foraging habitat, the site will retain its essential capacity to support foraging by the Grey-headed Flying Fox, as part of such locally abundant habitat; and the value of the potential roosting habitat along Maria River should not be affected by the proposal.

Spotted-Tail Quoll:

The loss/severe modification of about 6ha of the site's habitat is not considered likely to significantly reduce the habitability of the site for the Spotted Tail Quoll as over 450ha will be retained as is, and the species has been recorded in rural areas. It is not known if the site is critical to the survival of any Spotted Tail Quoll, though given presence of wild dogs and foxes, the chances are low.

Given that critical habitat components such as tree hollows, fallen logs, prey diversity and abundance, and over 450ha of vegetation on the property should persist, it seems unlikely that the proposal will significantly adversely affect the site's habitat potential to the point that the site could not fulfil its functions as specified above.

Swift Parrot:

As mentioned previously, the study site is not breeding habitat, and given the limited abundance of Swamp Mahogany, is probably not a significant area of potential foraging habitat. Its use is likely to be opportunistic, as part of the other potential habitat in the area. The site is thus not considered critical to the survival of the species.

Due to the nature of the proposal and recommendations, the proposal is expected to essentially retain its potential as foraging habitat as about 450ha of forest containing potential habitat for this species will be retained and protected.

Australasian Bittern:

The site is not considered potential breeding habitat for this species and would only be used for foraging as a small part of its local range. The current value of the site to this species will be retained post development, as no potential foraging habitat will be impacted by the proposal. Hence the proposal will not remove areas critical to the survival of the species.

Koala:

The site contains Core Koala Habitat as per SEPP 44 guidelines, and matches the definition of Critical Habitat in the interim assessment guidelines (DSEWPC 2013). However, no primary preferred Koala food trees are likely to be removed, nor threat levels significantly increased. Hence the proposal has no significant adverse effect on critical habitat.

e) *Disrupt the breeding cycle of an important population (Vulnerable) or population (Endangered* or:

The Grey-headed Flying Fox is dependent on a sufficient extent of reliable sources of nectar, pollen and fruits for successful reproduction, and uses specific maternity roosts (Eby 2000). The site is not maternity habitat, nor is it likely to be suitable. Its large sized and dominance by a range of vegetation types suggests it has good potential to support a considerable number of Grey-headed Flying Fox during breeding seasons (if flowering periods coincided). The proposal will retain most if not all of the winter flowering species which are the most important to the breeding cycle (Eby 2000), as the swamp forest communities are largely unaffected, and over 450ha of forest will be retained in the residual habitat. Thus it should not affect the breeding cycle of the Grey-headed Flying Fox or any important population.

Similarly for the Spotted Tail Quoll, the extent of habitat to remain post-development should be more than sufficient to retain a reasonable semblance of the site's present capacity to support life cycle functions for a pair of Spotted Tail Quoll that may depend on the site. The development is not of significant scale to affect an important population, given that such a population would range over thousands of hectares, and the residual will be managed to favour this species continued presence.

The study site does not represent potential breeding habitat for the Swift Parrot or Australasian Bittern. The current potential for these species to occur on site post development will be retained, as will carrying capacity. Thus the proposal is not capable of affecting the breeding cycle of the important population.

As no preferred food trees will be removed, the breeding cycle of the Koala is unlikely to be affected by the proposal.

f) *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,* or:

As detailed previously, given their ecology, demonstrated mobility, and habitat limitations of the property: while a negative effect, the degree of vegetation/habitat loss is not considered likely to be significant enough to affect a population of any of the subject species to the point it would be likely to cause a decline of the species.

g) *Result in invasive species, that are harmful (by competition, modification of habitat, or predation) to a Vulnerable and/or Endangered species, becoming established in the Vulnerable and/or Endangered species' habitat*, or:

No new species that affects will be introduced.

No feral species that may affect the Grey-headed Flying Fox, Spotted Tail Quoll, Swift Parrot or Australasian Bittern is likely to be introduced (since foxes and wild dogs already occur). However, cats may be expected to be kept by residents. These are a potential predator, though as they are pets, are not strictly an "invasive" species. These pets will be kept under restricted conditions and feral animals are to be controlled as per the recommendations.

For the Koala, domestic dogs are banned under the KSC KPoM. Feral dogs already occur on the property and surrounding areas.

h) *Introduce disease that may cause the species to decline; or*.

No disease is likely to be introduced that would cause any of the subject species to decline.

i) *Interferes substantially with the recovery of the species*.

Ideally, the goal in threatened species recovery is to increase the number and extent of the threatened species, so that it is not in risk of becoming extinct (DotE 2014a, 2014b).

The proposal as modified by the recommendations of this assessment aims to essentially retain the current potential of the site to support opportunistic foraging by the subject species by retaining the majority of the habitat, and confining development to the southeast of the site, and also control potential threats eg incremental vegetation removal. Given that the bulk of the habitat on site will be protected and managed for conservation, this is considered likely to benefit the recovery of the species.

9.2.2.2.3 Conclusion

The proposal is not considered likely to have a significant impact on the, Grey-headed Flying Fox, Spotted-Tailed Quoll, Swift Parrot, Australasian Bittern or the Koala.

9.3 EPBCA 1999 - MIGRATORY SPECIES

No migratory species were observed during the survey.

As detailed in 4.1.2, a number of birds are considered potential occurrences eg Swift Parrot, Australasian Bittern and Rainbow Bee-eater. The aerial foraging White-throated Needletail and Fork-tailed Swift are

also likely local occurrences, while the Osprey and White-bellied Sea-eagle may be incidental fly-overs or opportunistic foragers in the open water of the wetland eg for eels and tortoises. These species are considered in the following assessment.

9.3.1 Factors to Be Considered

The guidelines to assessment of significance to this Matter, define an action as likely to have a significant impact on a migratory species, if it will:

a) **Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or;**

b) **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species, or;**

c) **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.**

An **important area of habitat** is:

1. Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or:
2. Habitat utilised by a migratory species which is at the limit of the species range, or;
3. Habitat within an area where the species is declining.

9.3.1.1 Assessment of Significance

This section addresses each of the previous points listed.

The site is not considered likely to constitute an *important area of habitat* on the basis of the following:

1. The site has not been confirmed to be used by a migratory species, though several are at least considered potential occurrences. This value of this habitat is as a fraction of a significant extent of similar habitat not only in the Shire, but the North Coast Bioregion. While the site is large, is it not considered capable of supporting an ecologically significant proportion of any of these species (at most, only a small group or transients individuals).
2. While some migratory species occurring in the locality may be at the limits of their range, no such species were recorded in the study area. Additionally, similar habitat is known to occur both north and south of the Shire.
3. If the site were located at the limits of a species whose abundance and range is declining, it would not be considered significant as such habitat is locally abundant in the area, and habitat with greater capability occurs within 10km eg State Forest, conservation reserves, etc.

In regards to point (**a**): the proposal does not affect important habitat. The proposal will modify only about 6ha of vegetation in the east of the site fronting Beranghi Road, with the majority of the site remaining intact and retaining its potential to support these species. This residual land will be appropriately managed and protected for the purposes of conservation.

In regards to point (**b**): An invasive species is one that may become established in the habitat, and harm the migratory species by direct competition, modification of habitat, or predation. No such invasive species is to be introduced by the proposal, though pet cats may be kept which could increase predatory rates. The latter is considered unlikely however as cats and exotic predators are to be controlled as per the recommendations.

In regards to point (**c**): No disruption on the lifecycle of any migratory bird is likely as:

- Habitat affected is either only marginally suitable, and/or locally abundant.
- No nesting/breeding habitat is affected.
- The majority of potential habitat is to be retained and managed for conservation purposes, hence retaining the site's potential to support the lifecycle requirements of these migratory species.

In view of the above, no migratory bird is considered likely to be significantly affected by the proposal.

10.0 SEVEN PART TEST OF SIGNIFICANCE

10.1 GENERAL INFORMATION

The 7 Part Test is used to determine whether a proposed development is likely to have a significant effect on threatened species, Endangered Ecological Communities, Endangered Populations and Critical Habitat listed under schedules of the *Threatened Species Conservation Act 1995* known or considered reasonably likely to occur in the area influenced by a development proposal. Considerations must be given to the possible significant impacts a proposed development may have on threatened species, populations, ecological communities, and their habitats (DECC 2007).

The content of the 7 Part Test is specified by Section 5A of the *Environmental Planning and Assessment Act 1979*, as amended by the *Threatened Species Act 1995,* which in turn has been amended by the *Threatened Species Conservation Amendments Act 2002*.

10.1.1 Entities to be Assessed

10.1.1.1 Recorded Threatened Species

As detailed in section 3.6.2, the following threatened fauna species were confirmed to occur on the site:

- Powerful Owl
- Glossy Black Cockatoo
- Koala
- Yellow-bellied Glider
- Brushtailed Phascogale
- Little Bent-wing Bat (probable call detection)
- Yellow-bellied Sheathtail Bat (possible call detection)
- Green-thighed Frog

These were thus automatically subject to the 7 Part Tests.

10.1.1.2 Potentially Occurring Threatened Species

Table 8 of this report derived from Appendix 1 considers 22 other fauna species to have varying (very low to highly likely) potential to facilitate habitat in the development envelope and/or within the remainder of the property. Some of these species would only use habitat well away from the development envelope eg wetland birds. Nevertheless, all of the species are subject to the 7 Part Tests as per DECC (2007) requirements (see Appendix 1).

Similarly, as detailed in section 3.2.1 and derived from Appendix 1, no threatened flora species are considered to have any likely potential to occur on the site. Hence no other flora species are subject to the Seven Part Tests.

The following additional fauna species are thus subject to the 7 Part Tests:

- **Mammals:** Spotted Tail Quoll, Common Planigale, Eastern Chestnut Mouse, Grey-headed Flying Fox, Hoary Bat, East Coast Freetail Bat, Eastern False Pipistrelle, Eastern Bent-wing Bat, Eastern Cave Bat

- **Birds:** Masked Owl, Little Eagle, Square-tailed Kite, Little Lorikeet, Varied Sittella, Swift Parrot, Osprey, Black Bittern, Australasian Bittern

- **Reptiles**: Stephens Banded Snake, Pale-headed Snake

- **Amphibians**: Wallum Froglet

10.1.1.3 EECs and Endangered Populations

As detailed in 3.2.2, the EEC *Swamp Sclerophyll Forest on Coastal Floodplains* and *River-Flat Eucalypt Forest on Coastal Floodplains* were considered to occur in limited areas of the site.

These automatically require 7 Part Test assessment.

10.1.2 Local Populations and EEC Occurrence

The guidelines associated with the revised factors have provided definitions for key terms with the most significant being that of the "*local population*" and "*local occurrence*" for threatened species and EECs respectively, as follows (DECC 2007):

> **"Local population**: the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.
>
> - The *local population* of a threatened *plant* species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.

- The *local population* of *resident fauna* 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.
- The *local population* of *migratory or nomadic fauna* species comprises those individuals that are likely to occur in the study area from time to time….

The local population of the potentially occurring threatened species is thus defined as follows:

Table 14: Definition of local populations

Species	Local Population
Glossy Black Cockatoo	The local breeding pair for which the study site/area constitutes a minute portion of larger potential foraging territory. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Square-tailed Kite Little Eagle	The local breeding pair for which the study area may constitute a minute portion of larger potential foraging territory. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Swift Parrot	Any individuals which may use the property as a minute portion of their non-breeding foraging habitat from Victoria to southeast Qld. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Little Lorikeet	The pairs/individuals which may use the property as a small portion of foraging and breeding habitat falling within a wider foraging range. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Varied Sittella	The family group/s which use the property and any adjoining habitat for foraging and breeding.
Black Bittern Australasian Bittern	Individuals or pairs of birds that may use the wetland for foraging and roosting habitat as part of the local extent of such habitat. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Powerful Owl	Local pair of birds which may include study area as small portion of large foraging territory. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Masked Owl	As for Powerful Owl. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Osprey	Local pair of birds which may include study area as small portion of large foraging territory. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Koala	Core Koala Habitat on site with Koalas recorded. Hence local population would be the Koalas potentially using property as part of larger home range.
Eastern Chestnut Mouse	Individuals potentially occurring within the swamp forest and heath on the property.
Common Planigale	All individuals potentially occurring within the study area, and any other populations on the property.
Brushtailed Phascogale	All individuals known to be occurring within the study area both resident on the property and occurring in adjacent habitats given ecology of the species.
Yellow-bellied Glider	Colonies which use site as part of their home range. Detection in south and to west suggests at least two colonies, hence local population exceeds property and study area.
Spotted-tail Quoll	Individual/s which may include study area as small portion of large foraging territory. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Grey Headed Flying Fox	Any individuals known to use habitat within study area depending on seasonal flowering incidences. Local population thus requires much more habitat that found within study area to meet lifecycle requirements.
Yangochiropteran Bats	Any individuals potentially using habitat within study area depending on lifecycle stage. Local population requires much more habitat that found within study area to meet lifecycle requirements.
Green-thighed Frog	Known population on property

Species	Local Population
Wallum Froglet	Any potential population which may occur in the swamp forest in the west, and possibly east-northeast of the property. These local populations would be largely restricted to the property.
Stephens Banded Snake Pale-headed Snake	Any snakes on the property, whose home range would largely be restricted to the property.

The local occurrence of the EECs as per the DECC (2007) definition is that within the study area ie within 100m of the site.

10.2 SEVEN PART TESTS

10.2.1 Seven Part Test Response Structure

To minimise repetition and superfluous information, the responses to the 7 Part Tests for consideration of threatened species are structured as follows:

- In Part (a), species are grouped together based on broadly common ecology (i.e. mobile bird species such as the owls or species with similar habitats such as the Yangochiropteran bats) or similar impacts, and subject to a common 7 Part Test response to part (a).
- Parts (d) and (f) are collectively responded to depending on the entities. Part (b) deals with Endangered Populations of which one is relevant to the proposed development. Part (c) applies specifically to EECs. Part (e) deals with Critical Habitat, which is not relevant to the subject proposed development.

10.2.2 Seven Part Test Responses

10.2.2.1 Part (a)

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

THREATENED FAUNA:

Species with no affected habitat: **Osprey, Black Bittern, Australasian Bittern, Wallum Froglet.**

These species may potentially forage in the northwest swamp forest at or along Maria River as part of their local occurrence. All have been recorded in the locality (OEH 2014a, pers. obs.), but none were recorded on the property.

The proposal will have no direct impact on these species as the wetland is outside the development envelope, and protected from any significant clearing (apart from extension of boundary fences into the wetland).

Given the potential habitat for these species on site will be designated as E2 environmental conservation and is located well away from the development envelopes, any substantial indirect impacts arising from the proposal are unlikely.

(b) Swift Parrot

The Swift Parrot has been recorded in the Crescent Head area (OEH 2014a). Suitable habitat occurs on the site primarily in the northwest swamp forest where Swamp Mahogany occurs which is a key habitat component and offers potential foraging habitat during coastal non-breeding visitations by this species (SPRT 2001, OEH 2014b, DotE 2014b, Menkhorst *et al* 1999, Oliver 2000, Garnett and Crowley 2000).

The best potential habitat for this species on site in the northwest will not be affected by the proposal as development envelopes will be located well away from here. A small area of swamp forest containing Swamp Mahogany also occurs over part of the northern development envelope, hence modification of vegetation here may see some removal of potential habitat. This represents a very small extent of habitat within the study area, and a minute fraction of potential habitat within the non-breeding range of this bird (SPRT 2001, OEH 2014b, DotE 2014b, Menkhorst *et al* 1999, Oliver 2000).

Overall thus, while the proposal will have a net negative impact on the current carrying capacity of the study area for these species, the order of magnitude is not considered likely to be sufficient to place a local viable population at risk of extinction as:

- Nesting habitat is not affected.
- No significant cause of mortality will be created.
- The overwhelming majority of potential habitat on the property will remain, and similar habitat is extensive in the locality. Hence potential seasonal occurrence should not be effectively prevented.
- No indirect impacts are likely.

(c) *Yangochiropteran Bats*: Little Bent-wing Bat, Eastern Bent-wing Bat, East-Coast Freetail Bat, Greater Broad-nosed Bat, Yellow-bellied Sheathtail Bat, Eastern False Pipistrelle, Eastern Cave Bat.

Survey '*probably'* recorded the Little Bent-wing Bat; and '*possibly'* the Yellow-bellied Sheathtail Bat. The other species are considered potential occurrences due to local records, or records in the mid-north coast of NSW in similar habitats (OEH 2014b).

There are no caves on-site or similar structures, thus breeding or key roosts by dependant bats do not occur on the site. There are also no other suitable structures such as buildings. Culverts along the adjacent Beranghi Rd were checked for potential roosts, however none were used nor likely to be used to lack of crevices.

Tree hollows in a full spectrum of sizes occur abundantly on the site, thus there is a plethora of roosting opportunities for the main hollow-roosting species ie East Coast Freetail Bat, Greater Broad-nosed Bat, Hoary Bat, Yellow-bellied Sheathtail Bat, and possibly the Little Bent-wing Bat and Common Bent-wing Bats. In addition, many of the very large senescent trees had fire-hollowed trunks/bases, which a few recording active use by bats.

The site in total is considered potential foraging habitat to varying degrees per community and portion depending on vegetation structure. The existing access trails and boundary firebreaks were considered good foraging substrates particularly for the Broad-nosed Bat, East Coast Freetail Bat and Bent-wings.

The proposal consists of three 2ha development envelopes in the southeastern corner of the site. The remainder of the site is to be left essentially intact. The extent of vegetation loss/removal on the development envelopes will vary per individual owner's aspirations, but at least 0.5ha per development envelope is expected to be cleared. Some limited vegetation will also be required to be removed to allow provision of services, access roads and boundary fences. Thus, the maximum total amount of vegetation to be removed/modified by the proposal is an estimated 6ha.

This is considered fairly inconsequential to the site's habitat potential for the bats dependant on vegetative cover given:

- Over 450ha of native vegetation and hence foraging habitat will remain outside the development envelopes in the residual habitat.
- The above will include the majority of potential roosts in tree hollows;
- Hollow-bearing trees and KFTs will be selectively retained in the development envelopes.
- No/minimal impact on riparian vegetation along Maria River.

No significant barrier to movement will be created as these species have no known barriers, and sufficient habitat will remain on site for connectivity.

In consideration of the fact that the majority of potential foraging and roosting habitat will be retained and conserved; that most of these bats have been recorded in or near human habitats; it is considered that the proposal is unlikely to have a significant impact on the local population of any of the subject bat species.

(d) Grey-headed Flying Fox:

The subject land consists of mosaic of dry and wet sclerophyll forest, and swamp forests. This site adjoins a significant expanse of relatively intact forest stretching to varying extents north and to a lesser extent south. To the north, this vegetation adjoins Maria River National Park. Thus the general area has high forage potential for this species. The riparian vegetation along Maria River is consisted the best area for potential roosting, though none were detected or are known to exist locally (NPWS 2002b).

The Grey-Headed Flying Fox was not recorded by this survey, most likely due to lack of flowering trees at the time. The species is considered highly likely to occur during suitable flowering periods. Given the size of the site, the number of foraging individuals might range from a few to several dozen at least.

The revised proposal is a 3 Lot rural subdivision, which consists of three 2ha development envelopes in the southeastern portion of the site. The remainder of the site is to be left essentially intact. This will result in up to 6ha of vegetation removal/modification (eg edge effects around the dwelling). This loss/modification of vegetation will mainly be confined to the dry sclerophyll forest and a small area of swamp forest, which is likely to be seasonally used by this species.

This action is not considered likely to have a significant impact on the viability of the site population as:

- About 450ha will remain intact and is to be retained, protected and beneficially managed for conservation.
- Additional/alternative foraging habitat lies adjacent to the site (west, north and south), and in nearby extensive conservation areas.

- The species has been recorded in highly modified habitats indicating high tolerance of human presence.

The roosting potential of the site along Maria River is also maintained as this area has been excluded from development envelopes, and hence not only retains vegetation but negates risk of human conflict.

On the basis of the above, the proposal is not considered likely to result in an impact that may significantly affect the lifecycle of a local Grey-Headed Flying Fox population, to the point of increasing extinction risk.

(e) Square-tailed Kite and Little Eagle:

These species were not recorded in the study area by the survey, but local records of the Square-tailed Kite and coastal records of the Little Eagle (OEH 2014a) suggest they could potentially incorporate the property as a minute part of a very large territory (Smith *et al* 1995, Debus and Czechura 1989, NSWSC 2010b, etc). Hence ecologically, while a local breeding pair may use the development envelope/study area for foraging, etc, at some time, the local population (the breeding pair) of these species would extend well beyond the development envelope/study area to meet their full lifecycle requirements (as detailed in Appendix 1).

As mentioned above, the proposal will result in the direct modification of up to approximately 6ha of potential foraging habitat on the site for these species. Overall, the loss is considered a negative effect (incremental and cumulative) on the current carrying capacity of the study area, and a contribution to the main threatening processes affecting the species (OEH 2014b, NSWSC 2010b, Smith *et al* 1995, Johnson *et al* 2007).

However, due to the ecology of the subject species; that no nests are impacted; that the majority of habitat will remain to sustain most of the current potential habitat usage on the remainder of the site; and the presence of extensive areas of forest adjacent and more so within range of the site (e.g. Maria National Park, Limeburners Creek Nature Reserve etc): it is readily apparent that sufficient habitat for these species to forage and fulfil their lifecycle requirements will remain within their range post-development. Hence the proposal is not considered sufficient to result in a direct decline (i.e. reduce viability) of the local population of either of the subject species.

(f) Varied Sittella

This small passerine bird was not detected on the site, but has been recorded in the locality (OEH 2014a). This species may have territories (9-20ha) which the forested part of the property/study area is sufficient in extent to support several breeding pairs (OEH 2014b, NSWSC 2010e, Noske 1998, 1985). Hence a local population could solely depend on habitat within the property/study area for its lifecycle processes. Continuity with adjoining and at least similar habitat north and south suggests ready genetic exchange with other populations, and hence viability.

The proposal will result in the direct modification of up to approximately 6ha of potential foraging and nesting habitat in the southeast corner of the site for this species. Overall, the loss is considered a negative effect (incremental and cumulative) on the current carrying capacity of the study area, and a contribution to the main threatening processes affecting the species (OEH 2014b, NSWSC 2010e).

The site modification is however considered relatively insignificant to the Varied Sittella given that the far majority of habitat on site will remain post development which would retain the current potential for this species to occur; and the current linkages to extensive areas of forest within range of the site (e.g. Maria National Park, Limeburners Creek Nature Reserve etc) will remain. Indirect impacts such as increased human presence and potential introduction of pet cats can be managed through existing statutory controls and conservation oriented management of the residual site habitat.

Hence the proposal is not considered sufficient to result in a direct decline (i.e. reduce viability) of the local population of the Varied Sittella.

(i) Eastern Chestnut Mouse and Common Planigale

The subject land consists of approximately 459ha of relatively intact forest that adjoins similar forest to the north, and to a lesser extent to the south. The site's vegetation is a mosaic of dry sclerophyll, wet sclerophyll (very limited) and swamp forest, with various sub-forms and ecotones. Disturbance to the site has mostly constituted periods of logging, which have ranged from localised patches of virtual clearing to selective thinning. This has produced a wide range of tree ages and floristic associations. Fire has occurred at irregular intervals as suggested by the extent of Allocasuarinas which are fire sensitive (personal observations). The eastern fringe appears to have been subject to the most recent fire.

The swamp forests (especially the west), drainage lines, Open Dry Sclerophyll Forest C – Scribbly Gum/*Melaleuca sieberi* and generally the northeast corner were considered the best potential habitat for these species due to the dense groundcover and moistness of the vegetation. Pitfall and Elliot A trapping in these areas failed to detect these species, however the limited effort and large extent of the site made thorough census exceedingly difficult. Both species have been recorded in the locality (OEH 2014a), and on the basis of potential habitat within the known distribution of the species, are regarded in this assessment as low to fair chance of occurrences.

Given the cited home range of about 0.5ha, even if these species are limited to the western quarter of the site (where swampier forest dominates), the site could support several hundred individuals. The site is also interconnected with similar habitat to the north and south, thus may be part of a larger population.

The proposal will result in the direct modification of up to approximately 6ha dry sclerophyll forest and swamp forest in the southeast corner of the site. This vegetation is considered to have the lowest potential for these species due to its dryness and generally higher levels of disturbance. The proposal will also introduce secondary threats such as pet cats and human presence (noise, artificial lighting etc)

Given that the best potential habitats are retained, it is considered that the loss/modification of about 6ha of lesser significant potential habitat is unlikely to affect the potential occurrence or viability of a local population of these species.

The establishment of the E2/E3 zoning for the site will see exclusion of activities which may degrade the potential habitat of these species eg cattle grazing, firewood collection, and secondary fragmentation via proliferation of tracks and clearing.

On the provision of the rezoning maintain the values of the E2 zone and that the recommendations and ameliorative measures proposed by this assessment are adopted and successfully implemented, the

proposal is not considered likely to result in an impact that may significantly affect the lifecycle of a local Common Planigale and/or Eastern Chestnut Mouse population, to the point of increasing extinction risk.

(k) Green-thighed Frog

The subject land consists of about 459ha of relatively intact forest that adjoins similar forest to the north, and to a lesser extent to the south. The site's vegetation is a mosaic of dry sclerophyll, wet sclerophyll (very limited) and swamp forest. Given the cited broad range of habitats, the Green-thighed Frog could potentially occur in all and/or any of these habitats, though the swamp forest communities of the west may possibly be too acid.

A single Green-thighed Frog was found by the survey on-site. This individual was found on a ridge in the Open Dry Sclerophyll Forest B – Scribbly Gum with *Xanthorrhoea*. In this location, the forest was very dry and relatively open, with a groundcover dominated by a mixture of Wiry Panic, Bladey Grass and *Xanthorrhoea* spp. This was surprising given that the distance to the nearest drainage line potentially with ephemeral water was at least 500m, and that this was the driest location on the entire property. This suggests the non-breeding movements of the frog are very complex. Consequently, all the Scribbly Gum forest communities are considered likely to be known habitat for the Green-thighed Frog, as are the wet sclerophyll and drainage lines.

Potential breeding habitat on the site is offered by the dams scattered mainly over the eastern end; pools (both ephemeral and semi-permanent) in the drainage lines; the ephemeral billabong in the northwest swamp forest; any other temporary billabong in the western quarter; and any potential rain filled depression scattered over the site deep enough to resist drying out before metamorphosis is complete. The survey was performed in the non-breeding season and also did not coincide with enough rain (and also fell into a 1:100 drought) to stimulate breeding, thus it has not been confirmed that the site contains a viable population of the Green-thighed Frog. However, given the extent of the site, potential population size, and range of habitat opportunities, such a population is logically likely to occur.

The direct loss/modification of about 6ha of the site's vegetation may reduce the extent of potential foraging/non-breeding habitat. This is not considered likely to be significant to the persistence of the species on the site as:

- Key potential breeding areas are not affected.
- Over 450ha of potential foraging/non-breeding habitat will remain and be protected.
- The risk of individuals being killed during establishment of proposal is very low.
- New dams may create new Plague Minnow-free breeding habitat.
- The species has been recorded in highly disturbed habitats (eg road side ditches), and there is suggestion that some disturbance in at least part of its habitat is acceptable and perhaps even desirable.

Thus, it is considered on the basis on the above information that while the loss/modification of up to 6ha of the site's habitat is ideally undesirable and a negative impact, the retention, protection and conservation management of the overwhelming majority of the site (containing the most critical habitat components and best secondary habitat); control of exotic predators; and creation of new potential breeding habitat considerably outweighs this negative impact. Hence the proposal is unlikely to see a significant impact on the local population of Green-thighed Frog.

(l) Brushtailed Phascogale:

The subject land consists of about 459ha of relatively intact forest that adjoins similar forest to the north, and to a lesser extent to the south. The site's vegetation is a mosaic of dry sclerophyll, wet sclerophyll (very limited) and swamp forest. Disturbance to the site has mostly constituted periods of logging, which have ranged from localised patches of virtual clearing to selective thinning. This has produced a wide range of tree ages and floristic associations.

Due to the varying ages of the vegetation, tree hollows are relatively abundant, though in some locations patchy. Hollows range throughout the spectrum of size ranges, with smaller hollow entrances being especially common, which is ideal for this species.

No specific census was taken on prey abundance, however given the diversity of habitats, range of flowering seasons and state of the vegetation on-site, it could be reasoned that foraging potential was likely to be good.

A single Phascogale was detected on-site by this survey, and the species has been recorded in other locations in the locality eg Setters Way, Crescent Head (personal observations). Given the known home range of the species, and the connectivity to other forested habitat to the north and south, it is likely that the site forms a viable population.

The proposal is a 3 Lot rural subdivision, with 2ha development envelopes which may at least be partially cleared; and a residual of 450ha which is to be protected and managed as a conservation area under E2 Environmental Conservation zoning. In total, the majority of the site will retain its potential to support the Brushtailed Phascogale.

The extent of vegetation loss/removal on the development envelopes will be limited but the remainder of the 2ha may be subject to at least edge effects. Some vegetation will also be required to be removed to allow provision of services, boundary fences and access driveways giving an estimated total of 6ha. This loss/fragmentation of vegetation will be confined to the dry sclerophyll and swamp forest in the southeast corner of the site, which offers potential habitat for this species as a small fraction of potential and known habitat on the 459ha property. Given the cited home range of the species ranges from 20-70ha for females and over 100ha for males (Traill and Coates 1993, Soderquist and Ealey 1994, Soderquist 1995, 1994), the amount of vegetation removal/modification would only represent a fraction of this species range and hence lifecycle requirements. Potential breeding habitat in hollow-bearing trees should be retained within the development envelopes.

No significant barrier to movement is considered likely to be created in the development areas as no significant gap will be created and the species has been recorded in rural to rural-residential areas around Kempsey, demonstrating an ability to cross open land. Hence it should retain its potential to move considerable distances as per its normal lifecycle requirements.

Wild dogs and foxes currently exist on the site, and are an existing threat to the local Phascogale population. It is recommended that new owners participate in feral animal control programs, thus reducing this threat. Furthermore, cats should be restricted to yards due to tick risk, hence pet predation is unlikely to be a significant problem. Water tanks will be used, but leaf excluders should ensure risk of drowning is negated.

On the provision of the E2/E3 zoning of the site is effective in negating further habitat modification, and that the recommendations of this report are adopted and successfully implemented: the proposal is not considered likely to result in an impact that may significantly affect the lifecycle of a local Brushtailed Phascogale population, to the point of increasing extinction risk.

(m) Spotted Tail Quoll:

The Spotted Tail Quoll has been recorded within 10km of the study site, but was not recorded on-site by the survey.

The subject land consists of about 459ha of relatively intact forest that adjoins similar forest to the north, and to a lesser extent to the south. The site's vegetation is a mosaic of dry sclerophyll, wet sclerophyll (very limited) and swamp forest. Disturbance to the site has mostly constituted periods of logging, which have ranged from localised patches of virtual clearing to selective thinning. This has produced a wide range of tree ages and floristic associations.

Due to the varying ages of the vegetation, tree hollows are relatively abundant, though in some locations patchy. Hollows range throughout the spectrum of size ranges, which is ideal for the Quoll and potential prey species. Additionally, many old trees have their bases burnt out, offering dens, and there are a reasonable number of fallen logs offering refuge.

Prey abundance was generally good. Arboreal prey potential was very good with abundant Sugar Gliders, and also the presence of Yellow-bellied Gliders and Brush-Tail Possums. Terrestrially, small mammals were common, as were bandicoots, but most macropods were large. Birds were reasonably common, though this would vary with season eg flowering periods. Other groups such as frogs and reptiles appeared poorly represented, though the seasonal conditions may have affected detectability. Overall though, the site could support foraging by the Quoll as part of its large territory.

Potential occurrence of the Quoll is significantly reduced by the presence of wild dogs and foxes, and reports of baiting programs. The wild dog and fox are potential predators and competitors (eg for carrion). The Quoll is also known to be readily able to dig up buried baits, and consume several baits in one night, thus ensuring their susceptibility to poisoning (Murray *et al* 2000).

The proposal is a 3 Lot rural subdivision that will confine development to the southeast corner of the site within 2ha development envelopes. Vegetation loss for dwellings and associated services, fences and access driveways will be limited to approximately 6ha. The residual habitat on the site will be zoned E2 under the KSC LEP 2012 which affords protection and management for conservation; hence the majority of the site will retain its potential to support the Quoll. Further, no breeding habitat is likely to be affected by the proposal as hollow trees and logs can be selectively retained within the development envelopes.

No significant barrier to movement is considered likely to be created in the development areas as no significant gap will be created; and the species has been recorded in rural areas, demonstrating an ability to cross open land. Hence it should retain its potential to move considerable distances as per its normal lifecycle requirements.

On the provision of the E2/E3 zoning of the site is effective in negating further habitat modification, and that the recommendations of this report are adopted and successfully implemented: the proposal is not

considered likely to result in an impact that may significantly affect the lifecycle of a local Quoll population, to the point of increasing extinction risk.

(o) Koala:

The property consists of 459ha of forest arranged in a complex mosaic of dry sclerophyll, wet sclerophyll and swamp forests, all of which has been disturbed by logging and/or fire. Soils vary with location, with the most fertile soils most likely to occur in the west on the floodplain of the Maria River, and in the drainage lines.

Assessment of the site for SEPP 44 Potential Koala Habitat determined over 80% of the site to be Potential Koala Habitat. This was particularly due to the abundance of Scribbly Gum, with Swamp Mahogany locally common in swamp forests; and Tallowwood being scattered over the dry sclerophyll forest communities.

A single Koala was observed once on the site during this survey. Scats were found all over the site, with a concentration in the western quarter. The property overall was determined to be Core Koala Habitat on the basis of recent (Darkheart 2002) and historical records (Kendall and Kendall 1994, Standing 1990, Bionet 2014a) of Koalas on or within range of the site (as per the SEPP 44 definition of Core Koala Habitat). Due to the poor soils over most of the site, Koalas on the site are considered likely to have large home ranges (possibly >100ha), as confirmed by Biolink (2011).

The Beranghi-Maria River-Dulconghi Hill area is known to support a sizable and viable Koala population (Standing 1990). The Koalas on site are likely to form a part of this larger population.

The proposal will result in the loss of approximately 1.5ha of vegetation within the 3 designated development envelopes for building envelopes (ie buildings, on-site sewage treatment system, etc) along with provision of services, APZs, access roads and boundary fences. The remainder of the development envelope could be subject to some further modification eg underscrubbing to increase bushfire protection.

This loss/fragmentation of vegetation will be confined to the dry sclerophyll and part of the swamp forest in the southeast, which contains Koala habitat, but appears to have the least levels of Koala usage. Most of the trees lost will be Scribbly Gums and non-browse species, however these are extremely common on the site. Dogs are also required to be banned under the KSC CKPoM, and wild dogs observations are encouraged to be reported for control programs.

No significant barrier to movement will be created due to the design of the subdivision and fencing restrictions as per the CKPoM; and environmental protection zoning with will not allow clearing of residual habitat for agriculture, fence lines etc. No roads capable of supporting safe speeds >40kph will be established or exist on site, hence vehicle strike risk on site will be minimal.

Disease incidence is unlikely to be affected as over 450ha of habitat will be retained post-development, including all of the highest quality habitat (eg northwest swamp forest). This will negate the risk of nutritional stress or high human contact which may induce stress, and hence risk disease.

On the provision of the E2/E3 zoning of the site is effective in negating further habitat modification, and that the recommendations of this report are adopted and successfully implemented: the proposal is not

considered likely to result in an impact that may significantly affect the lifecycle of a local Koala population, to the point of increasing extinction risk.

(p) Little Lorikeet:

This small passerine bird was not detected on the property, but has been recorded in the locality (OEH 2014a). This species may potentially occur on the property and general area during seasonal flowering periods, particularly of Blackbutt which is a preferred species (NSWSC 2010). Broad-Leaved Paperbark and Swamp Mahogany are also significant as they may flower during seasonal shortages in nectar flows. Nesting may also potentially occur in tree hollows, depending on local flowering incidences and extent. Due to its dependence on flowering incidence and the unreliability of flowering seasons (Law *et al* 2000), a local population would have to range far beyond the property to meets its lifecycle processes.

The proposal will directly impact this species via loss of at least 1.5ha of potential foraging habitat for building envelopes. No or at most only very few potential nest hollows may be removed (eg if a compromise can't be reached between retaining a KFT or hollow-bearing tree, the KFT will take priority).

This action is not considered likely to have a significant impact on the viability of the local population as:

- About 450ha will remain intact and is to be retained, protected and beneficially managed for conservation.
- Additional/alternative foraging habitat lies adjacent to the site (west, north and south), and in nearby extensive conservation areas.
- The species has been recorded in highly modified habitats indicating high tolerance of human presence.

On the provision of the E2 zoning of the site is effective in negating further habitat modification outside that considered in this assessment; the provisions of the CKPoM are effectively implemented; and that the recommendations of this report are adopted and successfully implemented: the proposal is not considered likely to result in an impact that may significantly affect the lifecycle of a local Koala population, to the point of increasing extinction risk.

(q) Yellow-bellied Glider

The subject land consists of about 459ha of relatively intact forest that adjoins similar forest to the north, and to a lesser extent to the south. The site's vegetation is a mosaic of dry sclerophyll, wet sclerophyll (very limited) and swamp forest. This is ideal for this species as it provides a range of potential foraging habitats and seasonal nectar flows.

Due to the varying ages of the vegetation yet still retaining many old growth attributes, tree hollows are relatively abundant, though in some locations patchy. Hollows range throughout the spectrum of size ranges, with larger hollow entrances being common, which is ideal for this species.

This species was recorded on site as a colony in the mid-south, and another colony to the west. At least one colony is expected to claim at least part of site, and interact with adjacent colonies, hence the local population extends off the property and study area.

As noted above, at least 1.5ha of habitat is expected to be cleared and the remainder of the 2ha envelopes at least impacted by edge effects. The remaining >450ha of habitat, to be zoned E2, will essentially remain as is and hence maintain support for potentially multiple colonies of this species. Connectivity will also be retained as fragmentation is limited to a localised area, and the species can cross current gaps.

On the provision of the E2 zoning of the site is effective in negating further habitat modification, and that the recommendations of this report are adopted and successfully implemented: the proposal is not considered likely to result in an impact that may significantly affect the lifecycle of a local Yellow-bellied Glider population, to the point of increasing extinction risk.

10.2.2.2 Part (b)

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

Not applicable.

10.2.2.3 Part (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,**

Two EECs were determined to occur on the property: *Swamp Sclerophyll Forest on Coastal Floodplains*; and *River-flat Eucalypt Forest on Coastal Floodplains*.

Part of the *Swamp Sclerophyll Forest on Coastal Floodplains* extent appears to occur in part of the proposed development envelopes (vegetation mapping is indicative only of the extent of communities).

These areas will probably be avoided, or at best partially cleared or modified for an APZ, as higher ground will be sought for the dwelling sites and effluent disposal. Regardless, the local occurrence of the Swamp Sclerophyll Forest EEC is relatively very extensive, and hence the modification/removal of fraction of this extent is clearly incapable of placing its viability at likely risk of extinction.

10.2.2.4 Part (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**

At a minimum, the proposal will result in the direct loss/modification of approximately 1.5ha of vegetation, with in total about 6ha at least indirectly impacted eg by edge effects.

The remainder of the property should be effectively protected from further modification via adverse land uses due to the E2 zoning.

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

At present, the site is only separated from adjacent forest to the north and south by a firebreak about 10m wide, and internal roads and trails which currently exist, and will remain to facilitate bushfire management.

Clearing and vegetation modification for the proposal will be limited to the 6ha development envelopes in the southeast of the property. This will keep fragmentation to a minimum and adjacent to existing fragmentation. E2 zoning of the remainder will effectively protect it from further fragmentation.

The fragmentation associated with the proposal is not considered likely to form any barrier for the majority of the subject species which are highly mobile and able to cross cleared areas agricultural landscapes. Smaller terrestrial species to which open ground may pose at least a predator ambush risk are considered subject to this threat already due to existing tracks, but the best habitat is largely unaffected.

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,

As detailed in (a) and section 3.4, the habitats on the property form part of a relatively large extent of at least similar habitat for most of the subject species. The swamp forest in the northwest is somewhat localised. Small mammals, the Varied Sittella and the frogs may potentially support local population's largely restricted to the property.

The proposed development will result in the loss/severe modification of about 1.3% of the site. The remainder will be protected as E2 which will ensure it is protected in perpetuity, and hence retains its value to threatened species. Hence, in a local context and regional context, the proposal is not considered likely to result in the removal of a significant area, as the majority will be retained.

10.2.2.5 Part (e)

whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No relevant areas of critical habitat have been declared, as yet, under Part 3 of the TSCA.

10.2.2.6 Part (f)

whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Recovery plans under the TSCA 1995 are currently approved for the Forest Owls (DEC 2006), Koala (DECC 2008), and Yellow-bellied Glider (DEC 2004). Relevant threat abatement plans apply for the fox and Plague Minnow (OEH 2014b).

The *Recovery Plan for Forest Owls* (DEC 2006) and *Recovery Plan for the Yellow-bellied Glider* (DEC 2004) outlines the loss of habitat as a major threatening process for these species. The proposal will incrementally and cumulatively contribute to this process as it will remove/modify up to 6ha of potential

foraging habitat. While this is a negative impact, overwhelming majority of the property will be protected under E2.

The loss/modification of habitat required for the proposal partially conflicts with intention of the *Recovery Plan* for the Koala (DECC 2008) to improve habitat and see expansion of the presence of Koalas in NSW, although the overwhelming majority of this habitat will be retained. Dogs will however be banned, and the potential for further habitat degradation via underscrubbing, grazing and an adverse fire regime is reduced by the E2 zoning and KSC CKPoM. Hence the proposal complies overall with the Recovery Plan.

The proposal will have no significance change to the status of the fox or Plague Minnow.

For the EECs and other fauna species, the OEH (2014b) has identified a number of priority actions per species. The proposal generally offers a good outcome to achieve some of these actions via:

- Securing protection of a large area of known and potential habitat.
- Minimising the risk of fragmentation impacting movements and genetic exchange.
- Potential adverse change to fire regime.

10.2.2.7 Part (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.

The TSCA 1995 defines a "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Loss and fragmentation of habitat due to urban, residential and rural development is a recognised threat to these species (Smith *et al* 1995, Lindenmayer and Fisher 2006, Johnson *et al* 2007, Smith *et al* 1995, Gibbons and Lindenmayer 2002, OEH 2014b, NPWS 1999b, Watson *et al* 2003, Gilmore and Parnaby 1994, NPWS 2003b, etc). The proposal thus qualifies as a class of activity that is considered a threatening process to all the subject species.

For all of the subject species, the proposal will or may contribute (to varying extents) to the following Key Threatening Processes:

Table 15: Contribution to Key Threatening Processes

KTP	Extent/manner which proposal affects KTP	Mitigable?
Clearing of native vegetation (NSWSC 2001c)	Permanent removal/modification of up to 6ha of native vegetation in moderate to high condition. Known habitat of multiple threatened species including critical habitat components.	Over 450ha protected under E2 zoning
Human induced climate change (NSWSC 2000d).	As above and use of fossil-fuelled vehicles, machinery, etc, during construction and operation.	As above.
Removal of dead wood, dead trees and logs (NSWSC 2004f).	Some small timber will be removed.	Over 450ha protected under E2 zoning
*Predation by feral cats (*NSWSC 2000a).	Appear absent at this time, but potential keeping of pet cats provides a potential reservoir for establishment of a feral population.	KSC pet registration encourages pet de-sexing.

KTP	Extent/manner which proposal affects KTP	Mitigable?
Predation by the European red fox (NSWSC 2000b).	Fragmentation for APZs will increase potential for this species to occur on the property (already occurs in wider area) and foraging success. Further degradation by grazing, underscrubbing, fencing, etc, would further benefit this species.	Landholders encouraged to actively control foxes on detection.
Invasion of native plant communities by exotic perennial grasses (NSWSC 2004g)	The modification/removal of vegetation for APZs primarily, and potentially for fences, firebreaks, trails, etc provides habitat for these species.	New edges limited to development envelopes, hence any weed invasion will be localised, if it occurs.
Invasion of native plant communities by Lantana (NSWSC 2006a)	Currently very limited on the property. Potential to increase along edges of APZ if lax maintenance, and along any fence lines, trails, etc.	New edges limited to development envelopes, hence any weed invasion will be localised, if it occurs.
Loss of hollow-bearing trees (NSWSC 2007)	All hollow-bearing trees should be selectively retained in the APZ.	Mitigated to most practical extent possible.

11.0 CONCLUSION

This survey has identified that the subject land has significant value for threatened species, with confirmation of at least 6 (possibly 8) occurring, and another 22 potentially occurring at least at some time. This is due to the large extent of the site, proximity to other large tracts of habitat, relatively intact nature of the site's vegetation, mosaic of varying vegetation types and habitats including a small river, abundance of tree hollows and tree ages, and hence range of habitat opportunities.

In addition, the site has been determined to support a small population of Koalas, and thus qualifies as Core Koala Habitat. The relevant provisions of the KSC CKPoM apply, and implementation will ensure the site retains its Koala habitat values.

The development proposal will slightly reduce the site's habitat values but only of a discrete area in the southeast via direct loss of about 1.5ha, and associated indirect impacts on a total of 6ha (a total of 1.3% of the property). All key habitat components (eg hollow-bearing trees and KFTs) are to be retained in the development envelopes, and the remainder of the 459ha property will be protected under E2 zoning. Given this, the order of magnitude of the net negative impacts of the proposal are considered unlikely to place a local viable population at risk of extinction.

REFERENCES

Australasian Bat Society (2000a). Bats in Caves. Draft report from the ABS sub-committee. *Australasian Bat Society Newsletter*, **15**: 13-16.

Australasian Bat Society (2000b). Bats in Mines. Draft report from the ABS sub-committee. *Australasian Bat Society Newsletter*, **15**: 17-20.

Andrews, A. (1990). Fragmentation of habitat by roads and utility corridors: A review. *Aust. Zool*. **26**(3&4):

Allison, F. R. (1991). *Little and Common Bent-wing Bat*. In: **Complete Book of Australian Mammals.** Strahan, D. (Editor), pp 344-345. Cornstalk Publishing, Sydney.

Anon (2002). The Frogs of NSW Wetlands. www.dlwc.nse.gov.au/care/wetlands/facts. Accessed Nov 20, 2002.

Antos, M. and Weston, M. (2006). Cheetham Wetlands Shorebird Project. Unpublished report to WWF Australia. Birds Australia.

Antos, M., Tzaros, C., Ehmke, G. and Weston, M. (2005). Cheetham Wetlands Shorebird Project – Final Report. Unpublished report to WWF Australia. Birds Australia.

Anstis, M. (2002). **Tadpoles of Southeastern Australia – A Guide With Keys**. Reed-New Holland, Sydney.

Austeco (1995). ***Fauna of the Grafton and Casino State Forest Management Areas***. Austeco Pty Ltd.

Australian Koala Foundation (2014). Website: www.savetheKoala.com.au Accessed 31/3/09.

Australian Koala Foundation (2007). **Planning Guidelines for Koala Conservation and Recovery: A Guide to Best Planning Practice**. Australian Koala Foundation, Brisbane. Website: www.savethekoala.com.au

Australian Museum (2002). *Wildlife of Sydney - Green Thighed Frog Fact File*. Australian Museum website, www.aus.museum. Accessed Nov 20, 2002.

Australian Museum Business Services (1996a). ***Species Impact Statement: Camden Haven High School***. AMBS, Sydney.

Ayers, D., Nash, S. and Baggett, K. (1996). **Threatened Species of Western NSW**. NPWS, Hurstville.

Barker, J. and Grigg, G. (1977). **A Field Guide to Australian Frogs**. Rigby, Adelaide.

Barret, G.W., Ford, H.A. and Recher, H.F. (1994). Conservation of woodland birds in a fragmented rural landscape. *Pacific Conservation Biology* **1**: 245-56.

Barratt, D. (1997). Home range size, habitat utilisation and movement patterns of suburban and farm cats (Felis catus). *Ecography*, **20**(3): 271-280.

Belcher, C.A. (2000). The Range, Status and Distribution of the Spot-tailed Quoll (Dasyurus maculatus) in the Otway Ranges. http://www.oren.org.au/issues/endspp/Tigerquoll/Belcher_report.htm

Belcher, C.A. (1994). **Studies on the Diet of the Tiger Quoll (*Dasyurus maculatus*).** M. Sc. Thesis, LaTrobe University, Melbourne.

Belcher, C.A. (1995). Diet of the Tiger Quoll (*Dasyurus maculatus*) in East Gippsland, Victoria. *Wildlife Research*, **22**: 341-357.

Belcher, C.A. (1998). Susceptibility of the tiger quoll, *Dasyurus maculatus*, and the eastern quoll, *D. viverrinus*, to 1080-poisoned baits in control programmes for vertebrate pests in eastern Australia. *Wildl. Res*. **25**: pp33-40.

Bell, P.J. and Mooney, N. (2002) Distribution, *Habitat and Abundance of Masked Owls (Tyto novaehollandiae) in Tasmania*, Department of Primary Industry Water and Environment, Hobart, Tasmania, In: **Ecology and Conservation of Owls**. Newton,I., Kavanagh, R., Olsen, J. and Taylor, I. (Editors) (2002). CSIRO Publishing, Collingwood.

Bell, S. J. (2001). Notes on population size and habitat of the vulnerable *Cryptostylis hunteriana* (Orchidaceae) from the Central Coast of New South Wales. *Cunninghamii* **7**(2): 195-204.

Bennett, A.F. (1993). Microhabitat use by the Long-Nosed Potoroo (Potorous tridactylus) and other small mammals in remnant forest vegetation of southeastern Victoria. *Wild. Res*. **20**: 267-85.

Bennett, A.F. (1991). *Roads, roadsides and Wildlife Conservation: A Review.* pp. 98-118 in Saunders, D. & Hobbs, R.J. (1991). **Nature Conservation 2: The Role of Corridors**. Surrey, Beatty and Sons Pty Ltd, Sydney.

Berrigan, J.A. (2004a). *Threatened Species, EPBCA and SEPP 44 Assessment for Proposed Community Title Rural Subdivision, Lot 2 DP 754441, Beranghi Rd, Parish Of Beranghi Shire Of Kempsey*. Unpublished report to M.L. Corbett. Darkheart Eco-Consultancy, Port Macquarie.

Berrigan, J.A. (2003a). *Threatened Species, EPBCA and SEPP 44 Assessment for Proposed Residential Subdivision on Lot 1 DP 871437, Frank Cooper St, South West Rocks*. Unpublished report to Covey and Associates. Darkheart Eco-Consultancy, Port Macquarie.

Berrigan, J.A. (2003b). *Threatened Species, EPBCA and SEPP 44 Assessments for Lot 15 DP 753212, Lot 80 DP 753212,West Minimbah Rd, Minimbah.* Unpublished report to Luke and Company, Port Macquarie. Darkheart Eco-Consultancy, Port Macquarie.

Berrigan, J.A. (2003c). *Habitat Inspection and Fauna Survey – Crescent Head Rd Kempsey Shooting Range*. Unpublished report to Sporting Shooters Association of Australia, Macksville Branch.

Berrigan, J.A. (2003d). *Threatened Species, EPBCA and SEPP 44 Assessments for Proposed Safari Tents Tourist Facility, Rancho Relaxo, Point Plomer Rd.* Unpublished report to Mr Warwick Short. Darkheart Eco-Consultancy, Port Macquarie.

Berrigan, J. A. (1999a). *Threatened Species and SEPP 44 - Koala Habitat Assessment For Proposed Cemetery And Associated Facilities, Lot 36 In DP 870205, Crottys Lane, Kempsey*. Unpublished report to Kempsey Shire Council, Kempsey. .Darkheart Eco-Consultancy, Port Macquarie.

Birds Australia (2002). Swift Parrot *Lathumus discolor*. www.birdsaustralia.com

Bischoff, T., Lutter, H. and Debus, S. (2000). Square-Tailed Kites breeding on the mid north coast of NSW. *Aust. Bird Watcher*. **18**:133-152.

Blakers, M. Davies, S.J.J.F. and Reilly, P.M. (1984). **The Atlas of Australian Birds**. RAOU and Melbourne University Press, Melbourne.

BMCC (2010a). Threatened Species of the Upper Blue Mountains. Blue Mountains City Council www.bmcc.nsw.gov.au

BMCC (2010b). The Life Cycle of the Giant Dragonfly. Blue Mountains City Council www.bmcc.nsw.gov.au

Bowen, M. and Goldingay, R. (2000). *Distribution and status of the Eastern Pygmy Possum (Cercartetus nanus) in NSW*. *Aust. Mamm*. **21**: 153-164.

Braithwaite, L.W., Turner, T. and Kelly, J. (1984). Studies on the arboreal marsupial fauna of eucalyt forests being harvested for woodlpulp at Eden, NSW. III. Relationship between faunal densities, eucalypt occurrence and foliage nutrients, and soil parent materials. *Aust. Wildlife Res*. **11**:41-48.

Brereton, R. (1996). *The Swift Parrot (Lathumus discolor) in south-east Tasmania*. Report to Australian Nature Conservation Agency, Canberra.

Briggs, B. (1996). **Tracks, Scats and Other Traces**. Oxford University Press, Melbourne. Bungawalbin Nature Reserve, north-eastern New South Wales. Wild. Res. ***25****: 243-*

Callaghan, J. and Phillips, S. (1998). **Interim Report on Monitoring of Impacts on Koalas Associated with the Upgrading and Part Alignment of Old Bogangar Road**. Report to Tweed Shire Council. Australian Koala Foundation. Brisbane.

Cameron, M. (2006). Nesting habitat of the Glossy Black Cockatoo in central NSW. *Biological Conservation* **127**: 402-410.

Campbell, A. 1999 (Ed). **Declines and Disappearances of Australian Frogs**. Environment Australia, Canberra

Cann, B., Williams, J. and Shields, J.M (2000). *Monitoring Large Forest Owls and Gliders After Recent Logging in Production Regrowth Forests of the Mid-North Coastal Region of NSW*. In: **Ecology and Conservation of Owls**. Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (Editors) (2002). CSIRO Publishing, Collingwood.

Carthew, S.M., Goldingay, R. L. and Funnell, D. L. (1999). *Feeding behaviour of the Yellow-bellied Glider (Petaurus australis) at the western end of its range*. *Wildl. Res*. **26**: pp 199-208.

Catchment Management Authority (2005). Local Government Infrastructure and the Native Vegetation Act. www.nativevegetation.nsw.gov.au

Catling, P.C. (1991). *Ecological effects of prescribed burning practises on the mammals of southeastern Australia*. In: Lunney, D. (ed). **The Conservation of Australia's Forest Fauna**. Royal Zoological Society, Sydney.

Catterall, C.P. (2004). Birds, garden plants and suburban bushlots: where good intentions meet unexpected outcomes. In: **Urban Wildlife: More than meets the eye**. Lunney, D. and Burgin, S. (Eds). RZSNSW, Mossman.

Catterall, C, Storey, R. and Kingston, M,B. (1997). *Reality versus rhetoric: a case study monitoring regional deforestation*. IN: P. Hale and D. Lamb (Eds). **Conservation outside nature reserves**. Pp 367-377. Centre for Conservation Biology, University of Queensland, Brisbane.

Centennial Parklands (2009). *Native Fauna Factsheet*. www.centennialparklands.com.au).

Churchill, S. (2009, 1998) **Australian Bats**. Reed-New Holland, Sydney.

Clancy, G.P. (1989). A survey of breeding ospreys (Pandion haliaetus) in northeastern coastal NSW 1980-1982. *Corella* **13** (1): 9-14.

Claridge, A.W., Tanton, M.T. and Cunningham, R.B. (1993). Hypogeal fungi in the diet of the Long-Nosed Potoroo (Potorous tridactylus) in mixed species and regrowth eucalypt forest stands in southeastern Australia. *Wildl. Res*. **20**: 321-37.

Clout, M.N. (1989). Foraging behaviour of Glossy Black Cockatoos. *Aust. Wildl. Res*. **16**: 467-73.

Cogger, H.G. (1992, 2000). **Reptiles and Amphibians of Australia**. Reed, Sydney.

Cooke, R., Wallis, R. and Webster, A. (2000). *Urbanisation and the Ecology of Powerful Owls (Ninox strenua) in Outer Melbourne, Victoria*. In: **Ecology and Conservation of Owls**. Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (Editors) (2002). CSIRO Publishing, Collingwood.

Corben, C.J. (1991). *Comments on frog decline in southeast Qld*. In: **Report of a Workshop on Declining Frog Populations in Qld**. Unpublished report to QNPWS, Brisbane.

Craig, S.A. (1985). Social organisation, reproduction and feeding of a population of Yellow-bellied Gliders, *Petaurus australis*. *Aust. Wildl. Res*., **12**: 1-18.

Croft, Peter, Reid, Nick, and Hunter, John T. (2010) Experimental burning changes the quality of fallen timber as habitat for vertebrate and invertebrate fauna: implications for fire management. *Wildlife Research* **37:** 574–581

Dadds, B. (2000). Reproductive, population and movement ecology of adult *Litoria brevipalmata* (*Anura: Hylidae*) in a heterogeneous dry eucalypt forest in southeast Queensland. Honours Thesis, Science, Griffith University.

Darkheart Eco-Consultancy (2010a). *Threatened Species, SEPP 44 and EPBCA – MNES 1999 Assessments for Redevelopment of Lot 12 DP 1120476, Pacific Street, Crescent Head.* Unpublished report to Dennis Partners. Darkheart Eco-Consultancy, Laurieton.

Darkheart Eco-Consultancy (2006). *Flora and Fauna Survey and SEPP 44 Assessment of Proposed Rural Subdivision of Lot 23 DP 260716, Rodeo Drive, Kundabung.* Unpublished report to Mid Coast Environmental Services, Kempsey. Darkheart Eco-Consultancy, Port Macquarie.

Darkheart Eco-Consultancy (2005a). *Threatened Species, EPBCA and SEPP 44 Assessments for Rural Residential Subdivision on Lot 10 DP 997372, Old Station Rd, Kempsey*. Unpublished report to Hopkins Consultants. Darkheart Eco-Consultancy, Port Macquarie.

Darkheart Eco-Consultancy. (2005b). *SEPP 44 Koala Habitat Management Plan for Proposed Rural-Residential Subdivision Of Lot 9 DP 593441, Memory Lane, Kempsey.* Unpublished report to Timber Traders Pty. Ltd. Darkheart Eco-Consultancy, Port Macquarie.

Darkheart Eco-Consultancy. (2004a). *Threatened Species, EPBCA and SEPP 44 Assessments for 37 Brushbox Crescent.* Unpublished report to Mr John Burton. Darkheart Eco-Consultancy, Port Macquarie.

Darkheart Eco-Consultancy. (2004b). *Threatened Species, EPBCA and SEPP 44 Assessments for Lot 50 DP 247905, Bloodwood Crescent.* Unpublished report to Mr Richard Watt. Darkheart Eco-Consultancy, Port Macquarie.

Darkheart Eco-Consultancy (2004c). *Threatened Species, EPBCA and SEPP 44 Assessments for Lot 2 DP 70939, Aerodrome Rd, Aldavilla.* Unpublished report to Patterson, Britton and Partners Pty Ltd. Darkheart Eco-Consultancy, Port Macquarie.

Darkheart Eco-Consultancy (2004d). *Threatened Species, EPBCA and SEPP 44 Assessments for Dwelling and Workers Cottage on Lot 99 Pt Plomer Rd, Kempsey Shire*. Unpublished report to Ms P. Thompson and Mr P. Payne. Darkheart Eco-Consultancy, Port Macquarie.

Darkheart Eco-Consultancy (2004f). *Threatened Species/8 Point Test, EPBC Act – Matters of National Environmental Significance and SEPP 44 – Koala Habitat Assessments for Proposed Residence on Lot 2 DP 749884, Plomer Rd.* Unpublished report to Global Consulting Engineers Pty Ltd. Darkheart Eco-Consultancy, Port Macquarie.

Date, E.M., Recher, H.F and Ford, H. (1992). Status of Rainforest Pigeons in northern NSW. Unpublished Report to NPWS.

Davey, S.M. (1984). *Habitat preferences of arboreal marsupials within a coastal forest in southern NSW*. pp 509-16. In: Smith, A. and Hume, I.D. (Eds) (1984). **Possums and Gliders**. Australian Mammal Society.

Davis, W.E. and Recher, H.F. (1993). Notes on the breeding biology of the Regent Honeyeater. *Corella*, **17**(1): 1-4.

Debus, S. (1994). *Aspects of the Biology, Conservation and Management of the Threatened Forest Owls and Raptors in NSW*. Thesis, Master of Science (Zool.), University of New England, Armidale.

Debus, S. and Czechura, G.V. (1989). The Square-tailed Kite, *Lophoictinia isura* in Victoria. *Aust. Bird. Watcher* **13**:118-123.

Debus, S.J.S. (1993) *The Mainland Masked Owl Tyto novaehollandiae: a Review.*

DECCW (2009). *Threatened species survey and assessment guidelines: field survey methods for fauna: Amphibian*s. DECCW NSW, Hurstville

Department of Environment and Climate Change (2008a). *Hygiene protocol for the control of disease in frogs*. Information Circular Number 6. DECC NSW, Hurstville.

Dept Environment and Climate Change (2008b). **Recovery Plan for the Koala (*Phascolarctos cinereus*)**. NSW DECC, Hurstville.

DECC (2008c). A new Biodiversity Strategy for NSW: discussion paper. NSW DECC, Hurstville.

DECC (2008d). **Best Practice Guidelines for Green and Golden Bell Frog Habitat**. DECC, Hurstville.

Dept Environment and Climate Change (2007a). *Threatened Species Assessment Guidelines: The Assessment of Significance*. NSW DECC, Hurstville.

Dept Environment and Climate Change (2007b). *Private Native Forest Code for Northern NSW*. NSW DECC, Hurstville.

DECC (2007c). NSW Adaptation Strategy for Climate Change Impacts on Biodiversity. NSW DECC, Hurstville.

DECC (2007d). NSW Biodiversity and Climate Change Adaptation Framework, NSW DECC, Hurstville.

DECC (2007e). *Bat roosts*. **Private Native Forestry Note 7**. DECC, Hurstville.

Department of Environment and Conservation (2006). **Recovery Plan for the Large Forest Owls: Powerful Owl (***Ninox strenua***), Sooty Owl (***Tyto tenebricosa***), and Masked Owl (***Tyto novaehollandiae***)**. NSW DECC, Hurstville

Department of Environment and Conservation (2005a). **Green and Golden Bell Frog** (*Litoria aurea*) **Recovery Plan.** Draft for Public Comment. NSW DEC, Hurstville.

Dept Environment and Conservation (2004). *Wildlife Corridors*. Fact sheet. Department of Environment and Conservation. www.environment.nsw.gov.au

Dept of Environment, Water, Heritage and the Arts (2009a). **Littoral Rainforest and Coastal Vine Thickets of Eastern Australia. Policy Statement 3.9**. DEWHA, Canberra.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009b). **EPBC Act Policy Statement 3.19. Significant Impact Guidelines for the vulnerable green and golden bell frog *Litoria aurea***. Canberra, ACT: DEWHA. Available from: http://www.environment.gov.au/epbc/publications/litoria-aurea.html.

Dept of Environment, Water, Heritage and the Arts (2008a). *Approved Conservation Advice for Cryptostylis hunteriana (Leafless Tongue-Orchid)*. www.environment.gov.au

DEWHA (2008c). *Approved Conservation Advice for Coeranoscincus reticulatus (Three-toed Snake-tooth Skink)*. www.environment.gov.au

Department of the Environment and Heritage (2006a). **Background Document For The Threat Abatement Plan**: **Infection Of Amphibians With Chytrid Fungus Resulting In Chytridiomycosis.** DEH, Canberra.

Department of the Environment and Heritage (2006b). **Background Document For The Threat Abatement Plan: Infection Of Amphibians With Chytrid Fungus Resulting In Chytridiomycosis**. DEH, Canberra

Dept of Environment (2014a). *Environment Protection and Biodiversity Conservation Act* – Matters of National Environment Significance Search Tool. www.environment.gov.au

DoE (2014b). Species Profile and Threats Database - Homepage. www.environment.gov.au.

DSEWPC (2010a). **Approved Conservation Advice for *Pseudomys novaehollandiae* (New Holland Mouse).** DEWHA, Canberra.

DSEWPC (2010b). **Listing Advice for *Pseudomys novaehollandiae* (New Holland Mouse).** DEWHA, Canberra.

Dept of Sustainability and Environment, Victoria. (2003). **Flora & Fauna Guarantee Action Statement #74: New Holland Mouse (*Pseudomys novaehollandiae*).** DSE, Melbourne.

Dept of Transport and Main Roads, Qld. (2010). **Fauna Sensitive Road Design Manual**. DTMRQ, Brisbane.

Dickman, C. (1996). **Overview of the Impacts of Feral Cats on Australian Native Fauna.** Report prepared for the Australian Nature Conservation Agency, Canberra.

Dique, D.S., Preece, H.J., Thompson, K. and de Villiers, D.L. (2004). Determining the distribution and abundance of a regional koala population in southeast Queensland for conservation management. *Wildlife Research* **31**(3): 109-119

Dique, D.S., de Villiers, D.L. and Preece, H.J. (2003). Evaluation of line transect sampling for estimating koala abundance in Pine Rivers Shire, southeast Queensland. *Wildlife Research* **30**(2): 127-135.

Dobson M. (2002) *An Assessment of Diet, Home Range, and Nest Box Usage of the Squirrel Glider (Petaurus norfolcensis) in a Brisbane City urban remnant*. Honours thesis, School of Environmental Science and Management, Southern Cross University.

Dobson, M., Goldingay, R.L., and Sharpe, D.J. (in press). Feeding behaviour of the Squirrel Glider in remnant habitat in Brisbane. **Australian Mammology**.

Downy, P. O. (2003). Invasive weeds and plant conservation. In: **Plant conservation: approaches and techniques from an Australian perspective**. Brown, C.L., Hall, F., and Mill, J. (Eds). Australian Network for Plant Conservation, Canberra

Driscoll, C. (2003). Pollination ecology of Tetratheca juncea (Tremandraceae): finding the pollinators. *Cunninghamia* (2003) **8**(1): 133–140

Dwyer, D. (1992) *Common Bent-wing Bat*. In: **Complete Book of Australian Mammals.** Strahan, D. (Editor). Cornstalk Publishing, Sydney.

Dwyer, D. (1992). *Little Bent-wing Bat*. In: **Complete Book of Australian Mammals.** Strahan, D. (Editor). Cornstalk Publishing, Sydney.

Dwyer, D. (1968). The biology, origin and adaptation of *Miniopterus australis* in NSW. *Aust. J. Zool*. **16**: 49-68.

Dwyer, D. (1966). The population pattern of *Miniopterus schreibersii* in northeastern NSW. *Aust. J. Zool*; **14**: 1073-1137.

Eby, P. (2000a). *A Case for Listing Grey-Headed Flying Fox (Pteropus poliocephalus) as Threatened in NSW Under IUCN Criterion A2*. In: **Proceedings of a Workshop to Assess the Status of the Grey-Headed Flying Fox in NSW**. Richards, G. (Ed.). Australasian Bat Society, Sydney.

Eby, P. (2000b). *Low Reproductive Periods in Grey-Headed Flying Foxes Associated With a Short Period of Food Scarcity*. In: **Proceedings of a Workshop to Assess the Status of the Grey-Headed Flying Fox in NSW**. Richards, G. (Ed.). Australasian Bat Society, Sydney.

Eby, P. (2002). *Using NSW planning instruments to improve conservation and management of Grey-Headed Flying Fox (Pteropus poliocephalus) camps*. In: **Managing the Grey-Headed Flying Fox as a Threatened Species in NSW**. Eby, P and Lunney, D. (Eds.). Royal Zoological Society of NSW, Sydney.

Ehmann, H. (1987). The habitat, microhabitat and feeding behaviour of the rainforest skink *Coeranoscincus reticulatus*. *Herpetofauna*, **17**:4-15.

Ehmann, H. (1996). *Green-thighed Frog*. In: Ehmann, H. (Ed.). **Threatened Frogs of NSW: Habitats, Status and Conservation**. Frog and Tadpole Study Group of NSW Inc.

Ellis, W.A., Hale, P.T. and Garrick, F.N. (2002). Breeding dynamics of Koalas in open woodlands. *Wildl. Res*. **29**: pp 19-25.

Ellis, W.A., Sullivan, B.J., Lisle, A.T., and Garrick, F.N. (1998). The spatial and temporal distribution of Koala faecal pellets *Wildl. Res*. **25**: pp 663-668.

Emison, W.B., Beardsdell, C.M., Norman, F.I., Loyn, R.H. and Bennett, S.C. (1987). **Atlas of Victorian Birds**. Dept Conservation Forests and Lands, and RAOU, Melbourne.

Engel, D. (2004). *Some observations on the Squirrel Glider (Petaurus norfolcensis) and implications of these to the management of this threatened species*. Newsletter of the Ecological Consultants Association of NSW. Vol 7 February 2004.

Evans, K.M. and Bunce, A. (2000). A comparison of the foraging behaviour of the Eastern Pygmy Possum (*Cercartetus nanus*) and nectarivorous birds in a Banksia integrifolia woodland. *Aust. Mamm* **22**: 81-86

Faulding, M. and Smith, A.P. (2008). *Squirrel Glider Review – Morriset Structure Plan. Report prepared for Lake Macquarie Council*. Unpublished report to Lake Macquarie Council. Austeco Environmental Consultants.

Ford, H.A. (1993). *The role of birds in ecosystems: Risks from eucalypt forest fragmentation and degradation*. Pp 33-40 in: **Birds and Their Habitats: Status and Conservation in Queensland**. Catterall, C.P., Dricoll, P.V., Hulsman, K. Muir, D and Taplin, A. (eds_). Qld Ornithological Society, Brisbane.

Fox, B.J., Taylor, J.E. and Thompson, P.T. (2003). Experimental manipulation of habitat structure: A retrogression of the small mammal succession. *Journal of Animal Ecology* **72**(6): 927-940.

Fox, B.J, Higgs, P. and Luo, J. (1993). Extension of the breeding season of the New Holland Mouse: a response to above-average rainfall. *Wildlife Research* **20**(5): 599 – 605.

Fox, B.J. (2000) *Eastern Chestnut Mouse*. In **Complete Book of Australian Mammals**. Ed R. Strahan. Angus and Robertson.

Frith, H.J. (1952). Notes on the pigeons of the Richmond River, NSW. *Emu*, **52**:88-99.

Garnett, S. (1993). *Threatened and Extinct Birds of Australia.* Royal Australian Ornithologists Union. **Report No. 82**. National Library, Canberra.

Garnett, S.T. and Crowley, G.M (2000). **The Action Plan for Australian Birds 2000**. Environment Australia Website.

Garnett, S.T., Pedler, L.P. and Crowley, G.M. (1999). The breeding biology of the Glossy Black Cockatoo, *Calyptorhynchus lathamii*, on Kangaroo Island, South Australia. *Emu*, **99**: 262-279.

Geiser, F. (1991). Hibernation in the Eastern Pygmy Possum, *Cercartetus nanus*. *Aust. J. Zool*. **41**: 67-75.

Gibbons, P. and Lindenmayer, D. (2002). **Tree Hollows and Wildlife Conservation in Australia**. CSIRO Publishing, Collingwood.

Gill, A.M., Woinarski, J.N.Z., and York, A. (1999). **Australia's Biodiversity – Response to Fire: Plants, Birds and Invertebrates**. Biodiversity Technical Paper No. 1. Dept. of Environment and Heritage, Canberra.

Gilmore, A. and Parnaby, H. (1994). *Vertebrate fauna of conservation concern in northeast NSW forests*. Northeast Forests Biodiversity Study Report No. 3e. Unpublished report, NSW NPWS.

Goldingay, R.L. (1986). *Feeding behaviour of the Yellow-bellied Glider at Bombala, NSW. Aust. Mamm*. 7(3) pp121-131.

Goldingay, R.L. and Kavanagh, R.P. (1991). *The Yellow-bellied Glider: a review of its ecology, and management considerations*. In: Lunney, D. (Ed.) (1991). **Conservation of Australia's Forest Fauna**. Royal Zoological Society of NSW, Mosman.

Goldingay, R. and Newell, D.A. (2005). Aspects of the population ecology of the Green and Golden Bell Frog (*Litoria aurea*) at the northern end of its range. *Aust. Zool*. **33**(1) pp 49-60.

Goldingay, R.L., Quin, D.G. and Churchill, S. (2001). Spatial variability in the social organisation of the Yellow-bellied Glider (*Petaurus australis*) near Ravenshoe, north Queensland. *Aust. J. Zool*. **49**: 397-409.

Goldingay, R. L., Sharpe, D.J., Dobson, M. and Beyer, G.A. (2006). Using ecological studies to understand the conservation needs of the Squirrel Glider in Brisbane urban forest remnants. *Aust. Mamm*. **28**: 173-184

Goldingay, R. L. and Sharpe, D.J. (2004a). *How do we conserve the Squirrel Glider in Brisbane's urban matrix*? In: **Urban Wildlife- more than meets the eye**. Lunney, D. and Burgin, S. (eds). NSW Royal Zoological Society of NSW, Sydney.

Goldingay, R. L. and Sharpe, D.J. (2004b). How effective is spotlighting for detecting the Squirrel Glider? *Aust. Wildl*. Res. **31**(4): 443-451.

Goldingay, R.L. and Taylor, B.D. (2006). How many frogs are killed on a road in northeast NSW? *Aust. Zool*. **33**(3): 332-337.

Griffith, S. (1993). **Conservation Status of Coastal Plant Communities In Northern NSW** - a review. NSW National Parks and Wildlife Service.

Hall, L and Richards, G. (2000). **Flying Foxes: Fruit and Blossom Bats of Australia**. Australian Natural History Series. University of NSW, Sydney.

Hamilton, M.A, Winkler, M.A and Downley, P.O. (2008). **Native Plant Species at Risk from Bitou Bush Infestation: A Field Guide for NSW**. DECC, Hurstville

Harden, G.J. (Editor). **Flora of NSW**. Vols 1-4. NSW Press, Sydney.

Hero, J.M., Hines, H., Meyer, E., Lemckert, F. and Newell, D. (2002). AmphibiaWeb: Information on amphibian biology and conservation [web application]. http://amphibiaweb.org/. Accessed Nov 20, 2002.

Hindell, M.A. and Lee, A.K. (1990). *Tree preferences of the Koala*. pp117-21 In: **Biology of the Koala**. Ed. by A.K. Lee, K.A. Handayde and G.D. Sanson. Surrey Beatty and Sons, Sydney.

Hines, H., Mahoney, M. and McDonald, K. (1997). *As Assessment of frog declines in Wet Subtropical Australia*. In: **Declines and Disappearances of Australian Frogs**. Campbell, A. (Ed). Environment Australia, Canberra.

Hourigan, C.L., Catterall, C.P., Jones, D. and Rhodes, M. (2009). A comparison of the effectiveness of bat detectors and harp traps for surveying bats in an urban landscape. *Aust. Wildl. Res*. **35**: 768-774.

Hulm, C. (1994). *The status and distribution of Miniopterus australis in northern NSW*. Integrated Project, Faculty of Resource Science and Management, Southern Cross University.

Hume, I.D. (1995). *The mystery of Koala food choice*. In: **Proceedings on a Conference on the Status of the Koala in 1995**. pp 55-64. Australian Koala Foundation, Brisbane.

Ingersoll, R. and Redpath, P. (2003). **The Flora and Fauna of Goolawah Reserve: A Resource Inventory for Planning and Management**. Conservation Volunteers Australia and Department of Sustainable and Natural Resources, Grafton.

Johnson, C.N. and Payne, A. (2002). Sex-biased dispersal in the Rufous Bettong (*Aepyprymnus rufescens*). *Aust. Mamm*. **24**: 233-235.

Jones, M. E. (2000). Road upgrade, road mortality and remedial measures: Impacts on a population of Eastern Quolls and Tasmanian Devils. *Wildlife Research* **27**: 289-296.

Jurskis, V. and Potter, M. (1997). **Koala Surveys, Ecology and Conservation at Eden**. Research Paper No. 34. State Forests, Sydney.

Jurskis, V., Rowell, D. and Ridley, D. (1994). **Survey Techniques and Aspects of the Ecology of the Koala Near Eden**. Research Paper No. 22. State Forests, Sydney.

Kavanagh, R.P. (2000a). *Comparative diets of the Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (T. novaehollandiae) in Southeastern Australia*. In: **Ecology and Conservation of Owls**. Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (Editors) (2002). CSIRO Publishing, Collingwood.

Kavanagh, R.P. (2000b). *Conservation and Management of large forest owls in Southeastern Australia*. In: **Ecology and Conservation of Owls**. Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (Editors) (2002). CSIRO Publishing, Collingwood.

Kavanagh, R.P. (1997). **Ecology and Management of Large Forest Owls in Southeastern Australia**. PhD Thesis. School of Biological Sciences, University of Sydney, Sydney.

Kavanagh, R.P. (1988). The impact of predation by the Powerful Owl on a population of the Greater Glider. *Aust. J. Ecol*. **13**:445-450.

Kavanagh, R.P. and Stanton, M.A. (2000). *Response to Habitat Fragmentation by the Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (T. novaehollandiae)and Other Nocturnal Fauna in Southeastern Australia*. In: **Ecology and Conservation of Owls**. Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (Editors) (2002). CSIRO Publishing, Collingwood.

Kendall, K. and Kendall, P. (2000). *SEPP 14, 44 and 46 and TSC Act 1995 Assessments on Portions 19, 46, 47, 129, 154 and 353, Parish of Beranghi, Dulconghi Hill, for Beranghi Cooperative*. Final Report. Kendall and Kendall Ecological Services Pty Ltd, Kempsey.

Kendall, K. and Kendall, P. (1999). *Flora and Fauna Assessment of the "Habitat Zone" – Dulconghi Heights Estate.* Final Report. Kendall and Kendall Ecological Services Pty Ltd, Kempsey.

Kendall, K. and Kendall, P. (1994). *Koala Habitat Inspection of Lot 2 DP 754441 Beranghi Rd, Beranghi*. Unpublished report to M.L. Corbett. Kendall and Kendall Ecological Services Pty Ltd, Kempsey.

Kortner, G, Gresser, S., Mott, B., Tamayo, P, Pisanu, P., Bayne, P. and Harden, R.H. (2004). Population structure, turnover and movement of Spotted-Tailed Quolls on the New England Tablelands. *Wildl. Res* **31**(5):475-484.

Laidlaw, W.S. and Wilson, B.A. (1995). The home range and habitat utilisation of Eastern Pygmy Possum (*Cercartetus nanus*) in coastal heathland, Anglesea, Victoria. *Aust. Mamm*. 19: 63-68.

Law, B.S and Dickman. C.R. (1998). The use of habitat mosaics by terrestrial vertebrate fauna: implications for conservation and management. *Biodiversity and Conservation* **7**:323-333.

Law, B., Chidel, M. and Turner, G. (2000). The use by wildlife of paddock trees. *Pacific Conservation Biology*, **6**: 130-143.

Law, B. and Chidel, M. (2002). Tracks and riparian zones facilitate the use of Australian regrowth forest by insectivorous bats. *Journal of Applied Ecology* **39**: 615-617

Law, B.S., Mackowski, C., Schoer L. and Tweedie, T. (2000) Flowering phenology of myrtaceous species and their relation to climatic, environmental and disturbance variables in northern New South Wales. *Austral Ecology* **25**, 160-178.

Law, B. and Urquart, C.A. (2000). Diet of the Large-Footed Myotis (Myotis macropus) at a forest stream roost in northern NSW. *Aust. Mamm*. **22**: 121-124.

Law, B.S. (1993). Roosting and foraging ecology of the Queensland Blossom Bat (*Syconycteris australis*) in northeastern NSW: Flexibility in response to seasonal variation. *Wildl. Res*. **20**: 419-431.

Law, B.S. (1994a). Banksia nectar and pollen: Dietary items affecting the abundance of the Common Blossom Bat (*Syconycteris australis*): in southeastern Australia. Australian Journal of Ecology **19**: 425-434.

Law, B.S. (1994b). Climatic limitations of the southern distribution of the Common Blossom Bat (*Syconycteris australis*) in NSW. Australian Journal of Ecology **19**: 366-374.

Lee, A.K. and Martin, R.W. (1998). **The Koala – A Natural History**. NSW University Press, Kensington.

Lee, A.K., Martin, R.W. and Handasyde, K.A. (19988). *Experimental translocation of Koalas to new habitat*. In: **Biology of the Koala**. Ed. by A.K. Lee, K.A. Handasyde and G.D. Sanson. pp 299-312. Surrey Beatty and Sons, Sydney.

Lindenmayer, D. (2002). **Gliders of Australia – A Natural History**. University of NSW Press, Sydney.

Long, K.I. (2001). Spatio-temporal interactions among male and female Long-Nosed Potoroos (*Potorous tridactylus*): mating system implications. *Aust. J. Zool*. **49**: 17-26.

Loyn, R.H., Traill, B.J. and Triggs, B. (1986). Prey of Sooty Owls in East Gippsland before and after fire. *Vic. Nat*. **103**:147-149

Lumsden, L. and Bennet, A. (2003) Bats and paddock trees. www.nre.vic.gov.au/notes/.

Luo, J., Fox, B.J. and Jeffreys, E. (1994). Diet of the Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*) I: Composition, Diversity and Individual Variation. *Wildl. Res*. **21**: 401-17.

Luo, J., and Fox, B.J. (1995). Competitive effects of *Rattus lutreolus* presence on the resource use by *Pseudomys gracilicaudatus*. *Aust. J. Ecol.*. **21**: 556-564.

Luo, J., and Fox, B.J. (1994). Diet of the Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*) II: Seasonal and Successional Patterns. *Wildl. Res*. **21**: 419-31.

Lundie-Jenkins, G. (1993). The diet of the Sooty Owl in the Blue Mountains. NSW. *Emu* **93**:124-127.

Lunney, D, Moon, C, Matthews, A., and Turbill, J. (1999). **Coffs Harbour City Koala Plan of Management: Part B Coffs Harbour Koala Study**. NSW NPWS, Hurstville.

Lunney, D. and Matthews, A. (2001). The contribution of the community to defining the distribution of a vulnerable species, the Spotted Tail Quoll, Dasyurus maculatus. *Wildl. Res*. **28**: pp 537-545.

Lunney, D. Gresser, S. O'Neill, L.E., Matthews, A. and Rhodes, J. (2007). The impact of fire and dogs on Koalas at Port Stephens, New South Wales, using population viability analysis. *Pacific Conservation Biology* **125**: 243-258.

Mackay, K. (1996). *Fauna Impact Statement for Portion 118, Padmans Rd, Elands, parish of Bulga for Boral Timber Division*.

Mackowski, C.M (1988). Characteristics of eucalypts incised by the Yellow-bellied Glider in northeastern NSW. *Aust. Mamm*. **11**(1) pp 1-13.

Mahony, M. (1996a). **Draft Final Report: Great Barred River Frogs Research Plan**. Unpublished report to the ANCA, Canberra and NSW NPWS, Hurstville.

Mahony, M. (1996b). **Survey of the distribution and abundance of declining frogs in northern NS**W. Unpublished report to Australian Nature Conservation Agency.

McDonald, R.C., Isbell, R.F, Speight, J.G., Walker, J. and Hopkins, M.S. (1990). **Australian Soil and Land Survey Field Handbook**. 2nd Edition. Goanna Printing, Canberra

McIntyre, A.D. and Henry, S.R. (2000). *Large Forest Owl Conservation in East Gippsland Forest Management Area, Victoria.* In: **Ecology and Conservation of Owls**. Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (Editors) (2002). CSIRO Publishing, Collingwood.

Marchant, S. and Higgins, P.J. (eds) (1990). **The Handbook of Australian, New Zealand and Australian Birds**. Oxford University Press, Melbourne.

Martin, R.W. and Lee, A. (1984). *The Koala, Phascolarctos cinereus, The Largest Marsupial Folivore*. In: **Possums and Gliders**. Smith, A.P. and Hume, I.D. (Eds). Australian Mammal Society, Sydney.

Martin, D., and Temple-Smith, P. (2010). **National Recovery Plan for the Long-nosed Potoroo *Potorous tridactylus tridactylus***. Department of Sustainability and Environment, East Melbourne.

Mason, R.J. (1997). Habitat use and population size of the Long-Nosed Potoroo (*Potorous tridactylus*) in a coastal reserve, northeastern NSW. *Aust. Mamm*. **20**: 35-42.

May, S. (1997). **The threat of feral predators to native forest fauna: Implications for forest management**. Forest Issues 3. NSW NPWS, Hurstville.

May, S.A. and Norton, T.W. (1996). Influence of fragmentation and disturbance on the potential impact of feral predators on native fauna in Australian forest ecosystems. *Aust. Wildl. Res*. **23**: 387-400.

Meek, P.D. and Briggs, B. (1996). Extension to the range of the Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*) to Jervis Bay, NSW. *Aust. Mamm*. **20**: 123-125.

Menkhorst, P., Schedvin, N. ad Geering, D. (1999). **Regent Honeyeater (*Xanthomyza phrygia*) Recovery Plan 1999-2003**. Dept of Natural Resources and Environment, Melbourne.

Menkhorst P.W. and Collier M. (1987) Diet of the squirrel glider Petaurus norfolcensis (Marsupialia: Petauridae), in Victoria. *Aust. Mamm.* **11**: 109-16.

Menkhorst, P.W. (1984). *The application of nest boxes in research and management of possums and gliders*. In: **Possums and Gliders**. Smith A.P. and Hume, I.D. (Eds). Australian Mammal Society, Sydney.

Menkhorst, P.W. and Collier, M. (1987). Diet of the Squirrel Glider, *Petaurus norfolcensis*, in Victoria. *Aust. Mamm*. **11**:109-116

Menkhorst, P.W., Weavers, B.W. and Alexander, J.S.A. (1988). Distribution of habitat and conservation status of the Squirrel Glider in Victoria. *Aust. Mamm*. 11: 109-16

Milledge, D., Palmer, C. and Nelson, J. (1991). *"Barometers of Change": The distribution of large owls and gliders in montane ash forests of the Victorian Central Highlands and their potential as management indicators*. In: **Conservation of Australia's Forest Fauna.** Lunney, D. (Ed.). The Royal Zoological Society of NSW, Sydney, pp. 53-65.

Moore, B. D. and Foley, W. J. 2005. Tree use by koalas in a chemically complex landscape. *Nature* **435**:488-490

Moore, B. D. and Foley, W. J. 2000. A review of feeding and diet selection in koalas (*Phascolarctos cinereus*). *Australian Journal of Zoology* **48:**317–333.

Mt. King Ecological Surveys (1993a*). Proposed residential canal development at Dunbogan - Fauna Impact Statement*.

Mt. King Ecological Surveys (1993b). *Fauna Survey of the Kempsey and Wauchope Forest Management Areas.* Prepared for the Forestry Commission of NSW.

NRE (2000). **Powerful Owl, *Ninox strenua* – Action Statement No. 92**. Victorian Dept Natural Resources and Environment, Melbourne.

NSW National Parks and Wildlife Service (2003a). **Recovery Plan for the Yellow-bellied Glider (*Petaurus australis*).** NSW NPWS, Hurstville.

National Parks and Wildlife Service (2003b). **Environmental Impact Assessment Guidelines: Green and Golden Bell Frog (*Litoria aurea*)**. NSW NPWS, Hurstville.

NSW National Parks and Wildlife Service (2003c). **Recovery Plan for the Barking Owl (*Ninox connivens*).** Draft for Public Comment. NSW NPWS, Hurstville.

NSW National Parks and Wildlife Service (2002a). **Recovery Plan for the Bush Stone-Curlew (*Burchinus grallaris*).** Draft for Public Comment. NSW NPWS, Hurstville.

NSW National Parks and Wildlife Service (2002b). **Recovery Plan for the Red Goshawk.** Draft for Public Comment. NSW NPWS, Hurstville.

NPWS (2001). *Threat Abatement Plan: Predation By the Red Fox (Vulpes vulpes)*. NSW NPWS, Hurstville.

NPWS (2000a). **Threatened Species of the Lower North Coast**. NSW NPWS, Hurstville.

NPWS (2000b). **Threatened Species of the Upper North Coast**. NSW NPWS, Hurstville.

NSW National Parks and Wildlife Service (1999a). *Threatened Species Management – Species Information.*

NSW National Parks and Wildlife Service (1995). *Integrated faunal information for public lands in northeastern NSW*. NSW NPWS.

NSW National Parks and Wildlife Service (1994a). *Lake Cathie/Lake Innes Management Study: Appendix D - Terrestrial Biological System.*

NSW Scientific Committee (2010a). *Final Determination to list the Little Lorikeet (Glossopsitta pusilla) (Shaw, 1790), as a Vulnerable Species.* www.environment.nsw.gov.au.

NSW Scientific Committee (2010b). *Final Determination to list the Little Eagle* (*Hieraaetus morphnoides*) *(Gould 1841), as a Vulnerable Species.* www.environment.nsw.gov.au.

NSW Scientific Committee (2010c). *Final Determination to list the Spotted Harrier (Circus assimilis), as a Vulnerable Species*. www.environment.nsw.gov.au.

NSW Scientific Committee (2010d). *Final Determination to list the Flame Robin (Petroica phoenicea) Gould 1837, as a Vulnerable Species.* www. environment.nsw.gov.au.

NSW Scientific Committee (2010e). *Final Determination to list the Varied Sittella (Daphoenositta chrysoptera) (Latham 1802), as a Vulnerable Species.* www environment.nsw.gov.au.

NSW Scientific Committee (2007a). *Loss of hollow-bearing trees:* key threatening process declaration. *final determination*. www.npws.nsw.gov.au.

NSW Scientific Committee (2006a). *Invasion, establishment and spread of Lantana* key threatening process declaration.. www.npws.nsw.gov.au.

NSW Scientific Committee (2006b). *Exotic vines and scramblers* - key threatening process declaration. www.npws.nsw.gov.au.

NSWSC (2006c). *Invasion and establishment of the Cane Toad Bufo marinus* - key threatening process declaration, www.npws.nsw.gov.au.

NSW Scientific Committee (2005a). *Herbivory and environmental degradation caused by feral deer - key threatening process declaration.* www.npws.nsw.gov.au.

NSW Scientific Committee (2004a). *Subtropical coastal floodplain forest of the NSW North Coast bioregion - endangered ecological community listing: final determination*. www.npws.nsw.gov.au.

NSWSC (2004b). *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing: final determination*. www.npws.nsw.gov.au.

NSWSC (2004c). *River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing: final determination*. www.npws.nsw.gov.au.

NSWSC (2004d). *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing: final determination*. www.npws.nsw.gov.au.

NSWSC (2004e). *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing: final determination*. www.npws.nsw.gov.au.

NSWSC (2004f). *Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing: final determination*. www.npws.nsw.gov.au.

NSWSC (2004g). *Littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing: final determination*. www.npws.nsw.gov.au.

NSWSC (2004h). *Removal of dead wood and dead trees as a Key Threatening Process under Schedule 3 of the TSCA 1995*. www.npws.nsw.gov.au.

NSWSC (2004i). *Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands - key threatening process declaration*. www.npws.nsw.gov.au.

NSWSC (2004j). *Final Determination - Invasion of native plant communities by exotic perennial grasses as a Key Threatening Process under Schedule 3 of the TSCA 1995*. www.npws.nsw.gov.au.

NSWSC (2004k). *Competition from feral honeybees* - key threatening process declaration. www.npws.nsw.gov.au.

NSWSC (2004l). *Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments* - key threatening process declaration. www.npws.nsw.gov.au.

NSWSC (2003a). *Final Determination - Competition from feral honeybees Apis mellifera L. as a Key Threatening Process under Schedule 3 of the TSCA 1995*. www.npws.nsw.gov.au.

NSWSC (2003b). *Invasion of native plant communities by exotic perennial grasses - key threatening process declaration*. www.npws.nsw.gov.au.

NSWSC (2003c). *Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations - key threatening process declaration.* www.npws.nsw.gov.au.

NSWSC (2002a). *Lowland rainforest on floodplain in the NSW North Coast Bioregion - endangered ecological community listing: final determination*. www.npws.nsw.gov.au.

NSWSC (2002b). *Final Determination 021220a – infection of frogs by amphibian chytrid causing the disease* chytridiomycosis. www.npws.nsw.gov.au. Accessed 30/4/04.

NSWSC (2002c). *Final Determination f21206g – Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations*. www.npws.nsw.gov.au. Accessed 30/4/04.

NSWSC (2002d).I*nfection of native plants Phytophthora cinnamomi*. www.npws.nsw.gov.au. Accessed 30/4/04.

NSWSC (2002e). *Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands as a Key Threatening Process under Schedule 3 of the TSCA 1995*. www.npws.nsw.gov.au.

NSWSC (2002f). *Competition and grazing by the feral European rabbit* - key threatening process declaration. www.npws.nsw.gov.au.

NSWSC (2001a). Hooded Robin (south-eastern form) *Melanodryas cucullata cucullata* (Latham 1802), as a VULNERABLE SPECIES on Schedule 2 of the Act – Final Determination. Gazetted 26/10/01. www.npws.nsw.gov.au.

NSWSC (2001b). Brown Treecreeper **(**eastern subspecies) *Climacteris picumnus victoriae* (Mathews, 1912), as a VULNERABLE SPECIES on Schedule 2 of the Act – Final Determination. Gazetted 26/10/01. www.npws.nsw.gov.au.

NSWSC (2001c) Grey-crowned Babbler (eastern subspecies), *Pomatostomus temporalis temporalis* (Vigors and Horsfield, 1827), as a VULNERABLE SPECIES on Schedule 2 of the Act – Final Determination. Gazetted 26/10/01. www.npws.nsw.gov.au.

NSWSC (2001d) *Final Determination - Clearing of native vegetation*" as a Key Threatening Process under Schedule 3 of the TSCA 1995. www.npws.nsw.gov.au.

NSWSC (2000a). *Predation by feral cats* - Key Threatening Process declaration. www.npws.nsw.gov.au.

NSWSC (2000b). *Predation by the European red fox* - Key Threatening Process declaration. www.npws.nsw.gov.au.

NSWSC (2000c). *'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition'* - Key Threatening Process declaration. www.npws.nsw.gov.au.

NSWSC (2000d). *Human-caused climate change* - key threatening process declaration. www.npws.nsw.gov.au.

NSWSC (1999a). *Predation by the plague minnow (Gambusia holbrooki)* - Key Threatening Process declaration. www.npws.nsw.gov.au.

NSWSC (1999b). *Invasion of Native Plant Communities by Chrysanthemoides monilifera* - Key Threatening Process declaration. www.npws.nsw.gov.au.

Noske, RA (1998). Social organisation and nesting biology of the cooperatively-breeding Varied Sittella *Daphoenasitta chrysoptera* in North-eastern New South Wales. Emu 98(2): 85-96.

Noske, RA (1985). Huddle-roosting behaviour of the Varied Sittella *Daphoenositta chrysoptera* in relation to social status. *Emu* 85(3) 188 – 194.

Office of Environment and Heritage (2014a). BIONET (http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas)

OEH (2014b) Threatened Species. www.threatenedspecies.environment.nsw.gov.au

OEH (2014c) Regional Corridors and Key Habitats. www.environment.nsw.gov.au

Oliver, D.L. (2000). Foraging behaviour and resource selection of the Regent Honeyeater (*Xanthomyza phrygia*) in northern NSW. *Emu*. **100**: 12-30

Olivier, D.L. (1998). The breeding behaviour of the endangered Regent Honeyeater, *Xanthomyza phrygia*, near Armidale, NSW. *Aust. J. Zool*. **46**: 153-170.

O'Neill, M. and Williams, J. (2003). *Species Impact Statement for Proposed Residential Subdivision on Lot 223 DP 754396 and Lot 511 DP 1048157*. Prepared for Machro Pty Ltd and Eric Norman Developments. Northern NSW Forestry Services, Casino.

Osawa, R. (1993). Dietary preferences of the Koala, *Phascolarctos cinereus*, for *Eucalyptus* spp. with a specific reference to their simple sugar contents. *Aust. Mammalogy*, **16**:87-89.

Osborne, W.A. and McElhinney (1996). Status, habitat and preliminary observations on calling of the Green and Golden Bell Frog on Bowen Island, Jervis Bay. In: Pyke, G.H. and Osborne, W.S. (eds: The Green and Golden Bell Frog (Litoria aurea) – Biology and Conservation. Aust Zool **30**(2) 218-224

Pahl, L.I. and Hume, I.D. (1990). *Preferences for Eucalyptus species of the New England Tablelands and initial development of an artificial diet for Koalas*. In: **Biology of the Koala** (Eds: Lee, A.K, Handasyde, K.A. and Sanson, G.D.). pp 123-128. Surrey Beatty and Sons, Sydney.

Phillips, S. (1994). **Koala Management Plan for the Proposed Searanch Residential Development**. Australian Koala Foundation, Brisbane

Patton, D.C. (1990). Domestic cats and wildlife. *Bird Observer* **696**: 34-35.

Phillips, S. (1997). *Some issues associated with the translocation of Koalas (Phascolarctos cinereus*). Paper presented to the Australian Veterinary Association Symposium.

Phillips, S. (2000). *Tree species preferences of the Koala (Phascolarctos cinereus) as a basis for the delineation of management areas for recovery planning in N*SW. Unpublished report prepared for the Koala Recovery Plan.

Phillips, S., Callaghan, J. and Thompson, V. (2000). The tree preferences of Koalas (*Phascolarctos cinereus*) inhabiting forest and woodland communities on Quaternary deposits in the Port Stephens area, NSW. *Wildl. Res*. **27**: pp 1-10.

Phillips, S.S. (2000a). Tree species preferences of the Koala (*Phascolarctos cinereus*) as a basis for the delineation of management areas for recovery planning in NSW. Unpublished report for the Koala Recovery Plan.

Phillips, S.S. (2000b). Population trends and the Koala conservation debate. *Conservation Biology*, **14** (3): 650-659.

Phillips, S., Coburn, D. and James, R. (2001). An observation of cat predation upon an Eastern Blossom Bat, *Syconycteris australis*. *Aust. Mamm*. **23**: 57-58

Parsons Brinkerhoff. (2004). Bulahdelah Upgrading the Pacific Highway: Environmental Impact Statement Technical Paper 7. Prepared for Roads and Traffic Authority of NSW.

Port Stephens Council (2001). **Port Stephens Council Comprehensive Koala Plan of Management (CKPoM) – June 2001).** Prepared by Port Stephens Council with the Australian Koala Foundation.

Preston, B.J. and Adam, P. (2004a). Describing and listing threatened ecological communities under the *Threatened Species Conservation Act 1995* (NSW): Part 1 – the assemblage of species and the particular area. *Environmental and Planning Law Journal*, **21**:250-263

Preston and Adams (2004b). Describing and listing threatened ecological communities under the *Threatened Species Conservation Act 1995* (NSW): Part 2 – the role of supplementary descriptors and the listing process. *Environmental and Planning Law Journal*, **21**:372-390

Prosser, P, Lock, M., Bodley, K, Groat, J. Myronuik, P and Courtney, P. (2007). **Husbandry manual for the New Holland Mouse (*Pseudomys novaehollandiae)***. *www.aszk.org.au/docs/**new_holland_mouse**_may_07.pdf*

Pyke, G.H., White, A.W., Bishop, P.J. and Waldman, B. (2002). Habitat use by the Green and Golden Bell Frog *Litoria aurea* in Australia and New Zealand. *Aust. Zool*. **32**(1). pp12-31.

Pyke, G.H. and White, A.W. (1996). Habitat requirements of the Green and Golden Bell Frog (*Litoria aurea*). In: Pyke, G.H. and Osborne, W.S. (eds: The Green and Golden Bell Frog (Litoria aurea) – Biology and Conservation. *Aust Zool* **30**(2) 218-224

Quin D.G. (1995) Population ecology of the squirrel glider (*Petaurus norfolcensis*).*Aust. Zool*.

Quin, D.G. (1993). **Socioecology of the Squirrel Glider and the Sugar Glider**. PhD Thesis. University of New England, Armidale.

Radle, A.L. (undated). **The Effect of Noise on Wildlife: A Literature Review**. University of Oregon, Eugene.

Recher, H.F., Date, E.M. and Ford, H. (1995). **The Biology and Management of Rainforest Pigeons in NSW**. *Species Management Report Number 16*. NSW NPWS, Hurstville.

Redhead, T.D. (1991). *Common Planigale*. In: Strahan, D. (Editor) (1991). **Complete Book of Australian Mammals**. p 75. Cornstalk Publishing, Sydney.

Redpath, P. (2002). *Partridge Creek Acid Sulfate Soil Hotspot Project: Targeted Fauna Survey and 8 Part Test Assessment*. Report prepared for Dept. Land and Water Conservation, Grafton.

Reed, P.C, Lunney, D. and Walker, P. (1990). *A 1986-87 survey of the Koala, Phascolarctos cinereus, in NSW, and an ecological interpretation of its distribution*. In: **Biology of the Koala**. Lee, A.K. Handasyde, K.A. and Sanson, G.D. (Eds). Surrey Beatty and Sons, Sydney.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). **Key to the Calls of Southeast Queensland and Northeast NSW**. Queensland Natural Resources and Mines, Brisbane.

Rhind, P.C. (1996). Habitat requirements and the effects of removal during logging on the marsupial Brushtailed Phascogale in Western Australia. *The Western Australian Naturalist*, **21**: 1-22.

Rhind, S. (1998). **Ecology of the Brushtailed Phascogale in Jarrah Forest of south-western West Australia**. PhD Thesis, Murdoch University, Perth, W.A.

Richards, G.C. (1983). *Queensland Blossom Bat (Synonycteris australis*). In: Strahan, D. (Editor) (1991). **Complete Book of Australian Mammals**. pp 289 Cornstalk Publishing, Sydney.

Richards, G.C. (1991a). *Forest bat conservation: Do we know the problems and solutions*? In: **Conservation of Australia's Forest Fauna**. Lunney, D. (Ed). Royal Zoological Society of NSW.

Richards, G.C. (1991a). *Golden Tipped Bat*. In: Strahan, D. (Editor) (1991). **Complete Book of Australian Mammals**. p 355. Cornstalk Publishing, Sydney.

Robinson, L. (1994) **Field Guide to the plants Native Plants of Sydney.** 2nd Edition. Kangaroo Press, NSW.

Robinson, M. (1996). **A Field Guide To Frogs of Australia**. Australian Museum/Reed, Sydney.

Russel, R. (1991). *Yellow-bellied Glider*. In: Strahan, D. (Editor) (1991). **Complete Book of Australian Mammals**. p 136. Cornstalk Publishing, Sydney.

Russell, R. (1984). *Social behaviour of the Yellow-bellied Glider in North Queensland*. In: **Possums and Gliders**. Smith, A.P and Hume, I.D (Eds). Australian Mammal Society, Sydney.

Sarre, A. (1999). Caught in the Crossfire – The Koala. *Ecos* 99, April-June: 9- 14.

Schlager, F.E. and Jarman, P.J. (1981). **The Distribution and Status of the Rufous Rat-Kangaroo (*Aepyprymnus rufescens*) and the Long-Nosed Potoroo (*Potorous tridactylus*), in Northern NSW: A Report to the NSW NPWS**. University of New England, Armidale.

Schultz, M. (1997a). *The Little Bent-wing Bat, Miniopterus australis, roosting in a tree hollow*. Aust. Zool.

Schultz, M. (1997b). Bats and other fauna in disused Fairy Martin (*Hirundo ariel*) nest. *Emu* **98**: 184-191.

Scotts, D. (2002) editor. **Key Habitats and Corridors for Forest Fauna of North-East NSW: A regional landscape to focus conservation, planning, assessment and management**. NSW NPWS, Hurstville.

Sharp, A. and Phillips, S. (1999). *Koalas, Science and Conservation*. In: Saving Our Natural Heritage - The role of science in managing Australia's ecosystems.

Sharpe D.J. (in press). Effect of Flowering Patterns on a Population of Squirrel Gliders (*Petaurus norfolcensis*) in North-east New South Wales. School of Environmental Science and Management, Southern Cross University, Lismore, NSW.

Sharpe D.J. and Goldingay R.L. (2009) Population ecology of the nectar-feeding squirrel glider (*Petaurus norfolcensis*) in remnant forest in subtropical Australia. *Wildlife Research* **37**(2) 77–88

Sharpe D.J. and Goldingay R.L. (1998) Feeding Behaviour of the Squirrel Glider at Bngawalbin Nature Reserve, north-eastern New South Wales. School of Resource Science and Management, Southern Cross University, Lismore, NSW.

Shortlands Wetlands Consultancy (1997). *EIS for the Proposed Restoration of Tidal Inundation of Yarrahapinni Wetland, Mid North Coast, NSW*. Prepared for the Yarrahapinni Wetlands Reserve Trust. SWC, Shortlands.

Simpson, K. and Day, N. (1996). **Field Guide to the Birds of Australia**. Viking, Sydney.

Smith A.P. and Murray M. (2003) Habitat requirements of the Squirrel Glider on the New South Wales central coast. *Wild. Res*. **30***:* 291-301.

Smith, A.P., Andrews, S.P. and Moore, D.W. (1995). *Coffs Harbour-Urunga Management Area - Proposed Forestry Operations - Fauna Impact Statement.* State Forests Of NSW

Smith, A.P. (2002a). *Squirrel Glider (Petaurus norfolcensis) Conservation Management Plan for Wyong Shire Council*. Unpublished report to Wyong Shire Council. Austeco, Armidale.

Smith, A.P. (2002b). *Effects of clearing on the Squirrel Glider (Petaurus norfolcensis)*. Unpublished report to Wyong Shire Council. Austeco, Armidale.

Smith, M. (2002). *Management of Roost Sites of the Grey-Headed Flying Fox (Pteropus poliocephalus) on the north coast of NSW: A National Parks and Wildlife Perspective*. In: **Managing the Grey-Headed Flying Fox as a Threatened Species in NSW**. Eby, P and Lunney, D. (Eds.). Royal Zoological Society of NSW, Sydney.

Soderquist, T.R., Lowe, K.W., Loyn, R.H and Price, R. T. (2000). Habitat quality of Powerful Owl territories in the box-ironbark forests of Victoria, Australia. **Proceedings of International Owl Conference**. Canberra, 2000.

Soderquist, T.R and Ealey, L. (1994). Social interactions and mating strategies of a solitary carnivorous marsupial, *Phascogale tapoatafa*, in the wild. *Wildl. Res*. **21**: pp 527-42

Soderquist, T.R. (1993a). Maternal strategies of *Phascogale tapoatafa*. 2. Juvenile thermoregulation and maternal attendance. *Aust. J. Zool*., **41**: 567-576.

Soderquist, T.R. (1993b). Maternal strategies of *Phascogale tapoatafa*. 1. Breeding seasonality and maternal investment. *Aust. J. Zool*., **41**: 549-566.

Soderquist, T.R., Lowe, K.W., Loyn, R.H and Price, R. T. (2000). Habitat quality of Powerful Owl territories in the box-ironbark forests of Victoria, Australia. **Proceedings of International Owl Conference**. Canberra, 2000.

Soderquist, T.R., Traill, B.J., Faris, F. and Beasley, K. (1996). Using nest boxes to survey for the Brushtailed Phascogale. *Victorian Naturalist*, **113**: 256-261.

Standing, V. (1990). **A Study Of Koalas in the Macleay Valley District - Past, Present and Future**. Koala Preservation Society of NSW, Port Macquarie.

State Forests of NSW (1994). **Walcha/Nundle and Styx River MA Fauna Survey**. State Forest of NSW, Sydney.

State Forests of NSW (2000). **Koala Management Plan – Pine Creek State Forest**. State Forest of NSW, North East Region.

Strahan, R., (1998) **The Mammals of Australia**, Reed New Holland, Sydney.

Suckling, C.G. (1992) *Squirrel Glider*. In: **Complete Book of Australian Mammals.** Strahan, D. (Editor). Cornstalk Publishing, Sydney.

Swift Parrot Recovery Team (2001). **Swift Parrot Recovery Plan**. Dept of Primary Industries, Water and Environment, Hobart.

Theischinger, G. (2009). Identification Guide to the Australian Odonata. DECCW, Hurstville

Thompson, B.(2002).**Australian Handbook for the Conservation of Bats in Mines and Artificial Cave-Bat Habitats**. Australian Centre for Mining Environmental Research.

Tideman, C.R. and Flavel, S.C. (1987). Factors affecting choice of diurnal roost site by tree-hole bats (Microchiroptera) in southeastern Australia. *Aust. Wildl. Res*., **14**: 459-473.

Tidemann, C. R. (2002). *Sustainable management of the Grey-headed Flying Fox Pteropus poliocephalus*. In: **Managing the Grey-Headed Flying Fox as a Threatened Species in NSW**. Eby, P and Lunney, D. (Eds.). Royal Zoological Society of NSW, Sydney.

Traill, B.J. (1995). **Coexistence and competition in a community of forest vertebrates**. PhD Thesis, Monash University, Melbourne.

Traill, B.J. and Coates, T.D. (1993). Field observations on the Brushtailed Phascogale (*Phascogale tapoatafa*). *Aust. Mam*. **16**: pp61-65

Trimper, P.G., Chubbs, T.E., Standen, N.M. and Humphries, G. (1998). Effect of low-level jet aircraft noise on the behaviour of nesting Osprey. *J. Applied. Ecol*. **38**: 122-130.

Trueman, J. (2010). *Petalura gigantea*: an ancient bog-dweller in trouble. http://www.uow.edu.au/~sharonb/wingecarribee/value/dragonfly.html. Accessed 20/12/10.

van der Ree, R., Soderquist, T. and Bennet, A.F. (2001). Home range use by the Brush-Tailed Phascogale (Phascogale tapoatafa) in high quality, spatially limited habitat. *Wildl. Res*. **28**: pp 517-525

van der Meulen, A.M. and Sindel, B.M. (2008). ***Pathway risk analysis for weed spread within Australia.*** School of Rural Science and Agriculture, University of New England, Armidale.

Wilson, B. and Laidlaw, S. (2003). Habitat characteristics for New Holland mouse *Pseudomys novaehollandiae* in Victoria, *Australian mammalogy*, **25** (1): 1-11.

World Wildlife Fund (2005). *Stockyard Point – Jam Jerrup: Shorebird Conservation Project 2004-2005 Final Report*. Unpublished report for the World Wildlife Fund, Australia.

World Wildlife Fund (2002). Threatened Species Network Fact Sheets: Brushtailed Phascogale and Spotted-Tailed Quoll.

Land and Environment Court Citations:

CBD Prestige Holdings Pty Ltd v Lake Macquarie City Council [2005] NSWLEC 367

Gales Holdings Pty Limited v Tweed Shire Council [2008] NSWLEC 209

Garrett v Freeman (No. 4) [2007] NSWLEC 389

Motorplex (Australia) Pty Limited v Port Stephens Council [2007] NSWLEC 74

Personal Communications:

Bernard Whitehead, Saltair Flora and Fauna, ph: 0414 850 029

APPENDIX 1: Eligibility for 7-Part Tests

The following tables are used as a summary to address threatened species (as detailed below) in terms of potential occurrence, and likelihood of being significantly affected by the proposal, and hence requiring formal 7 Part Test assessment. Threatened species have been assessed if it is:

a) Recorded on-site;

b) Not recorded on site, but recorded within a 10km radius (the locality), and may occur to some degree on-site or in the study area (land within 100m of site) due to potential habitat, key habitat component, etc;

c) Not recorded in the locality as yet, but recorded in the bioregion, and thus may occur in the locality, and possibly to some extent, may occur on the site, due to potential habitat.

The "*habitat requirements*" column is derived from the previously listed references. Likelihood of occurrence is based on the probability of occurrence in terms of:

- Habitat extent (eg sufficient to support an individual or the local population; comprises all of home range; forms part of larger territory, etc); quality (ie condition, including an assessment of threats, historical land uses on and off-site, and future pressures); interconnectivity to other habitat; and ability to provide all the species life-cycle requirements (either the site alone, or other habitat within its range);

- Occurrence frequency (ie on-site resident; portion of larger territory; seasonal migrant or transitory opportunist and thus when and how often, etc)

- Usage ie breeding or non-breeding; opportunistic foraging (eg seasonal, migratory or opportunistic); marginal fringe of core range; refuge; roosts; etc.

An indicative 1-5 scale used by the author to indicate the likelihood of the species to potentially occur in the habitat on the study sites (if they have not been recorded in the locality) is as follows:

- 0: *Unlikely* (<1% probability) - no potentially suitable habitat; too disturbed; or habitat is very poor. No or few records in region or records/site very isolated eg by pastoral land, urbanisation, etc.

- 1: *Low* (1-10%)- few minor areas of potential habitat; highly modified site/habitat; or few habitat parameters present, but others absent or relatively insignificant (sub-optimum habitat). Usually very few records in locality.

- 2: *Fair* (11-25%) - some significant areas of potential habitat, but some habitat parameters limited. Potential for occasional foraging eg from nearby more optimal areas or known habitat. Records at least within 10-15km radius of site.

- 3: *Good* (26-50%) - significant abundance of habitat parameters/areas of habitat, and more locally eg adjacent. Potential part of larger territory, but probably unable to support breeding in isolation. Recorded within 10km in similar habitat/environs.

- 4: *Moderate* (51-75%) - quite good potentially suitable habitat on and adjacent to the site, and/or good quality and abundance of some vital habitat parameters. Records within <10km, or adjacent to site, or adjacent to high quality habitat where species likely to occur.

- 5: *High* (>75%) - very good to optimum habitat occurring on or adjacent to the site (support breeding pair or population). Recorded within 5-10km of site in same or similar habitat.

The "*Assessment of Significance*" column is based on consideration of the habitat on-site, likelihood of occurrence, and consideration of the DECC guidelines for assessment under the 7 Part Tests (DECC 2007). Recognising that some species with very large ranges or varying tolerances to habitat modification, some species which may have low potential to occur in the study area and will obviously not be significantly affected by the proposal will not be formally assessed to avoid production of superfluous information. Rather these species are assessed in the final column with justification for this assessment. However, recognising that significance is open to interpretation, the decision on whether a species is formally assessed or not by the 7 Part Tests in this assessment is based on the following rules:

a) If there is *any* justifiable risk, based on consideration, of a significant impact as a result of direct or indirect impacts, a 7 Part Test is required (ie the Principle of Uncertainty is applied).

b) Any threatened species recorded on-site or in the study area, or of at least fair chance of occurrence on-site in terms of potential habitat, is **automatically** selected for the 7 part Tests, unless the proposal clearly has no potential for a significant effect and formal assessment is superfluous (justification provided).

A1.1 FLORA

Table 16: Eligibility for Seven Part Test Assessment – Flora

The following species have been recorded in the locality, or within their range regionally in similar habitats to that on the property.

SPECIES	HABITAT REQUIREMENT	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
Allocasuarina defungens	A straggly oak about 2m high with blue-green foliage found in heath on sand (sometimes clay and sandstone soils), and swamp sclerophyll forest margins. This plant has been recorded. Recorded on Hastings LGA, Kempsey, Bare Point, Coffs Harbour, Greater Taree City Council LGA, Bulahdelah and Camden Haven databases	Recorded in locality in Limeburners Creek Nature Reserve. Appears unlikely to occur on site as suitable habitat generally not present and not recorded during this or previous surveys.	Unlikely to occur and no loss of known or potential habitat. Seven Part Test is not required.
Arthraxon hispidus	A grass found in (or is likely to occur in) littoral rainforest, dry rainforest, subtropical rainforest, warm-temperate rainforest, cool-temperate rainforest, wet sclerophyll forest and riparian forests (including gallery rainforests) at no particular altitude. Variable geology and various, mainly richer loams soils are favoured. Recorded on Coffs Harbour database.	No suitable habitat on site and not found during survey. Unlikely to occur.	Unlikely to occur on property hence no risk of a significant impact. Seven Part Test is not required
Chamaesyce psammogeton	A herb that grows on fore dunes and exposed sites on headlands. Recorded on Bare Point, Kempsey, Hastings, Nambucca, Coffs Harbour and Bulahdelah LGA databases.	Recorded in locality. No suitable habitat on site. Considered unlikely potential occurrence.	No potential habitat affected by proposal and appears unlikely to occur, hence no risk of a significant impact. Seven Part Test is not required.
Cynanchum elegans	A twiner occurring predominately in dry rainforest, littoral rainforest and the ecotone between dry rainforest and open forest, however it has been found in the Manning Valley and Hastings in Open Forest types on specific geologies eg limestone and serpentine respectively (Garry Germon pers. comm. 2004, personal observations). It occurs on a variety of	No suitable habitat on site and not found during survey. Unlikely to occur.	Unlikely to occur and no loss of known or potential habitat. Seven Part Test is not required.

SPECIES	HABITAT REQUIREMENT	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	lithology's and soil types. It has been found between the altitudinal ranges of 0 to 600 metres ASL and rainfall >760mm annually (NPWS 1999).		
Maundia triglochinoides	An aquatic herbaceous plant found in swamps or shallow fresh water on heavy clay on the north and central NSW coast. Recorded on Hastings, Port Stephens, Richmond Valley and Kempsey databases.	Suitable habitat to some extent exists in the swampier sections of the paperbark forest, however it was not found during this or previous surveys. Unlikely to occur	Unlikely to occur on property hence no risk of a significant impact. Seven Part Test is not required
Parsonsia dorrigoensis	A climber found in sub-tropical and warm temperate rainforest, and sclerophyll forest often on brown clay soils on the north coast south to the HastingsRiver. It is associated with Blackbutt, Tallowwood, Brush Box, Crabapple, Lilly Pilly, Tree Heath and Water Gum. It may favour some disturbance, including fire.	No suitable habitat on site and not found during survey. Unlikely to occur.	Unlikely to occur on property hence no risk of a significant impact. Seven Part Test is not required
Phaius tankervilliae *(recorded on Port Macquarie-Hastings LGA database)* *and* ***P. australis*** *(Bare Point, Coffs Harbour)*	Large terrestrial orchids that generally grow in *Melaleuca quinquenervia* swamps on the coast or at sea level, as well as littoral rainforest, dunes (including stabilised dunes), riparian forests (including gallery rainforests), swamp forests, swamps (including marshes and intermittent wetlands), mainly at low altitudes. Sandy alluvium is the favoured geology and sandy, damp to humic soils are favoured. Flowers September-October.	The swamp forest is considered structurally suitable habitat for these species (at least in some areas). However site disturbance, lack of records and failure to detect on site suggests unlikely occurrence.	Unlikely to occur on property hence no risk of a significant impact. Seven Part Test is not required
Thesium australe	A parasitic herb commonly associated with Kangaroo Grass, and has been recorded on coastal headlands at Coffs Harbour, Hat Head, Crescent Head, Diamond Head and Perpendicular Point in Kangaroo Grass areas. Recorded on Hastings LGA, Kempsey, Bare Point, Coffs Harbour, Korogoro and Camden Haven databases.	Recorded in locality in the headlands of Crescent Head. Suitable habitat does not strictly exist in the study area (i.e. not on headlands), and was not found by routine searches. Considered unlikely potential occurrence due to targeted surveys not detecting this species.	Unlikely to occur hence no risk of a significant impact. Seven Part Test is not required.

A number of other species (see table below) recorded in the bioregion are known or considered potential occurrences within the locality. However due to a number of factors, these species were not considered potential occurrences on site. Thus the proposal is not considered to have a significant impact on the viability of any local population of the subject species and Seven Part Test evaluation was not required.

Table 17: Threatened flora species considered unlikely to occur on the site

Preferred Habitat	Species	Site considered unsuitable habitat	Disturbance history likely to have excluded species	Lack of local records	Outside Known Distribution	No risk of detectable impacts
Dry Sclerophyll/Open Forest/ Woodland	*Acacia courtii*	X		X	X	X
	A. ruppii	X		X	X	X
	Ancistrachne maidenii	X		X	X	X
	Angophora robur	X		X	X	X
	Astrotricha cordata	X		X	X	X
	Babingtonia prominens	X		X	X	X
	Banksia conferta subsp. conferta	X		X	X	X
	Bertya sp. Cobar-Coolabah	X		X	X	X
	Bertya sp. (Chambigne NR M Faterni 24)	X		X	X	X
	Bertya sp. (Clouds Creek M. Fatemi 4)	X		X	X	X
	Boronia hapalophylla	X		X	X	X
	Boronia umbellata	X		X	X	X
	Callistemon linearifolius	X		X	X	X
	Chiloglottis anaticeps	X		X		X
	Corybas dowlingii	X		X	X	X
	Cyperus rupicola	X		X	X	X
	Cyperus semifertilis	X		X	X	X
	Cryptostylis hunteriana			X	X	X
	Dichanthium setosum	X		X	X	X
	Diuris arenaria	X	X	X	X	X
	Diuris disposita	X	X	X	X	X
	Diuris pedunculata	X	X	X		X

Preferred Habitat	Species	Site considered unsuitable habitat	Disturbance history likely to have excluded species	Lack of local records	Outside Known Distribution	No risk of detectable impacts
	Diuris venosa	X	X	X	X	X
	Newcastle Double-Tail Orchid *(Diuris praecox)*	X	X	X		X
	Dillwynia tenuifolia	X		X	X	X
	Doryanthes palmeri			X	X	X
	Dracophyllum macranthum	X		X	X	X
	Drynaria rigidula	X		X		X
	Eucalyptus glaucina	X		X	X	X
	Eucalyptus microcodon	X		X	X	X
	Eucalyptus nicholii	X		X	X	X
	Eucalyptus pachycalyx	X		X	X	X
	Eucalyptus parramattensis subsp. parramattensis Endangered Population			X	X	X
	Eucalyptus tetrapleura	X		X		X
	Grevillea banyabba			X	X	X
	Grevillea caleyi	X		X	X	X
	Grevillea mollis	X		X	X	X
	Grevillea quadricuada	X		X	X	X
	Grevillea rhizomatosa	X		X	X	X
	Hakea archaeoides	X		X		X
	Lindsaea incisa			X	X	X
	Macrozamia johnsonii	X		X	X	X
	Melaleuca groveana			X		X
	Melaleuca irbyana	X		X	X	X
	Melaleuca sp. *gibberagee*	X		X	X	X
	Melaleuca tamariscina ssp irbyana	X		X	X	X
	Melichrus hirsutus			X	X	X
	Olax angulata	X		X	X	X
	Philotheca obovatifolia	X		X	X	X

Preferred Habitat	Species	Site considered unsuitable habitat	Disturbance history likely to have excluded species	Lack of local records	Outside Known Distribution	No risk of detectable impacts
	Polygala linarifolia			X	X	X
	Tetratheca juncea	X	X	X	X	X
Rainforest/Wet Sclerophyll Forest	***Acacia bakeri***	X		X	X	X
	Acronychia littoralis	X		X		X
	Archidendron hendersonii	X		X	X	X
	Asperula asthenes		X	X		X
	Acacia chrysotricha	X		X	X	X
	Acalypha eremorum	X		X	X	X
	Amyena plicatula	X		X	X	X
	Arthropteris palisotii	X		X	X	X
	Baloghia marmorata	X		X	X	X
	Belvisia mucronata	X		X	X	X
	Bosistoa transversa	X		X	X	X
	Brachyscome ascendens	X		X	X	X
	Caesia parviflora var. minor	X		X	X	X
	Cassia brewsteri	X		X	X	X
	Choricarpia subargentea	X		X	X	X
	Clematis fawcetti	X		X	X	X
	Corchorus cunninghamiana	X		X	X	X
	Corokia whiteana	X		X	X	X
	Corynocarpus rupestris subsp. rupestris	X		X	X	X
	Cryptocarya foetida	X		X	X	X
	Cupaniopsisrupicola	X		X	X	X
	Daphnandra sp. c illawarra	X		X	X	X
	Davidsonia johnsonii	X		X	X	X
	Dendrocnide moroides	X		X	X	X
	Desmodium acanthocladum	X		X	X	X

Preferred Habitat	Species	Site considered unsuitable habitat	Disturbance history likely to have excluded species	Lack of local records	Outside Known Distribution	No risk of detectable impacts
	Dichanthium acanthocladum	X		X	X	X
	Diospyros mabacea	X		X	X	X
	Diospyros major var ebenus	X		X	X	X
	Diploglottis campbellii	X		X	X	X
	Eidothea hardeniana	X		X	X	X
	Eleocarpus sp. Rocky Creek	X		X	X	X
	Eleocarpus williamsianus	X		X	X	X
	Endiandra hayesii	X		X	X	X
	Eniandra muelleri subsp. *bracteata*	X		X	X	X
	Endiandra floydii	X		X	X	X
	Euphrasia bella	X		X	X	X
	Floydia praealta	X		X	X	X
	Fontainea australis	X		X	X	X
	Genoplesium littorale	X		X	X	X
	Geijera paniculata	X		X	X	X
	Gingidia montana	X		X	X	X
	Gossia fragrantissima	X		X	X	X
	Grammitis stenophylla	X		X	X	X
	Grevillea guthrieana	X		X	X	X
	Grevillea hilliana	X		X	X	X
	Grevillea masonii	X		X	X	X
	Haloragis exalata subsp. velutina.	X		X		X
	Harnieria hygrophiloides	X		X	X	X
	Hicksbeachia pinnatifolia	X		X	X	X
	Isoglossa eranthemoides	X		X	X	X
	Lepiderema pulchella	X		X	X	X
	Lindsaea brachypoda	X		X	X	X
	Macadamia tetraphylla	X		X	X	X

Preferred Habitat	Species	Site considered unsuitable habitat	Disturbance history likely to have excluded species	Lack of local records	Outside Known Distribution	No risk of detectable impacts
	Marsdenia longilobia	X		X		X
	Melicope vitiflora	X		X	X	X
	Niemeyera whitei	X		X	X	X
	Ochrosia moorei	X		X	X	X
	Olearia flocktoniae	X		X	X	X
	Owenia cepiodora	X		X	X	X
	Phyllanthus microcladus	X		X	X	X
	Peristeranthus hillii	X		X		X
	Plectranthus nitidus	X		X	X	X
	Pomaderris notata	X		X	X	X
	Pomaderris queenslandica	X		X	X	X
	Psilotum complanatum	X		X		X
	Randia moorei	X		X	X	X
	Rhynxhosia acuminatissima	X		X	X	X
	Quassia sp. Moonee Creek	X		X	X	X
	Sarcochilus dilatatus	X		X		X
	Sarcochilus fitzgeraldii	X		X	X	X
	Sarcochilus hartmannii	X		X		X
	Senna acclinis	X	X	X		X
	Sophora fraseri	X		X	X	X
	Symplocos baeuerienii	X		X	X	X
	Syzygium hodgkinsoniae	X		X	X	X
	Syzygium moorei	X		X	X	X
	Syzygium paniculatum	X		X	X	X
	Tasmannia glaucifolia	X		X	X	X
	Tasmannia purpurascens	X		X	X	X
	Tinospora smilacina	X		X	X	X
	Tinospora tinosporoides	X		X	X	X

Preferred Habitat	Species	Site considered unsuitable habitat	Disturbance history likely to have excluded species	Lack of local records	Outside Known Distribution	No risk of detectable impacts
	Triflorensia cameronii	X		X	X	X
	Triplarina imbricata (formerly *Baeckea camphorata)*	X		X	X	X
	Tylophora woolsii	X		X	X	X
	Typhonium sp. aff. brownii	X		X		X
	Uromyrtus australis	X		X	X	X
	Xylosma terrae-reginae	X		X	X	X
	Zieria floydii	X		X	X	X
Swamp Forest/ Aquatic/Wetland/Estuarine	*Alexfloydia repens*			X	X	X
	Aldrovanda vesiculosa			X	X	X
	Angiopteris evecta	X		X	X	X
	Asperula asthenes	X	X	X		X
	Cyperus aquatilis			X	X	X
	Centranthera cochinchinensis	X		X	X	X
	Dendrobium melaleucaphilum		X	X		X
	Eleocharis tetraquetra			X	X	X
	Lindsaea fraseri			X	X	X
	Melaleuca biconvexa			X		X
	Persicaria elatior			X		X
	Rotala tripartita			X	X	X
Heathland/ Shrubland	***Allocasuarina simulans***	X		X	X	X
	Babingtonia silvestris	X		X	X	X
	Callitris oblonga	X		X	X	X
	Eucalyptus approximans	X		X	X	X
	Elyonurus citreus	X		X	X	X
	Pultenaea maritima	X		X		X
	Rutidosis heterogama	X		X	X	X
	Senecio spathulatus	X		X	X	X

Preferred Habitat	Species	Site considered unsuitable habitat	Disturbance history likely to have excluded species	Lack of local records	Outside Known Distribution	No risk of detectable impacts
	Sophora tomentosa subsp. australis	X		X		X
	Zieria prostrata	X		X	X	X
Other/Miscellaneous	*Eucalyptus camfieldii*	X		X		X
	Galium australe	X		X		X
	Gaultheria viridicarpa subsp *viridicarpa*	X		X		X
	Grevillea beadleana	X		X	X	X
	Grevillea parviflora subsp. parviflora			X		X
	Hibbertia hexandra	X		X		X
	Kennedia retorsa			X	X	X
	Leucopogon confertus			X	X	X
	Lindernia alsinoides			X		X
	Mitrasacme pygmaea	X		X	X	X
	Myrsine richmodensis	X		X	X	X
	Neoastelia spectabilis	X		X	X	X
	Oberonia titania	X		X	X	X
	Oldenlandia galioides			X	X	X
	Prostanthera densa			X	X	X
	Prostanthera palustris			X	X	X
	Prosthanthera spinosa	X		X	X	X
	Rulingia prostrata	X		X	X	X
	Slyphelia perileuca	X		X	X	X
	Tephrosia filipes	X		X	X	X
	Ziera adenodonta	X		X	X	X
	Zieria lasiocaulis	X		X		X

A1.2 FAUNA

As previously noted in section 2.3.1, a significant number of threatened fauna have been recorded in the locality, and a number of others are considered potential occurrences by the consultant. In the table below, these species are evaluated for their potential to occur on the property; significance of the proposal to this potential occurrence; and thus their eligibility/requirement for Seven Part Test assessment.

Table 18: Fauna potential occurrence assessment and eligibility for Seven Part Tests

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
Swift Parrot (*Lathumus discolor*)	Breeds in Tasmania and winters in Victoria with some dispersal northwards. Feeds mostly on pollen and nectar of winter flowering eucalypts, but also feeds on fruit, seeds, lerps and insect larvae (Schodde and Tideman 1990). Also favours profusely flowering banksias. Favoured species are *E. robusta*, *Corymbia gummifera*, *E. globulus, E. sideroxylon, E. leucoxylon, E. labens, E. ovata, C. maculata, Banksia serrata* and *B. integrifolia*	*E. robusta* common in limited portions of site, but *Melaleuca quinquenervia* also common and a potential forage species. Not recorded by survey but no suitable trees flowering. Very low to fair chance as an opportunistic forager as part of larger migratory range.	Minimal loss if any of potential forage species on-site – swamp forests generally protected. Abundant alternative habitat within 10km – most of which is more suitable eg heath. No major impact potential as habitat to be preserved. **Seven Part Test undertaken** as potential to occur on site.
Little Lorikeet (*Glossopsitta pusilla*)	Gregarious, usually foraging in small flocks, often with other species of lorikeet feeding primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including, melaleucas and mistletoes. Mostly occurs in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. In south-east Queensland (Smyth *et al*. 2002), were more likely to occupy forest sites with relatively short to intermediate logging rotations (15–23 years) and sites that have had short intervals (2.5– 4 years) between fires.	Site contains a range of potential nectar sources for this species and nesting hollows also common. Recorded in locality including Maria National Park to northwest. Fair to good potential to occur on site, especially during flowering periods.	Minor loss of potential foraging habitat but potential to occur over property retained. No loss of nesting hollows. Fair to good chance of occurrence on site thus **Seven part Test** required.
Ground Parrot (*Pezoporus wallicus*)	Exclusively inhabits dense dry or moist heath that provides adequate cover and high density of food plants. Preferred food species are sedges and epacidaceous shrubs.	No heath on-site. Not recorded on-site or in locality. Unlikely to occur on-site.	No potential or known habitat affected. No impact thus Seven Part Test not required.
Barking Owl (*N. connivens*)	Well-forested hills and flats, eucalypt savannah (especially), and riverine woodland in coastal and sub-coastal areas. Prefers hunting in more open country for mammals (rabbits, rats, mice, small bats and small	General locality is structurally suitable though site may be a bit dense. Potential prey in area in form of arboreal mammals, rats, birds and other native	Loss of nesting resources and impacts on potential prey, though as not recorded on site, or even in locality; very low to unlikely to

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	marsupials) and birds (small up to Frogmouths and Magpies). Large territories. Nest in hollows.	mammals. Site has potential for foraging as part of a larger territory. Hollow trees suitable for breeding. Not recorded in 10km radius or by survey (nearest record in Crowdy Bay National Park). Very low to unlikely to occur on-site.	occur and risk of major impact is very unlikely, thus seven part test not required.
Masked Owl (*Tyto novaehollandiae*)	Eucalypt forest and woodlands with sparse understorey. Nests in tree hollows. Requires high diversity and abundance of prey 200-600g weight. Large territory.	As for Barking Owl. Recorded within locality but not on-site by survey. Fair to good chance of occurrence on-site.	Minor loss of foraging habitat. Given chance of occurrence, **Seven Part Test undertaken** as to demonstrate no risk of significant impact.
Sooty Owl (*Tyto tenebricosa*)	Rainforest and tall, moist, diverse eucalypt forest. Roosts in dense foliage, tree hollows & caves/overhangs. Nests in hollow in tall forest tree. Requires high diversity and abundance of medium-sized arboreal and/or terrestrial prey. Large territory.	Property as well as proximate forest not preferred habitat. Species considered unlikely potential to occur.	Seven Part Test not required as no risk of substantial impacts on this species as not preferred habitat
Eastern Grass Owl (*T. capensis*)	Inhabit coastal and inland grasslands, coastal heath, agricultural crops and swamp margins. Dependant on good numbers of rodent prey. Highly mobile.	No suitable habitat in study area. Recorded in 10kim radius but not by site.	As for Sooty Owl.
Regent Honeyeater (*Xanthomyza phrygia*)	Nomadic. Inhabits temperate eucalypt woodlands and open forest, including forest edges, woodland remnants on farmland and urban areas. Also uses *Casuarina cunninghamiana* gallery forests. Requires reliable and ample nectar supplies to support semi-permanent (core breeding) habitat. Favoured nectar sources are *E. sideroxylon, E. albens, E. melliodora, E. leucoxylon, E. robusta, E. planchoniana*, and heavy infestations of mistletoe. Also take insects and orchard fruits. Breeds in pairs or small colonies in open woodland/forest and occasionally more disturbed woodland near housing and farmland, depending on food availability, from August-January. Breeding less likely to occur if nectar flows are low or unreliable, or heavy competition with more aggressive honeyeaters eg Noisy Miner, Red Wattlebirds and Noisy Friarbirds.	*E. robusta* relatively common only in limited portions of site ie swamp forest and drainage lines. Mistletoes occasional but not exceptionally common. Site has at least marginal foraging potential but not particularly exceptional. Recorded within 10km but not recorded on-site by survey. Generally very localised populations - more south and west of the region. Unlikely to occur unless as rare transient.	Minimal loss if any of potential forage species on-site – potential to occur on site retained. Very low chance if any of occurrence and key habitat components essentially retained, thus no risk of significant impact. Seven Part Test not required.
Painted Honeyeater (*Grantiella picta*)	Strongly migratory and locally nomadic. Exploits almost exclusively mistletoe-infested (mainly *Amyema* genus) eucalypt forest/woodland in mainly drier areas. Leaf	Preferred foraging/breeding habitat not present on property. Not recorded in the	No loss of key or significant potential habitat. No risk of significant impact. Seven Part Test not required.

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	insects occasionally taken. May extend range or visit woodland remnants and suburban gardens during poor seasons. Breeding habitat is mistletoe-laden eucalypt forest/woodland	locality or during survey. Considered unlikely chance of occurrence.	
Red Goshawk (*Erythrotriorchis radiatus*)	Found in tropical open woodland, taller woodland, open forests, rainforest edges and dense riparian vegetation of coastal and subcoastal drainages. Territorial and utilise same nest. Breeding territories estimated 50-220km^2. Preys on bird especially Honeyeaters, parrots, kookaburras and slight waterbirds, as well as some mammals, reptiles and large insects.	Not recorded on property or in locality (no recent records south of Clarence Valley). General locality is potentially generically suitable. Unlikely potential to occur due to sparseness of records and site located far south of known range.	No known habitat affected. No significant extent of potential habitat affected. No significant impact likely thus Seven Part Test not required.
Little Eagle (*Hieraaetus morphnoides*)	Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland, sheoak or acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993; Aumann 2001a). For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. It eats birds, reptiles and mammals, occasionally adding large insects and carrion (Marchant and Higgins 1993; Aumann 2001b; Debus et al. 2007). It is distributed throughout the Australian mainland except in the most densely forested parts of the Dividing Range escarpment (Marchant and Higgins 1993). It occurs as a single population throughout NSW.	Potential prey species present, with property considered forming part of much wider home range. Not recorded by survey and no nest found. Considered fair chance of occurrence foraging as a wider part of its range.	Modification of a small area of potential foraging habitat, with vast majority of foraging habitat to be retained, hence potential occurrence should be retained. **Seven Part Test required** as fair potential to occur, hence assessment required to demonstrate no risk of significant impact.
Spotted Harrier (C*ircus assimilis*)	Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods) (Marchant and Higgins 1993; Aumann 2001a). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. The species builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. Diet includes terrestrial mammals, birds and reptiles, occasionally large insects and rarely carrion (Marchant and Higgins 1993; Aumann 2001b). Many of the remaining key prey species (e.g. terrestrial grassland birds such as quail, button-quail, pipits, larks and songlarks) require ground cover	Not recorded in the locality, nor property by survey. Property does not contain preferred habitat type. Agricultural land dominant in locality, but would be in competition with local raptors eg Whistling Kite, Black-Shouldered Kite, Goshawks, etc. Given lack of local records, preference for more open and drier habitats, and most records occurring in upper hinterlands, species is considered a very low to unlikely chance of occurrence.	No critical or preferred habitat to be modified, potential to forage over property and adjacent habitat will remain post development. No significant impact likely thus Seven Part Test not required.

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	and are sensitive to habitat degradation from grazing (Marchant and Higgins 1993).		
Square-Tailed Kite (*Lophoictinia isura*)	Open forests and woodlands in coastal and subcoastal areas. Forages low over, or in, canopy for eggs, nestlings, passerines, small vertebrates and invertebrates. Large home range (>100km^2). Observed foraging in residential areas of Port Macquarie. Large stick nest in high fork of living tree. Breeds July-December. Probably migrates to northern Australia in winter. (Debus 1998, NSW NPWS 2000)	Potential prey species (particularly passerines) present, with development envelopes and property considered forming minute part of much wider home range. Not recorded by survey and no nest found. Not recorded in locality. Considered >fair chance of occurrence.	No critical or preferred habitat to be modified. Proposal will see loss of potential foraging habitat but potential to forage over remaining habitat will remain post development. No significant impact likely but as fair potential to occur, **Seven Part Test required.**
Varied Sittella (*Daphoenositta chrysoptera*)	Sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west (Higgins and Peter 2002; Barrett *et al.* 2003). It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Forest on property and adjacent land considered suitable habitat. Recorded in locality but not on property by survey. Potential nesting potential on property. Considered a fair to good chance of occurrence foraging on property as a breeding pair.	Modification of a small area of potential habitat, though vast majority of potential habitat to be retained. Considered fair to good chance of occurrence, hence **Seven Part Test required** to assess impacts.
Bush Stone Curlew (*Burchinus grallaris*)	Nocturnal, sedentary and territorial (when breeding) species generally inhabiting open grassy woodlands with few or no shrubs. Abundant leaf litter and fallen debris such as tree branches required for foraging and roosting. Nests in more open areas with very little groundcover (even recorded on mown lawns and golf courses). Coastally, often associated with Swamp Oak groves, saltmarsh, mangroves, *Melaleuca quinquenervia* woodlands and even golf courses, etc. May travel as far as 3km from roost site to foraging grounds.	Study area lacks preferred open grassy woodland structure. Presence of wild dogs and foxes likely to be a severe limitation. Not recorded by survey or locality. Very low to unlikely to occur as records are very sparse, with very few LGA records. More suitable habitat within its range in locality suggests most unlikely to specifically occur on the property.	Habitat modification of no particular significance given extent of similar and more structurally suitable available habitat within the locality. Overall, given minimal potential to currently occur, not breeding habitat, and potential to occur will be retained, no risk of significant impact. Hence Seven Part Test considered superfluous.
Brown Treecreeper (*Climacteris picumnus*) eastern subspecies	Medium-sized insectivorous bird occupying eucalypt woodlands, particularly open woodland lacking a dense understorey. Sedentary and nests in tree hollows within permanent territories, breeding in pairs or communally in small groups (Noske 1991). Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs	Site generally not ideally structurally suitable according to defined habitat requirements, though some more open patches of forest may be suitable. Abundance of hollows. Recorded at Big Hill, but not on-site. Considered at best	Modification of small area of marginal foraging habitat on site. Retention of majority of site habitat would retain potential to occur. No significant impact or potential to occur, hence tests not undertaken.

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	for ants, beetles and larvae (Noske 1979). Distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys, Coffs Harbour and Great Lakes Shire.	very low potential to occur due to very few coastal records (OEH 2014a).	
Eastern Osprey (*Pandion haliaetus christatus*)	Fish (mostly Mullet) and carrion eater. Forages along coastal rivers, lakes, beaches, creeks and inlets. Tall, dead tree for staging or feeding roost. Nests on exposed tree within 2km of water, but rarely adjacent, and with access to Paperbark or Swamp Oak for nest material. Breeds April-Sept. (Clancy, 1991)	Recorded in locality including record near northwest corner of site. No nest on site and no suitable foraging habitat – river adjacent is known habitat. Moderate chance of occurrence flying over site or roosting in trees along river.	No potential impact on potential foraging habitat, prey or potential roost or possible nest sites (all development restricted to southeast corner of site). **Seven Part Tests undertaken** due to chance of occurrence.
Black-Necked Stork/Jabiru (*Ephippiorhynchus asiaticus*)	Wetlands, mudflats, mangroves, floodplains, irrigated fields, farm dams. Forages in shallow water for small vertebrates. Shuns cover, prefers extensive open shallows. Nests in a tree, often above water in a secluded swamp. Eggs laid Aug-Nov in NSW. Adults resident, juveniles dispersive (DEC 2005a, Lindsey 1992).	No suitable habitat on site – dams too small to attract this species. River banks mostly too densely vegetated to allow walking of this large bird. Swamp forest similar likely to be too dense. Not recorded on-site but numerous records within 10km radius. Unlikely to occur.	No modification/removal of potential foraging or nesting habitat, thus no significant impact risk. Seven Part Test not required.
Brolga (*Grus rubicunda*)	Inhabits coastal and inland wetlands, shallow lakes, grassland, saltmarsh, farm and dry open land. Forages for large invertebrates, frogs, fish, seeds, green shoots and bulbs. Breeding occurs predominantly in tropical wetland and large inland swamps and irrigated grasslands at inland and central northern Australia (eg Queensland and Northern Territory), though has been recorded in the northwest and north-eastern corner of NSW and Victoria.	As for Jabiru, but records more scant and older, and not seen as frequently as Jabiru. Unlikely chance of occurrence.	No modification/removal of potential foraging or nesting habitat, thus no significant impact risk. Seven Part Test not required.
Comb Crested Jacana (*Irediparra gallinacean*)	Inhabit permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation. Forage on floating vegetation, walking with a characteristic bob and flick. They feed primarily on insects and other invertebrates, as well as some seeds and other vegetation.	Largest dam has potential as small area of foraging habitat within nomadic range. Maria River some potential though lacks aquatic vegetation beyond the edge of the riverbank. Recorded within 10km radius or on site. Unlikely to very low potential to occur on-site.	Dam not affected, and potential to occur in dam and along river not significantly affected, thus no impact likely. Seven Part Tests not required.
Black Bittern (*Dupetor flavicollis*)	Coastal waterways, estuaries, swamps with densely wooded edges, Swamp Oak, Mangroves. Secretive, partly nocturnal. Roosts in trees overhanging water or in dense reeds. Critical breeding habitat is mangrove belts	Maria River and in wetter years, swamp forest offers potential habitat for nesting, roosting and foraging. Minimal potential to occur drainage lines except in wettest	No impact on potential habitat on site, thus significant impact unlikely. **Seven Part Test undertaken** however as chance of occurrence on site.

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	(Lindsey 1992). Breeds Dec-Mar, nests in trees over water. (NSW NPWS 2000, DEC 2005a)	years. Dams similarly offer negligible potential – too small. Recorded within 10km. Good to high chance of occurrence along Maria River, and hence river margins of site. Low to fair chance of occurrence in wetter years in northwest swamp.	
Australasian Bittern (*Botaurus poiciloptilus*)	Wetlands, preferably with dense sedges, rushes, reeds. Prefers freshwater, but also uses densely vegetated saltmarsh and flooded grasslands. Roosts on the ground, forages in shallow water from a platform of trampled vegetation, nests above water on similar platform. Single or groups to 12. Usually sedentary, but nomadic in response to flood, drought.	As for Black Bittern.	As for Black Bittern. **Seven Part Test undertaken.**
Painted Snipe (*Rostratula benghalensis*)	Apparently migratory, breeding Oct-Feb. in southern Australia, but also nomadic, responding to conditions (Smith 1991). Favours shallow, densely vegetated freshwater wetland, feeds on mudflats, but also mangroves and open areas: predominantly inland areas. Solitary, secretive, feeds at dusk. Seldom stays in an area long. Nests in dense cover above water level (Lindsey 1992, Smith 1991).	As for Jabiru. Recorded within 10km. Unlikely to occur on-site.	Seven Part Tests not required as no potential habitat affected and unlikely to occur.
White Eared Monarch (*Monarcha leucotis*)	Normally restricted to northern NSW from Clarence River, with some records near Woolgoolga and around Port Macquarie. Most often found in rainforest, but also found in wet and dry sclerophyll, and swamp forest. Often on ecotone of these habitats and along road verges. Insectivorous, breeding about September to March. Records in Greater Taree LGA and Port Macquarie-Hastings LGA.	Single record in locality. Property lacks preferred rainforest/wet sclerophyll structure. Considered unlikely potential occurrence At most a rare incidental transient.	No risk of significant impact as overwhelming extent of potential habitats retained and unlikely to regularly occur. Seven Part Tests not required.
Olive Whistler (*Pachycephala olivacea*)	Inhabits the wet forests on the ranges of the east coast. Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes. Forage in trees and shrubs and on the ground, feeding on berries and insects.	Single record in the north of Limeburners Creek NR. Site habitat generally unsuitable and not recoded during survey. Unlikely to occur.	Unlikely to occur and no risk of impact. Seven Part Test not required.
Barred Cuckoo Shrike (*Coracina lineata*)	Gregarious rainforest/moist forest (especially creek gullies) species feeding mainly on fruit on tall rainforest trees and shrubs, and insects; generally moving with fruiting patterns. Has been recorded in swamp	No true rainforest on-site. Some fruiting rainforest species regenerating in southwest corner of swamp forest and wet sclerophyll may offer some	Development envelopes do not affect any potential habitat. As potential habitat not affected and no records on or adjacent to site, minimal risk of any major impact thus

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	sclerophyll with rainforest understorey in Port Macquarie (NPWS Atlas of Wildlife).	marginally suitable but only opportunistic foraging habitat – insufficient to support breeding. Recorded in 10km radius. Not found by survey. Very low to low chance of occurrence	Sevenpart test not required. Potential habitat also to be protected and allowed to recover.
Wompoo Fruit Dove (*Ptilinopus magnificus*)	Sub-tropical, littoral, warm temperate and dry rainforest, and wet sclerophyll with rainforest understorey. Feeds on fruit. Known to feed on Camphor Laurel and Lantana.	As for Barred Cuckoo Shrike. Recorded in 10km radius. Not found by survey. Very low to unlikely to occur.	As above.
Rose-Crowned Fruit Dove (*P. regina*)	Inhabits dense rainforest or vegetation containing fruit bearing trees, feeding on fruit. Migratory with fruiting patterns.	As for Barred Cuckoo Shrike. Not recorded in 10km radius. Not found by survey. Very low to unlikely to occur.	As above.
Freckled Duck (*Stictonetta naevosa*)	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates. Nesting usually occurs between October and December but can take place at other times when conditions are favourable. Nests are usually located in dense vegetation at or near water level.	No large open water bodies on site which represent suitable habitat for this species. Not recorded in locality and unlikely to occur on site.	Unlikely to occur and no risk of impact. Seven Part Test not required.
Blue-Billed Duck (*Oxyura australis*)	Deep, densely vegetated freshwater wetlands. Rarely comes ashore. Nests in vegetation over water. Nocturnal. Mainly inland. (Lindsey 1992)	As for Freckled Duck but recorded in locality.	As for Freckled Duck.
Common Planigale (*Planigale maculata*)	Wide variety of habitats. Preference for areas of dense groundcover due to heat/dehydration problems. May prefer ecotones of dry/wet habitats (Denny 1982). Preys on arthropods, small vertebrates, shelters in nest under/in fallen timber or rock (Strahan 1995). Home range about 0.5ha. Breeds Oct-Jan (NSW NPWS 2000).	Site overall offers potential on a structural basis, but best potential habitat is likely to be in swamp forest where groundcover is dense and moist. Site has endured long history of fire and logging which may have excluded this species. Not found by survey. Considered very low to fair chance of occurrence.	Loss of rather marginal habitat with swamp forest largely unaffected. Overall though, essential occurrence potential likely to be retained. Minimal risk of major impact, but as fair chance of occurrence **Seven Part Tests required** to assess significance to demonstrate no significant impacts.
Spotted-Tail Quoll (*Dasyurus maculatus*)	Various forested habitats with preference for dense forests. Requires tree hollows, hollow logs or caves for nesting. Large home range (>500ha) and may move over several kilometres in a few days. Tends to follow drainage lines.	Mosaic of dry and wet sclerophyll, swamp forest, and rural land in locality offers good potential habitat overall and Quoll has been recorded. Site is highly suitable on structural basis, though	Loss of rather marginal habitat with far majority largely unaffected. Overall essential occurrence potential likely to be retained. Minimal risk of major impact, but as fair chance of occurrence **Seven Part Tests**

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
		potential occurrence significantly limited by disturbance history and presence of foxes and wild dogs. Site may form part of large home range. Not recorded by survey but low to fair occurrence potential.	**required** to assess significance to demonstrate no significant impacts.
Long-Nosed Potoroo (*Potorous tridactylous*)	Coastal heath and shrublands; paperbark forest; woodland with dry heathy understorey; high elevation rainforest or moist hardwood forest; moist shrublands with dense or moderately dense understoreys and sedge-dominated groundcover; wet or dry sclerophyll forests where average annual precipitation exceeds 760mm. Requires thick groundcover for refuge, while foraging in open areas on ridges, slopes or gullies, typically on ecotones, and prefers sandy soils for digging. Eats roots, tubers, fungi, fleshy fruits, leaves, insects and other soil invertebrates. Optimum habitat generally considered a mosaic of regenerating dense understorey vegetation as result of patchwork of periodic low to medium intensity fires. Home range 2-5ha (NSW NPWS 2000).	Swamp forest and to lesser extent remainder of site (eg where dense saw sedge) offers potential habitat. Presence of foxes and wild dogs as well as previous disturbance history considered likely to have excluded this sensitive species. Unlikely chance to occur.	Loss/major modification of very marginal habitat considered insignificant, especially as about 450ha to be retained for conservation of threatened species on the site. Overall essential occurrence potential to be retained. No risk of major impact, thus Seven part tests not required to assess significance.
Squirrel Glider (*Petaurus norfolcensis*)	Dry, open forest and woodland, and occasionally wet eucalypt and rainforest. Most common in floriferous sub-coastal and coastal forests with abundant winter flowering trees and shrubs (coastal populations apparently rely heavily on *Acacia* sap and flowering Banksias.	Study area vegetation not considered suitable as no preferred understorey species eg *Banksia integrifolia*. Recorded in locality (east along coast) but not on-site – numerous Sugar Gliders were. Rarely co-occurs with Yellow Bellied Glider. Considered unlikely to very low occurrence potential.	Site considered marginal due to lack of preferred understorey species, and dominance by Sugar Glider. Proposal does not affect known or significant potential habitat, nor significant extent of potential habitat. Proposal will also retain potential for viable population as about 450ha retained and protected for conservation to benefit of threatened species, thus no risk of significant impact. Seven part tests not required to assess significance.
Eastern Pygmy Possum (*Cercartetus nanus*)	Found in rainforest, sclerophyll forest, woodland and tree heath. Predominantly nectarivorous (opportunistically insectivorous and also eats fruits during flowering lulls) feeding on Banksias, Leptospermum, Melaleucas, Eucalypts and Callistemons. Nest in very small hollows, or within bark/leaf nests in tree forks (eg Melaleucas and Banksias), Myrtaceous shrubs, abandoned bird nests or under loose eucalypt bark. Often winters in torpor.	No typical/preferred habitat on site and not recordd in locality or on site by survey. Very low to unlikely chance of occurrence.	No impact on known/critical habitat and unlikely to occur on site. Seven Part Test not required.

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*)	Appears to prefer heathland especially dense wet heath and swampy areas usually occupied by Swamp Rat (AMBS 1996). Also recorded from mid-elevation grasslands, open dry and wet sclerophyll woodland. In the Port Macquarie area, associated with heathland with dense shrub layer of *Banksia ericifolia*, *B. serratifolia, Xanthorrhoea* spp, *Dillwynia floribunda, Boronia spp*, *Leptospermum flavescens* and *Melaleuca nodosa*. Requires specific fire regime, greatest density 3-4 years after fire. Omnivorous, seeds, fungi, green stem, arthropods. Home range <0.5ha (NSW NPWS 2000).	Generally, entire site structurally suitable, especially swamp forest communities. Not recorded but if in small abundance is very difficult to detect. Long history of at times intense logging and variable fire regime may have excluded species from area. Recorded in swamp forest thus potential to occur in western swamps. Not recorded locally however considered low chance to occur on site.	Loss of small area of marginal habitat on site– swamp forest habitat largely unaffected. Overall though, essential occurrence potential likely to be retained. Minimal risk of major impact, but as low chance of occurrence **Seven Part Tests required** to assess significance to demonstrate no significant impacts.
Grey-headed Flying Fox (*Pteropus poliocephalus*)	Nomadic frugivore and nectivores on rainforest, eucalypt, melaleuca and Banksia. Recorded flying up to 45km from roost (generally max. of 20km). Roosts colonially with short term individual or small groups. spring or summer roosts are maternity sites. Dependant on winter flowering species eg *E. robusta* and *E. tereticornis.*	General locality including site offers potential for seasonal feeding. Swamp forest has particular foraging potential due to autumn-winter flowers. Pink Bloodwood also common and significant. No known roosts on site, though riparian vegetation along river structurally suitable. Recorded within 10km, and high chance of seasonal occurrence on-site.	Loss/ modification of small portion of potential foraging habitat. Highly likely to occur on site thus **Seven Part Tests required** to assess significance.
Common/Eastern/ Queensland Blossom Bat (*Syconycteris australis*)	Roosts in rainforest and wet sclerophyll forest. Feeds in heathlands and paperbark swamps up to 4km from roost. Key food species include Banksia, Melaleucas, Callistemons and Bloodwoods.	*M. quinquenervia* dominated swamp forest offers best potential for foraging, though seasonal. Dense sections of wet sclerophyll may offer marginal potential refuge. Overall though, insufficient preferred foraging habitat and limited overlapping flowering periods within foraging range, thus site has only relatively marginal/seasonal potential Recorded several locations within 10km, and considered unlikely potential occurrence on-site, except perhaps during autumn-winter flowering (then low chance).	Potential roosting areas unlikely to be affected No significant loss of potential foraging habitat – potential to occur will essentially remain post-development. Has been recorded roosting and foraging close to developments and even urban areas eg Scotts Head thus tolerant of some human presence. No significant risk of major impact, thus Seven Part Tests not required.
Common/Eastern/Large Bent Wing Bat (*Miniopterus schreibersii*)	Habitat generalist - forages above well-forested areas. Roosts in old buildings, caves, mines etc and in tree hollows. Dependant on nursery caves and communal roosts. Recorded foraging along vegetated roadside	Site overall has highly suitable foraging potential but limited potential for roosting (not breeding or key lifecycle roosts). Not recorded on site but has been within	Considered at least fair potential to occur and small area of potential habitat impacted. Unlikely to lead to significant impact, however **Seven Part Test required** as potential to occur.

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	verges; along tracks in forest, and interfaces of forest and pasture.	10km radius. Fair to high chance of occurrence.	
Little Bent Wing Bat (*M. australis*)	Generally forages above and below canopy of well-forested areas. Roosts in old buildings, caves, mines etc. Recently found roosting in tree hollows and bananas. Dependant on nursery caves and communal roosts. Recorded foraging along vegetated roadside verges; along tracks in forest, and interfaces of forest and pasture.	As for Common Bent-wing but *probably* detected on-site by survey.	Loss of small area of potential habitat and probable detection on site. **Seven Part Test required.**
East Coast Freetail Bat or Eastern Little Mastiff-Bat (*Mormopterus norfolkensis*)	Specific habitat requirements of this species are poorly known. Has been recorded in habitats ranging from rainforest to dry sclerophyll and woodland, with most recorded in the latter (State Forests 1995, Allison 1991). Roosts in small colonies in tree hollows and under loose bark; has been found under house eaves, in roofs and metal caps on telegraph poles. Recorded roosting in roof in Hat Head village. Probably forages above forest or woodland canopy, and in clearings adjacent to forest. Most records are of single individuals, and is likely to occur at low densities over its range.	Track-forest interfaces and tracks under canopy structurally suitable for foraging. Narrow river bound by riparian vegetation also potentially suitable. Potential roosting hollows occur on site. Considered to have fair potential to occur on site.	Loss/modification of area of potential habitat in area where potentially may occur as forager as part of much wider range. **Seven Part Test required** as fair potential occurrence.
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	A large vespertilionid which feeds on moths and insects. Known to roost in caves, abandoned buildings, but mostly in trees hollows higher rainfall forested areas. It is suspected that some populations migrate in winter from higher altitudes to coastal areas, or may simply enter torpor. Prefers tall forests (>20m high) and extensive movements (eg 12km recorded between foraging and roost sites).	Area of continuous canopy over property and adjoining forest considered structurally suitable for foraging. Plenty of hollow-bearing trees potentially suitable for roosting. Not recorded on property by Anabat surveys but recorded in locality. Considered low to fair chance of occurrence, perhaps in warmer seasons.	As for East Coast Freetail Bat. **Seven Part Test required**.
Dwyer's Bat/ Large Eared Pied Bat (*Chalinobus dwyeri*)	Found in moderately wooded habitats such as dry sclerophyll forest, tall open eucalypt forests, woodlands, and sub-alpine woodlands, edge of rainforest and wet sclerophyll forest. Roosts in caves, mines and abandoned bottle-shaped mud nests of Fairy Martins. In caves and mines, tend to roost in twilight sections near entrance. Insectivorous but habits poorly known. Fly relatively slowly, direct and manoeuvrable, low to ground or 6-10m above ground.	General foraging preferences of this poorly known species suggests site and locality potentially structurally suitable foraging habitat. No case, mines, etc on or near site for roosting. Not recorded within 10km radius of site (or Shire, and very few regional records). Not recorded by survey. Likelihood to occur on site considered very low to unlikely.	Modification of structurally suitable potential foraging habitat but no impact on potential roosts. Lack of records in Shire suggest species not likely to occur on or near site. Much of current foraging structures and habitat retained (eg forest-pasture interface) and more adjacent to site. Seven Part Test not taken as no risk of significant impact considered likely.

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	Ecology poorly known. Found in almost all habitats, particularly wet and dry sclerophyll forests and woodlands below 500m altitude, and also open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts mainly in tree hollows, but also under bark, under roof eaves and in other artificial structures. Fast flying species, believed to forage above the canopy or closer to the ground in open areas. Insectivorous. May be summer migrant.	"*Possibly"* recorded on-site. Site overall is suitable for roosting and foraging.	Loss of small area of likely habitat on-site. **Seven Part Test required** to assess significance.
Greater Broad Nosed Bat (*Scoteanax rueppellii*)	Forages over range of habitats including rainforests and moist forests, but prefers ecotones between riparian forest, woodland and cleared land. Requires sparse understorey and will forage over water. Roosts in tree hollows. Feeds on larger insects, small vertebrates and perhaps other bats. Recorded foraging in rural residential areas and on edge of large forest remnants and pasture.	As for East Coast Freetail Bat. Recorded in locality, and a fair chance of occurrence on-site.	As for East Coast Freetail Bat. **Seven Part Test required**.
Hoary Bat (*Chalinolobus nigrogriseus*)	Occurs in a range of habitats, such as monsoon forest, tall open forest, open woodland, vine thickets, coastal scrub, sand dunes, grasslands, floodplains, watercourses and dams. Roosts in eucalypt tree hollows, as well as rock crevices. Breeding colonies have been recorded in roofs of buildings. Preferred prey is beetles and moths, but also spiders, mantids, crickets, grasshoppers, cicadas, bugs, diving beetles, flies and ants (thus may land and forage).	Site overall suitable for foraging and roosting. Not recorded in locality but recorded in open Blackbutt forest at two sites near Kempsey. Very few records in NSW, thus fair chance of occurrence.	As for East Coast Freetail Bat. **Seven Part Test required**
Beccari's Freetail Bat (*Mormopterus beccarii*)	Wide range of habitats from rainforest, floodplains, tall open forest, savannah woodlands, arid shrublands and grasslands. Commonly caught along watercourses, over water and over canopy as prefers areas free of obstructions due to low manoeuvrability. Feeds above canopy in fast flight but agility on ground suggests ability to forage on flightless insects. Very few records in NSW – sporadic and possibly summer nomadic.	Generally as for Hoary Bat. Not recorded in locality. Unlikely potential to occur as no reliable records south of around Lismore.	Unlikely to occur and no risk of impact. Seven Part Test not required.
Eastern Cave Bat (*Vespadelus troughtoni*)	Rare and poorly known bat. Cave dwelling bat roosting in small (5) to large (500) groups in sandstone overhang caves, boulder piles, mines, tunnels and sometimes buildings. Tend to roost in well lit portions of caves in avons, domes, cracks and crevices. Inhabits tropical mixed woodland and wet sclerophyll forest on the coast	General area considered structurally suitable for foraging though no known caves within range of site. Considered low potential to occur at best.	Loss of small area of potential foraging habitat unlikely to impact species. Low chance of occurrence, hence **Seven Part Test required.**

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	and dividing range, but extend into drier forest on western slopes and inland areas.		
Southern Myotis (*Myotis macropus*)	Tunnel, cave, bridges, old buildings, tree hollow and dense foliage roosting bat which prefers riparian habitat over 500m long with nearby roosting habitat. Key habitats are streams, rivers, creeks, lagoons, lakes and other water bodies. Feeds on aquatic insects and small fish. Has recently been observed foraging in small bodies of water.	No suitable foraging habitat on site – drainage lines lack sufficient waterbodies. Potential roosts in tree hollows but not near potential habitat hence unlikely to be used. Recorded in locality. Not detected on site by survey. Considered unlikely to very low chance of occurrence.	Unlikely to very low potential to occur. No risk of significant impact as potential habitat largely unaffected and site unlikely to be used by this species. Seven Part Test not required.
Golden-Tipped Bat (*Kerivoula papuensis*)	Spider eating specialist, capable of hovering and high manoeuvrability. Normally found in rainforest and along rainforest gullies within wet sclerophyll forest (often when lot of vines which suit prey species), but has been recorded in recently logged dry sclerophyll forest. Roosts in abandoned bests of gerygones and scrubwrens, but also found in dense foliage, rooves, and caves.	Recorded in locality. No suitable roosting habitat on or near site. Site forms probably marginal potential foraging habitat – adjacent State Forest has better potential. Unlikely to low potential to occur.	Unlikely to low potential to occur. No risk of significant impact. Seven Part Test not required.
Three-Toed Snake-Tooth Skink (*Coeranoscincus reticulatus*)	Poorly known ecology. Burrowing lizard found in moist layered forest, closed forest and tall open forest (Cogger 1992). Soil type appears important – rich dark or loamy basaltic soils (SFNSW 1994). Also recorded in closed forest on silica dunes, coastal eucalypt woodlands on sand, and in logged forest with tall softwood regrowth. Usually found under leaf litter, moist rotting logs, or loose friable soil. Feeds on earthworms and beetle grubs (NSW NPWS 2000).	No suitable habitat on-site. Recorded in Hat Head National Park. Unlikely to occur.	No potential habitat affected. No significant impact likely. Seven part tests not required.
Pale-Headed Snake (*Hoplocephalus. Bitorquatus*)	Wet and dry sclerophyll, preferring those with *Callitrus* spp, riparian vegetation, and occasionally rainforest. Terrestrial and semi-arboreal predator of small vertebrates (mainly lizards and frogs, small mammals and probably co-habitating bats). Shelters under decorticating bark and within hollows especially close to watercourses.	No Callitrus on site, though site generally suitable in structure. Abundance of hollows and logs on-site. Potential prey relatively common. Logging and past fire may have eliminated presence. Not detected by survey but extremely difficult to detect. Not recorded in locality. Unlikely to fair chance of occurrence.	Loss/severe modification of about 15% of potential habitat probably insignificant as greater proportion of site to remain essentially in present state, and hence retain current habitat potential. Minimal risk of major impact, but given chance of occurrence, **Seven Part Tests required** to demonstrate.
Stephen's Banded Snake (*H. stephensii)*	Inhabits variety of habitats including dry rainforest, sub-tropical rainforest, wet and dry sclerophyll, rocky outcrops (especially granite and sandstone) - requires close proximity to variety of vegetation formations. Nocturnal and primarily arboreal - sheltering under	Site generally suitable in structure. Abundance of hollows and logs on-site. Potential prey relatively common. Logging and past fire may have eliminated presence. Not detected by	As for Pale Headed Snake due to local records in similar habitat. **Seven Part Tests required**.

NAME	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANCE OF IMPACTS
	decorticating bark, within tree scars, hollows, logs, rock crevices and slabs. Active predator of variety of vertebrates including geckos, skinks, frogs, small mammals, bats, birds	survey but extremely difficult to detect. Recorded within Beranghi area. Low to good chance of occurrence.	
Green and Golden Bell Frog (*Litoria aurea*)	Found in permanent swamps and ponds. Prefers water bodies which are: still; shallow; unshaded; ephemeral; unpolluted; generally isolated; and free of native fish species or Plague Minnow (*Gambusia holbrooki)* and little macro-algae. Requires emergent vegetation, grass tussocks or rocks for shelter. May use disturbed sites opportunistically - may depend on several stages. Eats insects and other frogs. summer breeder. (Hero *et al* 2004).	No permanent swamps on-site. Few dams fairly permanent, but infested with Plague Minnow. Recorded in locality, but very unlikely to occur on site.	No potential habitat affected. No significant impact likely. Seven part tests not required.
Wallum Froglet (*Crinia tinnula*)	Predominantly confined to acidic paperbark swamps of coastal areas (Cogger 1992). Also found in wet heathland and Melaleuca sedgelands. Recorded breeding in flooded pasture adjacent to paperbark swamps.	Western swamp forest considered to have high potential for this species –eastern drainage lines only some marginal potential (low to fair). Recorded in 10km radius but not on site by survey, though difficult to detect outside of breeding season. Good potential to occur within 1km due to abundance of swamp forest.	Most of impacts do not affect potential habitat. Unlikely to be pollution of waters by stormwater etc as regulated by legislative controls. Risk of major impact unlikely. **Seven Part Tests undertaken** to demonstrate due to level of potential occurrence.
Giant Barred Frog (*M. iteratus)*	Moist hardwood forest, Antarctic Beech and rainforest near flowing streams. May also occur in coastal riverine rainforest and riparian vegetation. Forages in areas adjacent to riparian zones. Males call from under leaf litter or rocks by flowing streams. Eggs laid at streamside to await washing into stream by rainfall.	No freshwater flowing watercourse on site proximity to site. Drainage lines have ephemeral flow, and thus marginal potential. Plague Minnow occur in almost all pools within drainage lines. Site has endured long history of habitat modification likely to have excluded this species if it every occurred. Not found on-site by survey. Not recorded within 10km. Unlikely to extremely low potential to occur on-site.	No significant impact as no potential habitat affected by proposal (drainage lines effectively excluded except perhaps by internal boundary fences, which will have no significant impact on these species). Minimal risk of major impact, thus Seven part tests not required.
Stuttering Frog *(Mixophyes balbus)*	Found in wet forest usually above 100m, predominantly near slow-flowing mountain streams. Also found in moist gullies within areas of dry forest, where it may utilise very small, hardly flowing trickles of water (Tyler 1997). Other attributes similar to *M. iteratus.* Seldom found south of the Hastings (Tyler 1997).	As for *M. iteratus*.	As for *M. iteratus*.

A number of other species (see table below) are known or considered potential occurrences within the locality. However due to a number of factors, these species were not considered potential occurrences on site. Thus the proposal is not considered to have a significant impact on the viability of any local population of the subject species and a formal Seven Part Test evaluation was not considered required to superfluously demonstrate the proposal is unlikely to have a significant impact.

Table 19: Fauna considered unlikely to occur on the property

Preferred Habitat	Species	Site considered unsuitable habitat	Presence of predators likely to have excluded this species	Disturbance history likely to have excluded this species	Lack of local records
Rainforest/Wet Sclerophyll Forest	Marbled Frogmouth (*Podargus ocellatus*)	**X**			**X**
	Superb Fruit-Dove (*Ptilinopus superbus*)	**X**			**X**
	Parma Wallaby (*Macropus parma*)	**X**	**X**	**X**	**X**
Dry Sclerophyll Forest/Woodland/ Open Grassy Woodlands	Turquoise Parrot *(Neophema pulchella)*	**X**			**X**
	White-Browed Woodswallow (*Artamus superciliosus*)	**X**			**X**
	Grey-Crowned Babbler (*Pomatostomus temporalis temporalis*) eastern subspecies	**X**			**X**
	Diamond Firetail (*Stagonopleura guttata*)	**X**			**X**
	Speckled Warbler (*Pyrrholaemus sagittata*)	**X**			**X**
	Hooded Robin (*Melanodryas cucullata cucullata)* south-eastern form	**X**			**X**
	Flame Robin (*Petroica phoenicea*)	**X**			**X**
	Scarlet Robin (*Petroica boodang*)	**X**			**X**
	Rufous Bettong (*Aepyprymnus rufescens*)	**X**	**X**	**X**	**X**

Preferred Habitat	Species	Site considered unsuitable habitat	Presence of predators likely to have excluded this species	Disturbance history likely to have excluded this species	Lack of local records
Estuarine/Marine	Gould's Petrel (*Pterodroma leucoptera leucoptera*)	**X**			**X**
	Southern Giant Petrel (*Macronectas giganteus*)	**X**			**X**
	Sooty Tern (*Sterna fuscata*)	**X**			**X**
	Beach Stone-Curlew (*Esacus neglectus*)		**X**		
	White Fronted Chat *(Epthianura albifrons)*	**X**			**X**
Swamp/Aquatic/Freshwater/Wetland/Riparian	Giant Dragonfly (*Petalura gigantea)*	**X**			**X**
	Black Grass-Dart Butterfly (*Ocybadistes knightorum*)	**X**			**X**
	Magpie Goose (*Anseranas semipalmata*)	**X**	**X**		**X**
	Olongburra Tree Frog (*Litoria olongburensis*)	**X**			**X**

APPENDIX 2: Plant Species List

Table 20: Plants recorded on the site

COMMON NAME	SCIENTIFIC NAME
Canopy Trees	
Swamp Oak	*Casuarina glauca*
Pink Bloodwood	*Corymbia intermedia*
Grey Ironbark	*Eualyptus siderophloia*
Thick-Leaved Mahogany	*Eucalyptus carnea*
White Stringybark	*Eucalyptus globoidea*
Tallowwood	*Eucalyptus microcorys*
Blackbutt	*Eucalyptus pilularis*
An Ironbark	*Eucalyptus placita*
Red Mahogany	*Eucalyptus resinifera*
Swamp Mahogany	*Eucalyptus robusta*
Flooded Gum	*Eucalyptus saligna*
Narrow-leaved Red Gum	*Eucalyptus seeana*
Scribbly Gum	*Eucalyptus signata*
Brushbox	*Lophostemon confertus*
Broad-leaved Paperbark	*Melaleuca quinquenervia*
Turpentine	*Syncarpia glomulifera*
Understorey Trees	
Hickory Wattle	*Acacia implexa*
Maiden's Wattle	*Acacia maidenii*
-	*Acacia terminalis*
Lilly Pilly	*Acmena smithii*
Common Acronychia	*Acronychia oblongifolia*
Common Acronychia	*Acronychia oblongifolia*
Forest Oak	*Allocasuarina torulosa*
Black Oak	*Allocasuarina. littoralis*
Red Ash	*Alphitonia excelsa*
-	*Bursaria spinosa var macrophylla*
Weeping Bottlebrush	*Callistemon saligna*
Hard Quandong	*Elaeocarpus obovatus*
Rose Walnut	*Endiandra discolor*
Sandpaper Fig	*Ficus fraseri*
Cheese Tree	*Glochidion ferdinandi*
Dogwood	*Jacksonia scoparia*
Coastal Teatree	*Leptospermum laevigatum*
Narrow-Leaved Paperbark	*Melaleuca linariifolia*
-	*Melaleuca nodosa*
Siebers Paperbark	*Melaleuca sieberi*
Prickly Leaved Paperbark	*Melaleuca stypheloides*
Brush Muttonwood	*Myrsine howittiana*
Large Mock Olive	*Notolaea longifolia*
Geebung	*Persoonia conjuncta*
Geebung	*Persoonia levis*
Scentless Rosewood	*Synoum glandulosum*
Shrubs, Herbs and Young Trees	
Two-Veined Wattle	*Acacia binervata*
Box-Leaved Wattle	*Acacia buxifolia*
-	*Acacia elongata*

COMMON NAME	SCIENTIFIC NAME
Falcate Wattle	*Acacia falcata*
White Sally	*Acacia floribunda*
-	*Acacia longifolia*
Maidens Wattle	*Acacia maidenii*
Myrtle Wattle	*Acacia myritifolia*
Sweet-Scented Wattle	*Acacia suaveolens*
-	*Banksia oblongifolia*
-	*Banksia spinulosa*
Breynia	*Breynia oblongata*
Breynia	*Breynia oblongata*
Swamp Bottle Brush	*Callistemon pachyphyllus*
Orange Thorn	*Citriobatus pauciflorus*
Narrow-Leaved Palm Lily	*Cordyline stricta*
Native Cascarilla	*Croton verreauxii*
-	*Daviesia genistifolia*
-	*Daviesia squarrosa*
a hopbush	*Dodonea triquetra*
Quandong	*Elaeocarpus obovatus*
Coral Heath	*Epacris pulchella*
Dagger-Leaved Hakea	*Hakea teretifolia*
-	*Hovea purpurea*
Australian Indigo	*Indigofera australis*
Dogwood	*Jacksonia scoparia*
Prickly Tea-tree	*Leptospermum juniperinum*
A tea tree	*Leptospermum polygalifolium*
-	*Leucopogon lanceolatus*
-	*Leucopogon lanceolatus*
Crinkle Bush	*Lomatia salicifolia*
Crinklebush	*Lomatia salicifolia*
Cockspur Thorn	*Maclura cochinchinesis*
-	*Phyllanthus gunnii*
Slender Riceflower	*Pimelea linifolia*
Handsome Flat Pea	*Platylobium formosum spp formosum*
Elderberry Pomax	*Polyscias sambucifolia*
-	*Pomaderis lanigera*
a pea	*Pultenaea retusa*
Poison Peach	*Trema tomentosa*
A grass tree	*Xanthorrhea macronema*
Ferns and Mosses	
Common Maidenhair	*Adiantum aethiopicum*
Cartilage Fern	*Blechnum cartilagineum*
Gristlefern	*Blechnum cartilagineum*
Swamp Water Fern	*Blechnum indicum*
False Bracken	*Calochlaena dubia*
Native Rock Fern	*Cheilanthes sieberi*
Rasp Fern	*Doodia aspera*
Clubmoss	*Lycopodium spp*
Bracken Fern	*Pteridium esculentum*
Grasses	
A kerosene grass	*Aristidia sp.*
Carpet Grass	*Axonopus affinis*
Barbed-Wire Grass	*Cymbrogen refractus*

COMMON NAME	SCIENTIFIC NAME
Couch	*Cynodon dactylon*
Wiry Panic	*Entolasia stricta*
Bladey Grass	*Imperata cylindrica*
-	*Oplisemenus aemulus*
-	*Ottochloa gracillima*
Paspalum	*Paspalum dilatatum*
Vasey Grass	*Paspalum urvillei*
Tussock Grass	*Poa sieberiana*
Pale Pigeon Grass	*Setaria pumila*
Kangaroo Grass	*Themeda australis*
Groundcovers	
-	*Centella asiatica*
-	*Dampiera stricta*
Blue Flax Lilly	*Dianella caerulea*
Saw sedge	*Gahnia aspera*
Saw sedge	*Gahnia clarkei*
Cudweed	*Gnaphalium gymnocephalum*
-	*Gonocarpus micranthus ssp ramosissimus*
Violet-leaved Goodenia	*Goodenia hederacea*
a goodenia	*Goodenia heterophylla*
Settlers Flax	*Lepidosperma laterale*
Matrush	*Lomandra filliformis*
Spiny Mat Rush	*Lomandra longifolia*
Matrush	*Lomandra longifolia*
-	*Oxalis corniculata*
Purple Flag	*Patersonia glabrata*
Handsome Flat Pea	*Platylobium formosum*
White Root	*Pratia purpurascens*
Pastel Flower	*Pseuderanthemum variabile*
-	*Senecio amygdalifolius*
Violet	*Viola hederacea*
Lianas and Scramblers	
Appleberry	*Billardiera scandens var scandens*
Devils Twine	*Cassytha pubescens*
Kangaroo Grape	*Cissus antarctica*
Native Yam	*Dioscorea transversa*
Wombat Berry	*Eustrephus latifolius*
Scrambling Lily	*Geitonoplesium cymosum*
Glycine	*Glycine clandestina*
Glycine	*Glycine microphylla*
False Sarsaparilla	*Hardenbergia violacea*
Climbing Guinea Flower	*Hibbertia scandens*
Dusky Coral Pea	*Kennedia rubicunda*
Jasmine Morinda	*Morinda jasminoides*
Mollucca Bramble	*Rubus hilli*
Austral Smilax	*Smilax australis*
Native Sarsaparilla	*Smilax glyciphylla*
Wetland species	
Tassel Sedge	*Carex fascicularis*
-	*Chorizandra cymbaria*
River Lily	*Crinum pedunculatum*
Tall Spikerush	*Eleocharis sphacelata*

COMMON NAME	SCIENTIFIC NAME
Tussock Rush	*Juncus usiaticus*
-	*Lepyrodia muelleri*
a knotweed	*Persicaria strigosa*
Frogsmouth	*Philydrum lanuginosum*
Common Reed	*Phragmites australis*
-	*Ptilothrix deusta*
-	*Schoenus brevifolius*
-	*Schoenus lepidosperma*
Cumbungi	*Typha orientalis*
Parasites and Epiphytes	
Mistletoe	*Amyema pendulem*
Birdsnest Fern	*Asplenium australasicum*
Devils Twine	*Cassytha glabella*
Snake Flower orchid	*Cymbidium suave*
Elkhorn	*Platycerium bifurcatum*
Common Skeleton Fern	*Psilotum nudum*
Exotics	
Goatweed	*Ageratum houstonianum*
Farmers Friend	*Bidens pilosa*
Bitou Bush	*Chrysanthemoides monilifera*
Camphor Laurel	*Cinnamonum camphora*
Penny Wort	*Hydrocotyle bonariensis*
Lantana	*Lantana camara*
White Passionfruit	*Passiflora subpeltata*
Black Berry	*Rubus ulmifolius*
Senna	*Senna cotuleoides*
Paddy's Lucerne	*Sida rhombifolia*
Wild Tobacco	*Solanum maritianum*
Purple Top	*Verbena spp*

NATURECALL ENVIRONMENTAL

Sustainable Partners

ABN: 81 127 154 787
Head Office
PO Box 3401
Helensvale Town Centre
Helensvale
QLD 4212
Phone 1300 319 954
info@naturecall.com.au
www.naturecall.com.au

Monday, 20 July 2015

Mr Tim Mecham
Mid Coast Environmental Services
P0 Box 353
Kempsey 2440
Delivery via: Email [mecham@bigpond.com.au]

Dear Tim,

RE: Addendum to Statutory Ecological Assessments for Three Lot Subdivision of Lot 1 DP 196559, Beranghi Rd, Beranghi.

As requested, we provide an addendum to previous Darkheart (2014) assessment of the proposed development in regards to any new changes to legislation or new listings relevant to the subject land since the previous report.

Darkheart Eco merged with Naturecall in April 2014, and the 2014 report has been reviewed in line with current legislation and listings.

1. Background Information

1.2 Summary of Previous Assessment

The proposed development is to establish a 3 Lot rural subdivision on the site with two lots of 150ha and one 162ha lot. Development envelopes 2ha in size have been identified in the east of each Lot fronting Beranghi Road where dwellings and Asset Protection Zones (APZs) will be located. These will be zoned 'E3' *Environmental Management* and the remainder of the Lots are designated as 'E2' *Environmental Conservation* under the draft Kempsey Shire Council Local Environmental Plan (LEP).

On each Lot, about 0.5ha of vegetation in each 2ha development envelope will be allowed to be largely cleared for the establishment of a building envelope which is to encompass buildings and on-site sewage treatment systems, with the required APZ allowed to extend into the residual of the 2ha development envelope. These structures and all infrastructure is to be located to avoid/retain Koala food trees and preferably all hollow-bearing trees within the 2ha development envelope. Hence at most about 6ha of habitat may cleared/modified by the proposal (about 1.3% of the property).

No threatened flora species were detected, and none were considered likely potential occurrences. Portions of the property fall under the 1:100 ARI and are mapped as having alluvial soils. The supported vegetation was considered to qualify as the Coastal Floodplain EECs – *Swamp Sclerophyll Forest* (parts of the east and west) and *River-flat Eucalypt Forest* (adjacent to Maria River).

A comprehensive ecological survey over the entire property recorded 6 threatened species (3 mammals, 2 bird and 1 frog), with tentative call identification of two species of threatened bats. Based

on potential habitat on the property, local records and excellent connectivity to large areas of habitat, another 22 threatened fauna species were considered potential occurrences.

Previous survey determined the property contained Core Koala Habitat, but a Koala Plan of Management approved for a previous development is no longer proceeding. Hence the proposal was assessed under the Core Koala Habitat development provisions of the Kempsey Shire Council Koala Plan of Management, and deemed to be able to comply

The assessment concluded the proposal was unlikely to have a significant impact, and hence did not warrant referral to the Department of Environment under the EPBC Act or a Species Impact Statement, particularly due to the fact that over 450ha of the 459ha property would be protected under the E2 zoning.

1.2 Changes to the Proposal

There have been no changed to the proposal assessed in 2014.

2. Legislative Changes and Listings

2.1 Kempsey Shire Council Comprehensive Koala Plan of Management

There has been no change to this planning document which have consequence to the proposal.

No further assessment is required.

2.2 EPBC Act 1999 - Matters of National Environmental Significance

2.2.1 New Listings of Threatened Species, Threatened Ecological Communities, etc.

While a number of species and Threatened Ecological Communities (TEC) which occur in NSW have been listed as threatened (eg Eastern Curlew and Curlew Sandpiper; and Subtropical and Temperate Coastal Saltmarsh), no new listing is relevant to the proposal, hence no further assessment is required of any newly listed threatened species or TEC. An updated MNES search is provided in Appendix 2.

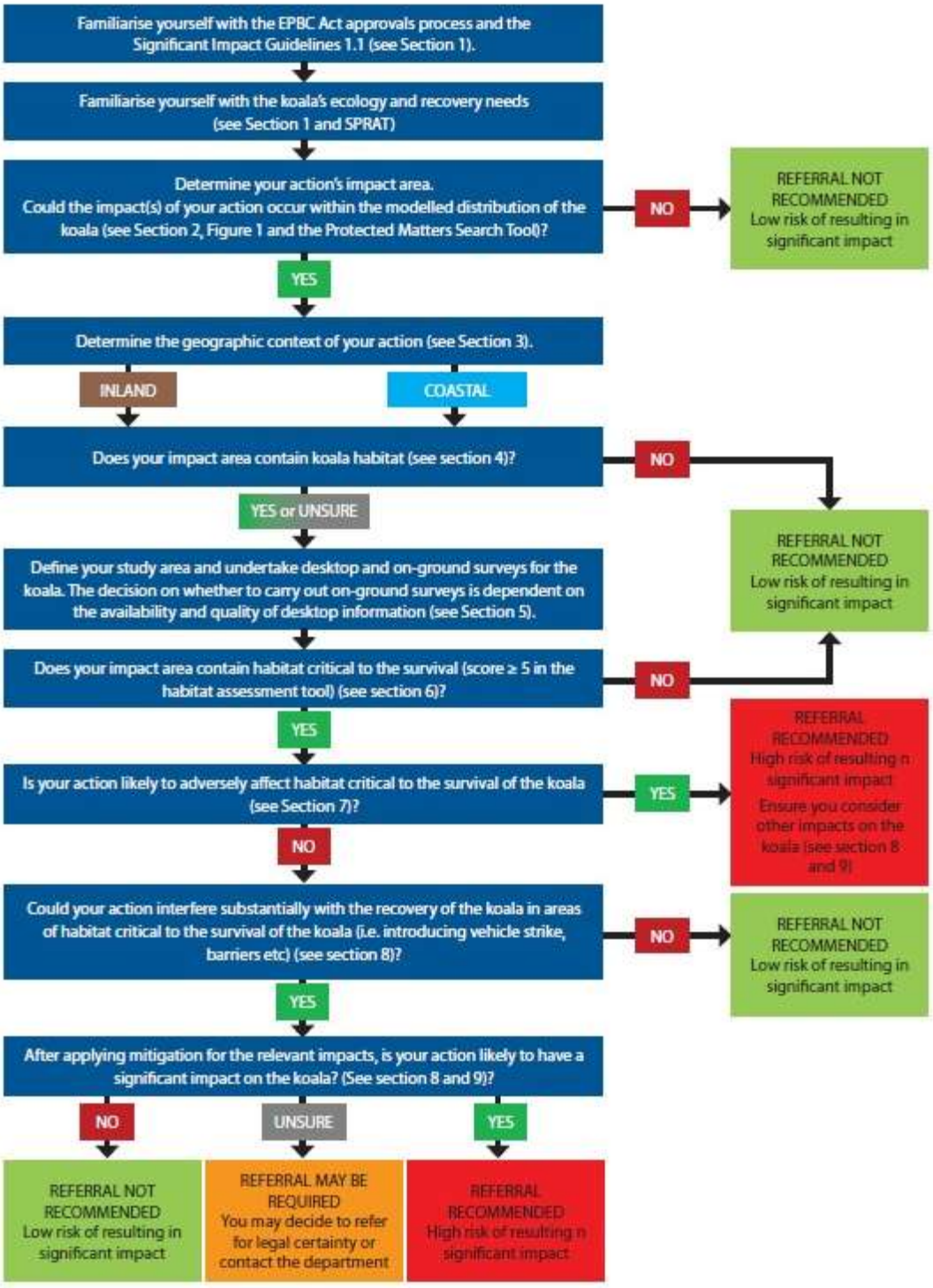
Similarly, there have been no changes to provisions or listings of migratory species, and all potentially occurring species have been previously assessed.

2.2.2 New Koala Impact Assessment Guidelines

The EPBC Act Koala referral guidelines (DoE 2014) have been finalised since the previous assessment, and now any proposal that may have an impact on the Koala requires assessment under the guidelines to determine if a referral to the minister is required.

Figure 1 below is a summary of the assessment pathway to be used when determining if a proposal is likely to have a significant impact and require referral. An assessment of the proposal as per the guidelines subsequently follows.

Figure 1: EPBC Act Koala referral assessment guidelines



Step 1: Critical Habitat Assessment

As per the above assessment process, the habitat on site has been assessed using the Koala habitat assessment tool (DoE 2014) to determine if it qualifies as critical habitat. To qualify as critical habitat, it must score 5 or more. This assessment is undertaken in the following table:

Table 1: Critical habitat qualification assessment

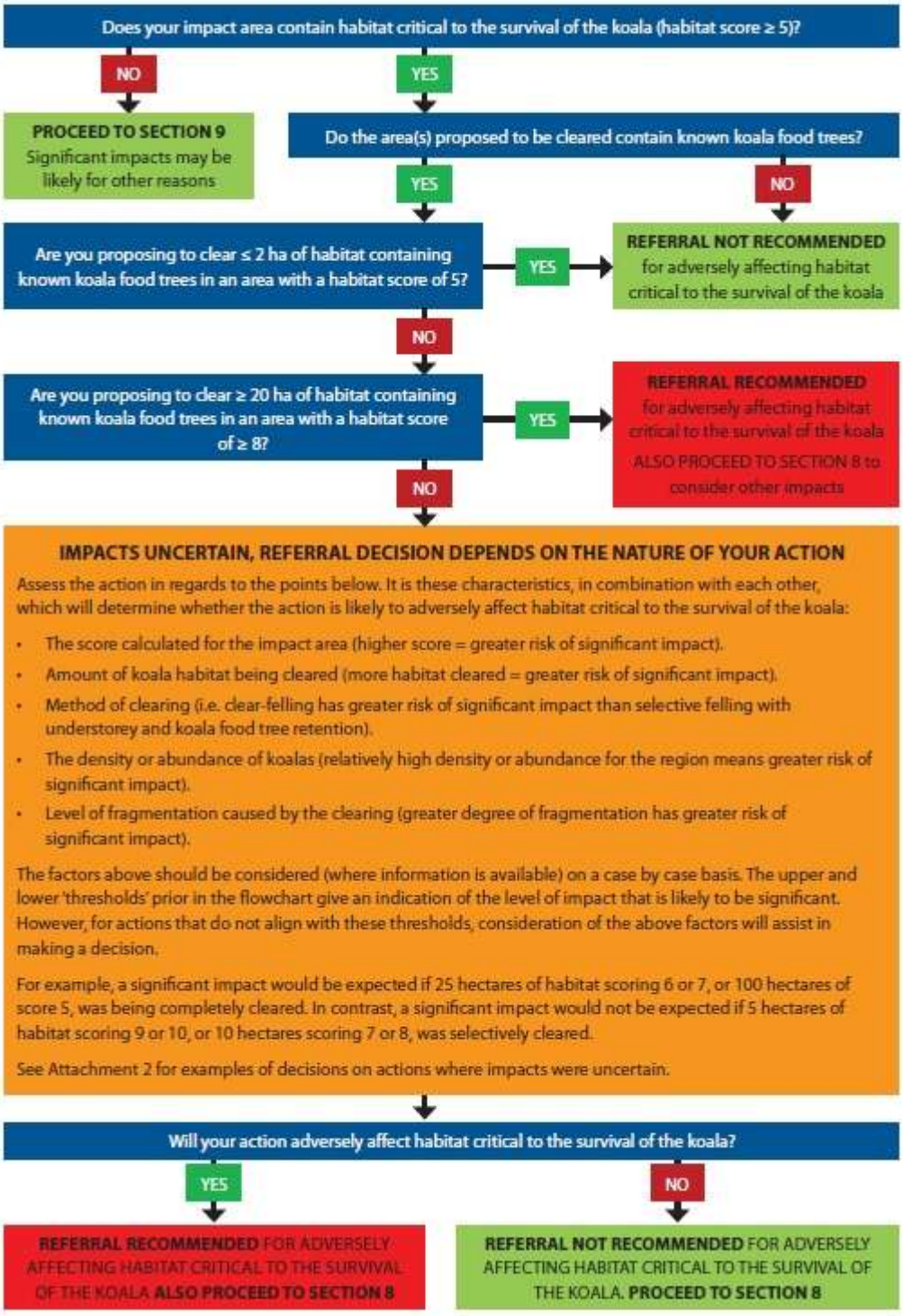
Attribute	Score	Reason	
Koala occurrence	2	Desktop	OEH Bionet has 88 records of Koalas within 10km of the site, with several within 2km (mostly old). One record appears to fall within the site boundary (appears to be Darkheart 2002 record). EPBCA PMST report identified the Koala as 'known to occur' in the study area.
		On-ground	Koala identified on site and site identified as Core Koala Habitat.
Vegetation structure and composition	2	Desktop	Aerial imagery indicates that site has extensive forest vegetation with an open canopy. CMA mapping shows the site is a mosaic of Scribbly Gum forest, Blackbutt-Turpentine, and Swamp Mahogany forest.
		On-ground	Site vegetation surveys found vegetation communities to contain Koala Food Trees at sufficient levels to be considered Potential Koala Habitat under SEPP 44.
Habitat connectivity	2	Reference to aerial imagery shows that the site vegetation (about 459ha) is adjunct to larger tracts of similar habitat >1000ha.	
Key existing threats	2	Desktop	Nearest road kill records are >5km along Pacific Highway. No records of road kill or dog attack within study area.
		On-ground	No evidence of Koala road kill found during survey. Domestic dog kill risk is low, but wild dogs known in area – hence risk of dog attack is high.
Recovery value	2	Due to the site's exposure, disturbed state and limited extent, it is unlikely to be important for achieving interim recovery objectives.	
Total	**10**	**Site qualifies as critical habitat**	

As per the Koala habitat assessment tool, the site qualifies as critical habitat, hence assessment to determine if the proposal will adversely affect this habitat and/or interfere substantially with the recovery of the Koala and require referral to the Minister, is required.

Step 2: Assessment of Adverse Effect on Critical Habitat Assessment

Figure 2 shows the assessment process for determining if a development will adversely affect habitat critical to the survival of the Koala and thus require referral.

Figure 2: Process for assessing adverse effects on critical habitat



The following table derived from the Koala Referral Guidelines (DoE 2014) assesses whether the proposal is likely to adversely affect habitat critical to the survival of the Koala, and hence requires referral to DoE:

Table 2: Critical habitat impact significance assessment

Factor	Y/N	Reason
Does impact area contain habitat critical to the survival of the Koala	Y	Site scores 10 as per the critical habitat assessment tool
Do the areas proposed to be cleared contain known Koala food trees	N	Site contains several eucalypt species which are known Koala food tree species, but these will all be retained as per the KSC CKPoM provisions.
Are you proposing to clear<2ha of habitat containing known Koala food trees in an area with a habitat score of 5	Y	Proposal may remove an estimated 1.5ha of habitat in an area with a habitat score of 10.
Are you proposing to clear >20ha of habitat containing known Koala food trees in an area with a habitat score of >8	N	Proposal will only remove an estimated 1.5ha of habitat.
Outcome	Unlikely to adversely affect critical habitat.	

As seen in Table 2 above, the proposal is unlikely to adversely affect habitat critical to the survival of the Koala, as it will not remove a sufficient extent habitat; and the overwhelming majority will be retained and protected in perpetuity. The Guidelines consider this level of critical habitat loss as insignificant.

The next stage of the assessment which assesses the proposal's impact on the recovery of the Koala, now applies.

Step 3: Assess Impacts on Recovery of the Koala

The Koala Referral Guidelines outline the following potential indirect impacts which may interfere with the recovery of the Koala:

- Dog attack
- Vehicle strike
- Facilitating the introduction or spread of disease or pathogens
- Barriers to dispersal and fragmentation
- Degradation of habitat critical to the survival of the Koala through hydrological change

The proposal is assessed against these potential indirect impacts in the following table:

Table 3: Impact of proposal on recovery of Koala

Factor	Site assessment	Mitigation measures proposed	Residual impact
Dog attack	Keeping of dogs required under KSC CKPoM to be banned. Residents encouraged to report wild dogs to Local Land Services for control.	Compliance dependant on KSC compliance enforcement under CKPoM.	No residual impact
Vehicle strike	Proposal will slightly increase volume of traffic on Beranghi Rd, and use of the main track to access the river. Given low speed on on-site tracks, and limited condition of Beranghi Rd and its condition, significant increase in strike risk is not likely.	Not applicable.	No increase in current impact risk likely
Disease	Minimal if any risk of increasing stress as Koala Food Trees (KFTs) required to be retained in development envelope; and all habitat on residual protected under E2	Not applicable.	No increase in current impact risk likely
Barriers and fragmentation	No new barriers will be created as a result of the proposal as per KSC CKPoM provisions. Vegetation clearing will slightly increase local fragmentation	Compliance dependant on KSC compliance enforcement under CKPoM.	No significant residual impact.
Hydrological change	No hydrological changes are likely to result from the proposal	Nil	No impact likely

Step 4: Conclusion:

The above assessment has determined that according to the DotE (2014) Guidelines, the proposal is unlikely to have a significant impact on the Koala via either impacting a significant area of critical habitat or substantially interfering with its recovery. Thus a referral to DotE is not required for the proposal.

2.3 *Threatened Species Conservation Act 1995*

As above, no relevant new threatened species have been listed under the Act that require additional statutory assessment due to known or potential occurrence.

Similarly, a review of the Bionet database (see Appendix 1) shows no new locally recorded species which was not considered for potential occurrence, or for which potential habitat occurs on site.

No further assessment is thus required.

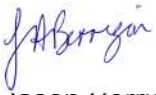
3. Conclusion

No relevant threatened species, EEC, or other legal entity has been listed that has any implications for the proposal; nor has there been any significant legislative changes with implications for the proposal.

Consequently, the conclusions of the Darkheart (2014) report remain valid, and the proposal does not require a Species Impact Statement or referral to the Dept of Environment.

It is anticipated this correspondence contains all the relevant information you require, however if any additional information is required, or you wish to discuss the project further please don't hesitate to contact Jason on 0410 522 399.

Yours faithfully,



Jason Berrigan,
B. Nat. Res. (Hons).Grad. Cert. (Fish.).
MECANSW, MRZSNSW, MABS, MAHS, MAPCN, MRBIA
Mobile: 0410 522 399
Email: jason@naturecall.com.au

NATURECALL ENVIRONMENTAL

Head Office:
Phone: 1300 319 954
Email: info@naturecall.com.au
All Mail: PO Box 3401 Helensvale Town Centre QLD 4212
Office: 1/52 Newheath Drive, Arundel, QLD

NSW Office:
Phone: 1300 319 954
Email: info@naturecall.com.au
Office: Level 1, Suite 3, 64 Clarence Street, Port Macquarie, NSW

Appendix 1: Bionet database search

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. Th
indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Sp
under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounde
Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Public Report
Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Entities in selected area [North: -3
152.82 East: 152.92 South: -31.26] returned a total of 147 records of 22 species.
Report generated on 20/07/2015 9:01 AM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status
Animalia	Amphibia	Hylidae	3169	*Litoria brevipalmata*		Green-thighed Frog	V,P
Animalia	Aves	Ciconiidae	0183	*Ephippiorhynchus asiaticus*		Black-necked Stork	E1,P
Animalia	Aves	Accipitridae	0230	*^^Lophoictinia isura*		Square-tailed Kite	V,P,3
Animalia	Aves	Accipitridae	8739	*^^Pandion cristatus*		Eastern Osprey	V,P,3
Animalia	Aves	Jacanidae	0171	*Irediparra gallinacea*		Comb-crested Jacana	V,P
Animalia	Aves	Cacatuidae	0265	*^Calyptorhynchus lathami*		Glossy Black-Cockatoo	V,P,2
Animalia	Aves	Psittacidae	0260	*Glossopsitta pusilla*		Little Lorikeet	V,P
Animalia	Aves	Strigidae	0248	*^^Ninox strenua*		Powerful Owl	V,P,3
Animalia	Aves	Tytonidae	0250	*^^Tyto novaehollandiae*		Masked Owl	V,P,3
Animalia	Aves	Neosittidae	0549	*Daphoenositta chrysoptera*		Varied Sittella	V,P
Animalia	Mammalia	Dasyuridae	1008	*Dasyurus maculatus*		Spotted-tailed Quoll	V,P
Animalia	Mammalia	Dasyuridae	1017	*Phascogale tapoatafa*		Brush-tailed Phascogale	V,P
Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*		Koala	V,P
Animalia	Mammalia	Petauridae	1136	*Petaurus australis*		Yellow-bellied Glider	V,P
Animalia	Mammalia	Petauridae	1137	*Petaurus norfolcensis*		Squirrel Glider	V,P
Animalia	Mammalia	Potoroidae	1175	*Potorous tridactylus*		Long-nosed Potoroo	V,P
Animalia	Mammalia	Pteropodidae	1280	*Pteropus poliocephalus*		Grey-headed Flying-fox	V,P
Animalia	Mammalia	Vespertilionidae	1372	*Falsistrellus tasmaniensis*		Eastern False Pipistrelle	V,P

Animalia	Mammalia	Vespertilionidae	1369	*Kerivoula papuensis*	Golden-tipped Bat	V,P
Animalia	Mammalia	Vespertilionidae	1346	*Miniopterus australis*	Little Bentwing-bat	V,P
Animalia	Mammalia	Vespertilionidae	1834	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V,P
Animalia	Mammalia	Vespertilionidae	1357	*Myotis macropus*	Southern Myotis	V,P

Appendix 2: EPBC Act MNES Search Tool Results

Australian Government

Department of the Environment

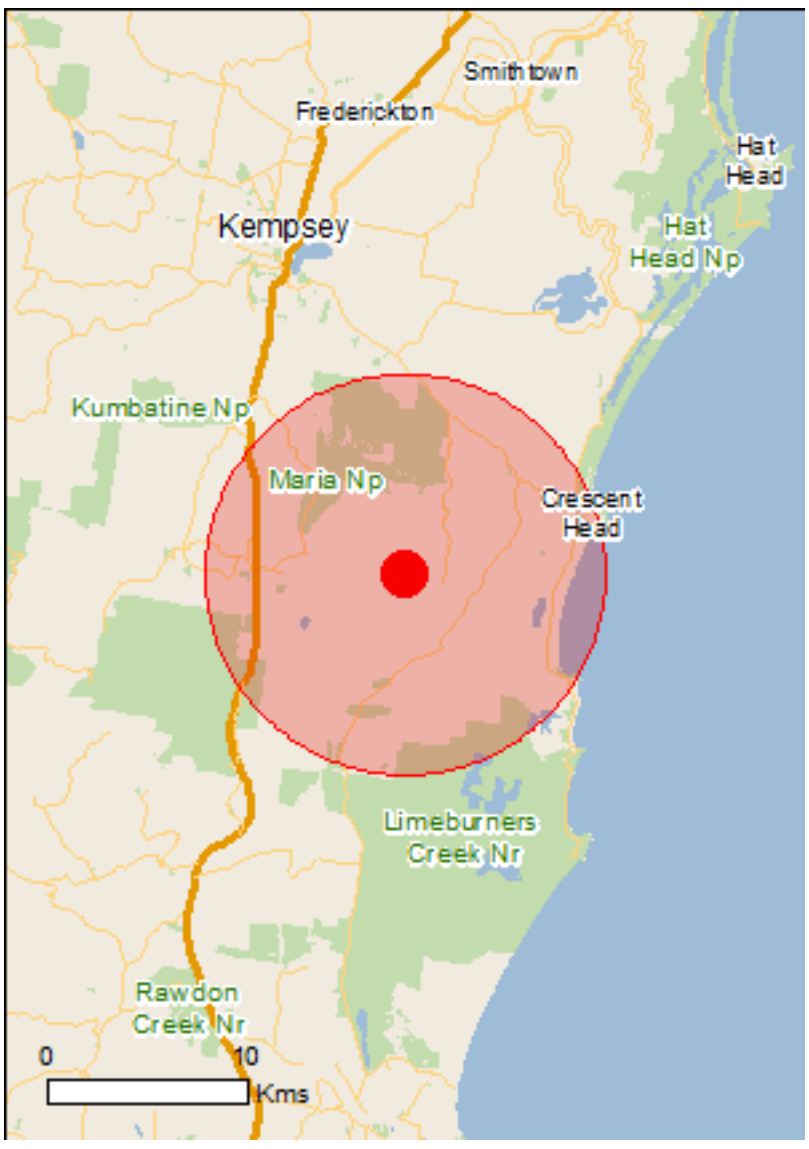
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

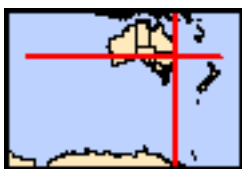
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 20/07/15 09:51:36



Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	54
Listed Migratory Species:	46

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	62
Whales and Other Cetaceans:	14
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	36
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans gibsoni Gibson's Albatross [82271]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta salvini Salvin's Albatross [82343]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mixophyes iteratus Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Allocasuarina defungens Dwarf Heath Casuarina [21924]	Endangered	Species or species habitat known to occur within area
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat known to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Parsonsia dorrigoensis Milky Silkpod [64684]	Endangered	Species or species habitat likely to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
[Thesium australe](#)		
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
[Caretta caretta](#)		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
[Chelonia mydas](#)		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
[Dermochelys coriacea](#)		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
[Eretmochelys imbricata](#)		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
[Natator depressus](#)		
Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Sharks		
[Carcharias taurus (east coast population)](#)		
Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat likely to occur within area
[Carcharodon carcharias](#)		
Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
[Rhincodon typus](#)		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#)		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
[Diomedea antipodensis](#)		
Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
[Diomedea dabbenena](#)		
Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
[Diomedea epomophora (sensu stricto)](#)		
Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
[Diomedea exulans (sensu lato)](#)		
Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea gibsoni](#)		
Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
[Diomedea sanfordi](#)		
Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
[Macronectes giganteus](#)		
Southern Giant-Petrel [1060]	Endangered	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Pandion cristatus Eastern Osprey [82411]		Breeding known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Solegnathus dunckeri Duncker's Pipehorse [66271]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		

Name	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Goolawah	NSW
Goolawah	NSW
Hat Head	NSW
Kumbatine	NSW
LNE Special Management Zone No1	NSW
Limeburners Creek	NSW
Maria	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		

Name	Status	Type of Presence
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area

Name	Status	Type of Presence
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Limeburners Creek Nature Reserve	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.21223 152.89119

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

bolwarra
environmental services

Monday, 6 February 2017

Mr Tim Mecham
Mid Coast Environmental Services
P0 Box 353
Kempsey 2440

Dear Sir,

Re: Kempsey Shire Council Comprehensive Koala Plan of Management Compliance for Proposed 3 Lot Subdivision of Lot 1 DP 196559, Beranghi Rd, Beranghi.

As per your request, we provide the following to demonstrate that future dwelling within the proposed development envelope on each proposed Lot can be established without triggering off the offset provisions of the CKPoM. We also comment on hollow-bearing trees and Allocasuarinas:

1 Background Information

1.1 Proposed Development

The proposed development is to establish a 3 Lot rural subdivision on the site with two lots of 150ha and one 162ha lot. Development envelopes 4ha (200m x 200m) in size have been identified in the east of each Lot fronting Beranghi Road where dwellings and Asset Protection Zones (APZs) will be located. These will be zoned '*E3 Environmental Management'* and the remainder of the Lots are designated as '*E2 Environmental Conservation*' areas under the Kempsey Shire Council Local Environmental Plan (LEP). An existing access to Maria River will also be designated a right of carriageway to allow all owners access to the river and thus avoid further track making.

On each Lot, a dwelling is to be established with an Asset Protection Zone (APZ) in each 4ha development envelope.

1.2 Assessment methodology

Kempsey Shire Council (KSC) require a demonstration that proposed subdivision can comply with the provisions of the CKPoM.

The site is mapped under the Comprehensive Koala Plan of Management (CKPoM) as having an individual Koala Plan of Management (IKPoM). This IKPoM accompanied the Development Application for a previous community title subdivision proposal (Darkheart 2002). This IKPoM however is no longer current as the previously approved development is no longer proceeding, and the provisions of the KSC CKPoM thus apply (KSC 2011, Biolink 2011).

The site has been previously determined to contain Potential Koala Habitat, and qualifies as Core Koala Habitat due to the presence of suitable food trees, identification of Koala scats and recent and historical sightings of Koalas on site (Darkheart 2002). Thus the proposal is assessed under the CKPoM provisions for land containing Core Koala Habitat.

The final compliance pathway would depend on whether KFTs are removed. As the proposal is a subdivision, loss of KFTs would trigger off area-based offsets under section 4.12 of the CKPoM.

To enable compliance with the CKPoM and given the E2 zoning of the majority of the property, all Koala food trees within the 4ha development envelopes on each Lot were located via a field survey (utilising a systematic belt transect) with trees >250mm diameter at breast height (over bark) flagged with tape and GPS located. This allowed confirmation that a future dwelling could be located on each Lot without requiring removal of any Koala Food Tree (KFT).

2 Compliance Assessment

2.1 Location of KFTs and Available Building Areas:

Figures 1-4 (attached) show the location of KFTs over each 4ha development lot.

A total of 280 KFTs were found. These primarily consisted of *E microcorys* (139) together with *E globoidea/E tindaliae* (137). Three *E seeana/tereticornis* (3) and one *E robusta* were also located.

As shown in these figures, there is available area for a dwelling on each Lot which avoids the requirement to remove any Koala Food Tree. Consequently, the proposal can demonstrate compliance with section 4.8 (a) of the CKPoM and not trigger off offset requirements; and must now demonstrate compliance with section 4.11.

2.2 Core Koala Habitat Performance Criteria Compliance Assessment

Section 4.11 of the CKPoM lists Performance Criteria for CKH. The proposal is assessed by these criteria to demonstrate compliance with the CKPoM in the following table:

Table 1: KSC CKPoM Compliance Assessment

Performance Criteria	Compliance Assessment
a) ensure there is no net loss of core koala habitat across the subject land;	All of the KFTs on site will be retained. Only a relatively small area of vegetation in the southeast corner of the site will be affected, with the remainder to be protected (about 450ha) under E2 zoning.
b) minimise the removal of any identified preferred Koala food trees, where they occur across the subject land;	The proposal will not remove any KFTs on the site as all structures and infrastructure must avoid/retain KFTs.
c) ensure such trees will not be negatively impacted by subsequent development works including the construction of buildings, associated infrastructure and/or provision of public utilities;	Figures 2-4 show there is adequate available area for a dwelling on each Lot to avoid the loss of any KFT. Any further vegetation removal on the development Lot must retain KFTs. KFTs occurring in proximity to the future dwellings, etc, and in the APZ are to be formally located pre-DA for these future dwellings; and flagged prior to the clearing/construction phase. Contractors to be instructed by proponent not to park under retained trees or store materials within the drip line.
d) ensure key linkages across the landscape are maintained, where they occur, to reduce the effects of habitat fragmentation;	Canopy retained across most of property, retaining linkage with similar vegetation to south and north on adjoining Lots.
e) comply with the Habitat Compensation Measures where relevant as per Section 4.12 of this plan;	Not applicable as all KFTs retained.

Performance Criteria	Compliance Assessment
f) where Onsite PKFT Tree Replacement Measures have been applied, as per Section 4.9 of this plan, measures to ensure the retention of replacement trees over time, which may include but are not limited to restrictions on title; and	Not applicable as all KFTs retained.
g) where Koala habitat and associated linkages are proposed to be retained on the development site to mitigate impacts, measures to ensure the protection of those areas in the long term, which may include but are not limited to restrictions on title;	Development Lots will be zoned E3 Environmental Management and residual land on site will be zoned E2 Environmental Conservation. This zoning ensures long-term protection and prohibits clearing of vegetation and RAMAs.
h) appropriate measures (ie erection of exclusion fencing) are to be in place to ensue Koalas are protected during site construction works. Should Koalas be found on site during clearing, construction or site works then provisions (i) and (j) in Section 4.11 apply.	Specific recommendations are provided in this report to ensure Koalas are not impacted during construction works.
i) Clearing of vegetation i. If clearing of certain vegetation is to occur following consideration of Section 4.8 of this plan, clearing for development purposes must not proceed until the area has been inspected for the presence of koalas and approval given in writing by a suitably qualified and/or accredited koala specialist. ii. Approval to proceed with the clearing of vegetation in accordance with this section is only valid for the day on which the inspection has been undertaken. iii. The koala specialist referred to in (i) above must remain on site during clearing of vegetation.	CKPoM measures will form a part of the Conditions of Consent
j) Protection of Koalas from undue disturbance	CKPoM measures will form a part of the Conditions of Consent
k) Swimming pools	CKPoM measures will form a part of the Conditions of Consent
l) Keeping of domestic dogs	CKPoM measures will form a part of the Conditions of Consent
m) Fencing	CKPoM measures will form a part of the Conditions of Consent
n) Road design standards	Not applicable – roads too short or limited maximum speed due to curvature and condition.
o) Rezoning	Development envelopes zoned E3; remainder zoned E2

3 Other Matters

3.1 Hollow-bearing trees

Darkheart (2014) recommended locating dwellings to avoid or minimise loss of hollow-bearing trees.

The envelopes have also been located to minimise loss of hollow-bearing trees. At most about 5 trees generally of low value (small hollows, and/or poorly formed) may require removal due to proximity to dwelling sites. Hollow-bearing trees are however very common in each 4ha lot, and form only a fraction of the total on the large property, the overwhelming majority of which is protected under E2 zoning.

3.2 Allocasuarinas

Darkheart (2014) recommended locating dwellings to minimise loss of Allocasuarinas due to their value as a food tree for the Glossy Black Cockatoo (Vulnerable – TSC Act 1995). Darkheart (2014) notes these trees are very common in the dry sclerophyll over the 462ha property; with localised clumps near watercourses; and not restricted to the proximity of the proposed development envelopes. During the original study in 2002-2004, many of these were only shrubs. They are now largely mature and hence producing fruit, and notably more abundant over the property then previously recorded.

To achieve APZ fuel loadings, some Allocasuarinas will be removed in the development envelopes. Due to existing canopy cover, no large dense patches are impacted. Most trees are low density. The higher density patches (eg. along watercourses) are retained with the overwhelming majority of this habitat component for the Glossy Black Cockatoo in the E2 zone which dominates the property.

This loss thus equates to a relatively minute fraction of this habitat component over the subject land (which overall now largely consists of mature trees), and hence will not significantly impact the breeding success of a local population of Glossy Black Cockatoo. Hence the conclusion of Darkheart (2014) remains valid.

3.3 Conclusion

The above confirms the proposal can comply with the KSC CKPoM and no offset is required; and a significant impact is unlikely, hence a Species Impact Statement is not required.

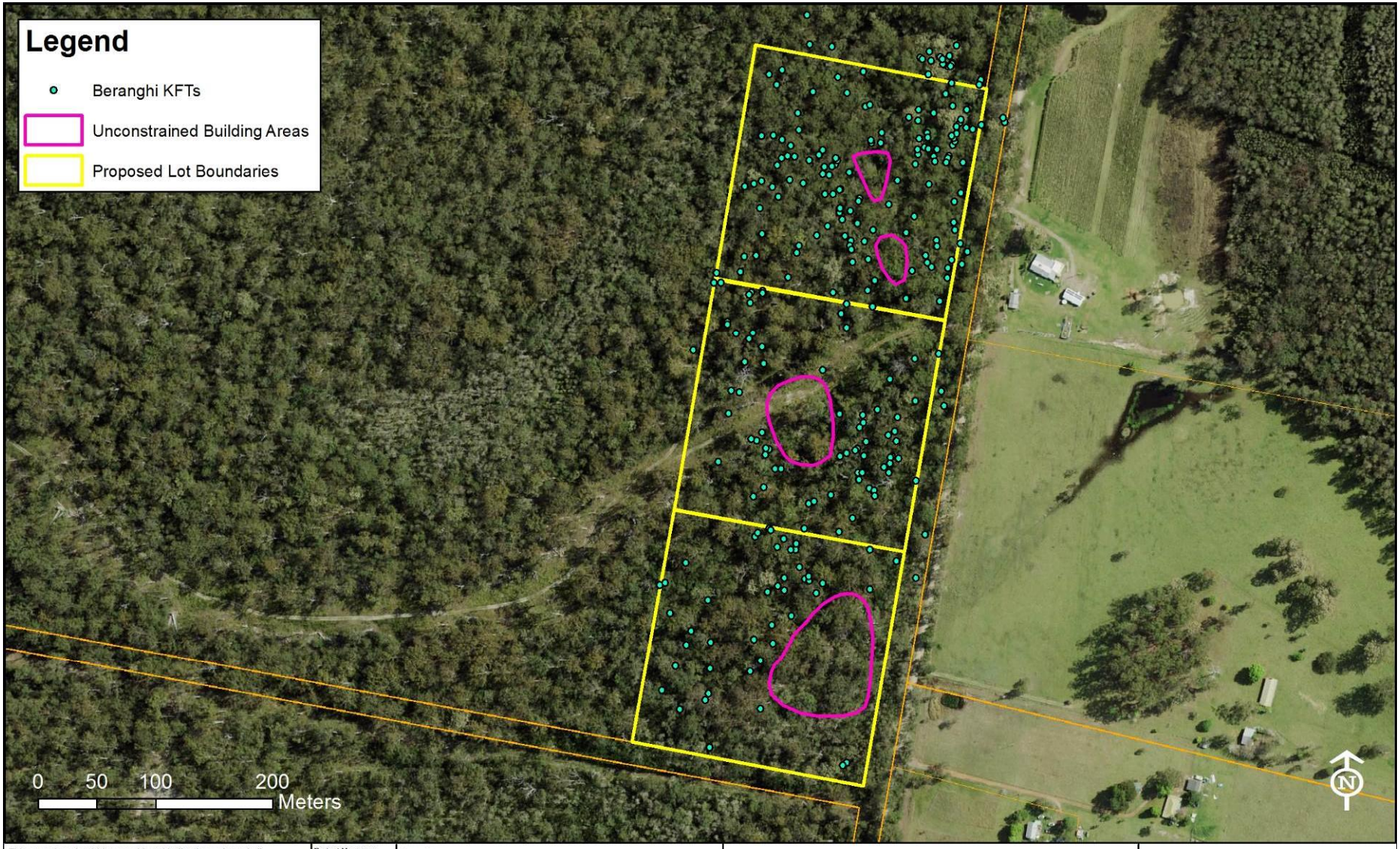
Yours faithfully,

Matthew Bailey.
Principal Ecologist, BES

Attachments:

1-4: KFT maps.

Figure 1: KFTs and lot layout



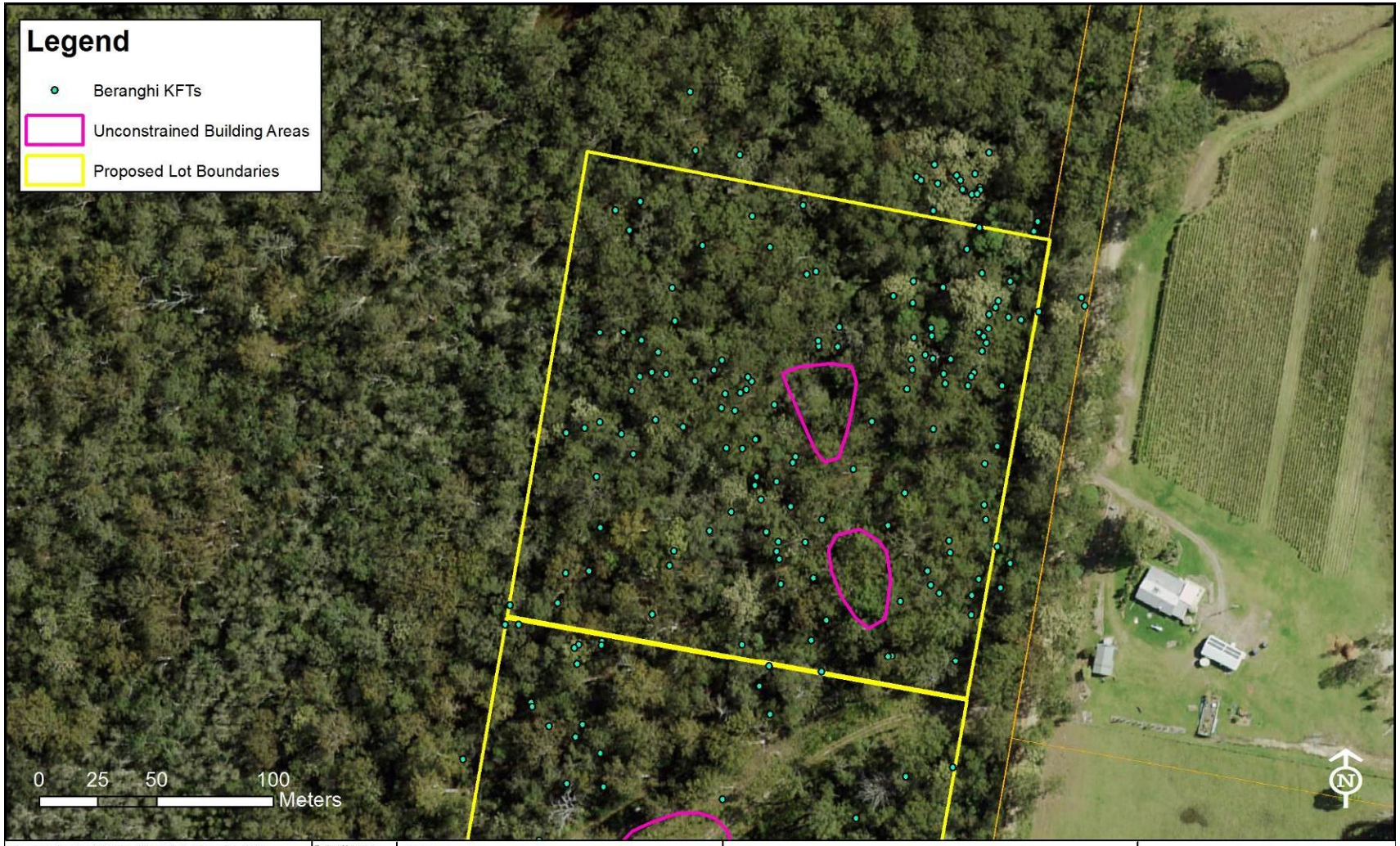
This mapping should be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Bolwarra Environmental Services (BES) which may not have been independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. BES takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: MB	Figure Name: Lot KFT's and unconstrained Building Areas
Drawn By: MB	
Date: 24-Nov-2016	Site: Lot 1 DP 196559, Beranghi Rd, Beranghi
Map Projection: MGA256	
Map Datum: GDA94	Client: Tim Mecham
Page: 1 of 1	

bolwarra environmental services

Scale:	Job Number:	Revision:
1 :3,000	xx	A

Figure 2: Lot 1 building area and KFTs



This mapping should be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Bolwarra Environmental Services (BES) which may not have been independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. BES takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager: MB	Figure Name: Lot KFT's and unconstrained Building Areas
Drawn By: MB	
Date: 24-Nov-2016	Site: Lot 1 DP 196559, Beranghi Rd, Beranghi
Map Projection: MGAz56	
Map Datum: GDA94	Client: Tim Mecham
Page: 1 of 1	

bolwarra environmental services

Scale:	Job Number:	Revision:
1:3,000	xx	A

Figure 3: Lot 2 Building Area and KFTs

Figure 4: Lot 3 Building Area and KFTs

This mapping should be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Bolwarra Environmental Services (BES) which may not have been independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, etc should be placed upon this map without independent validation of the information by the user. BES takes no responsibility for any subsequent errors, losses, etc that may arise from use of this data without independent verification.

Project Manager:	MB
Drawn By:	MB
Date:	24-Nov-2016
Map Projection:	MGAz56
Map Datum:	GDA94
Page:	1 of 1
Figure Name:	Lot KFT's and unconstrained Building Areas
Site:	Lot 1 DP 196559, Beranghi Rd, Beranghi
Client:	Tim Mecham

bolwarra environmental services

Scale:	Job Number:	Revision:
1 :3,000	xx	A

BUSHFIRE HAZARD ASSESSMENT

3 x Lot Subdivision and 3 x New Dwellings

No Lot 1 DP 196559
Beranghi Road
Crescent Head

Client:

Mr M L Corbet & J Phillips

Date:

August 2015

TABLE OF CONTENTS

41 Belgrave Street, Kempsey NSW 2440 – PO Box 353 Kempsey NSW 2440 – phone 0265631292 – mecham@bigpond.com – ABN 32098436812

1.0 INTRODUCTION

As requested a Bushfire Risk Assessment has been carried out for the proposed subdivision at Lot 1 D.P 196559 Beranghi Road, Crescent Head

This report is based on a site assessment carried out on the ////////////

The report is to demonstrate that bushfire risk is manageable. The development would be an integrated development and has a requirement for a Bushfire Safety Authority under Section 100B of the *Rural Fires Act 1997*.

NOTE

The report has been prepared with all reasonable skill, care and diligence.

The information contained in this report has been gathered from field survey, experience and has been completed in consideration of the following legislation.

1. Rural Fires Act 1997.
2. Environmental Planning and Assessment Act 1979.
3. Building Code of Australia.
4. Council Local Environment Plans and Development Control Plans where applicable.
5. NSW Rural Fire Services, Planning for Bushfire Protection, 2006. (PfBP, 2006)
6. AS 3959-2009 Construction of Buildings in Bushfire Prone Areas.

The report recognizes the fact that no property and lives can be guaranteed to survive a bushfire attack. The report examines ways the risk of bushfire attack can be reduced where the subdivision site falls within the scope of the legislation.

The report is confidential and the writer accepts no responsibility of whatsoever nature, to third parties who use this report or part thereof is made known. Any such party relies on this report at their own risk.

1.1 Objectives

The objectives of this report are to:

- Ensure that the proposed subdivision meets the aims and objectives of NSW Rural Fire Services, *Planning for Bushfire Protection*, 2006 and has measures sufficient to minimize the impact of bushfires; and
- Reduce the risk to property and the community from bushfire; and
- Comply where applicable with AS3959 – 2009.

1.2 Legislative Framework

In NSW, the bushfire protection provisions of the BCA are applied to Class 1, 2, 3, Class 4 parts of buildings, some Class 10 and Class 9 buildings that are Special Fire Protection Purposes (SFPPs).

The BCA references AS3959 – 2009 as the deemed-to-satisfy (DTS) solution for construction requirements in bushfire prone areas for NSW.
All development on bushfire prone land in NSW should comply with the requirements of Addendum Appendix 3 and other bushfire protection measures identified within PfBP, 2006.

The proposed subdivision is required to obtain a bushfire safety authority from the NSW Rural Fire Service.

1.3 Location

The site is located at Lot 1 D.P 196559 Beranghi Road, Crescent Head.

The site is located 16.1km southeast of Kempsey and approximately 6km along Beranghi Road from Crescent Head Road. Crescent Head Road leads to Kempsey.

All the above mentioned roads are public roads.

Locality – Crescent Head
Local Government Area – Kempsey Shire Council
Closest Rural Fire Service – Crescent Head
Closest Fire Control Centre – Kempsey

The site location of the proposed dwelling can be seen in **Figure 1** and **Figure 2** below:

Figure 1 – Topographic Map

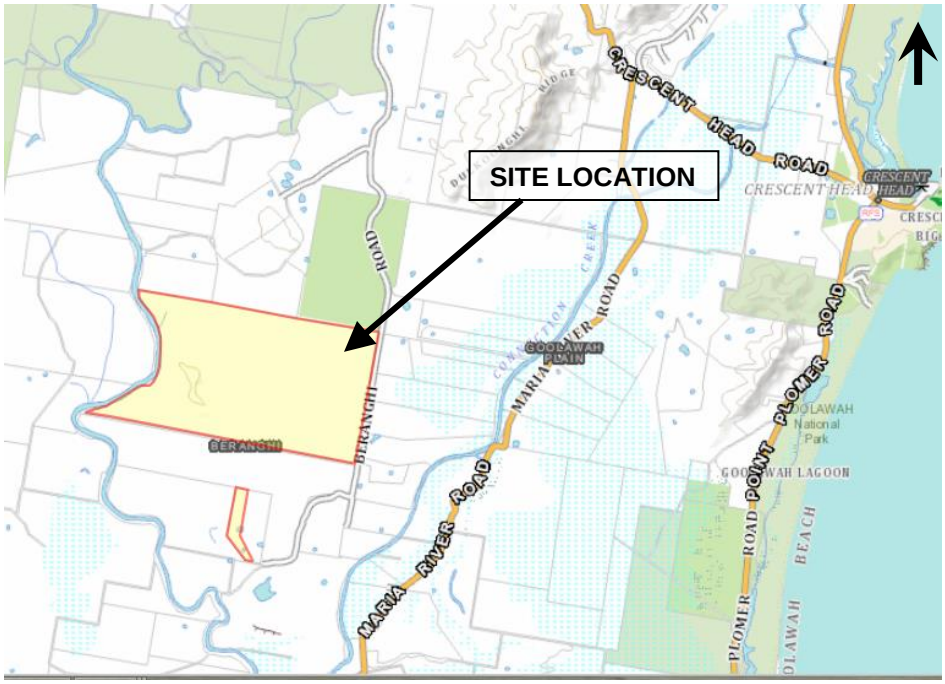
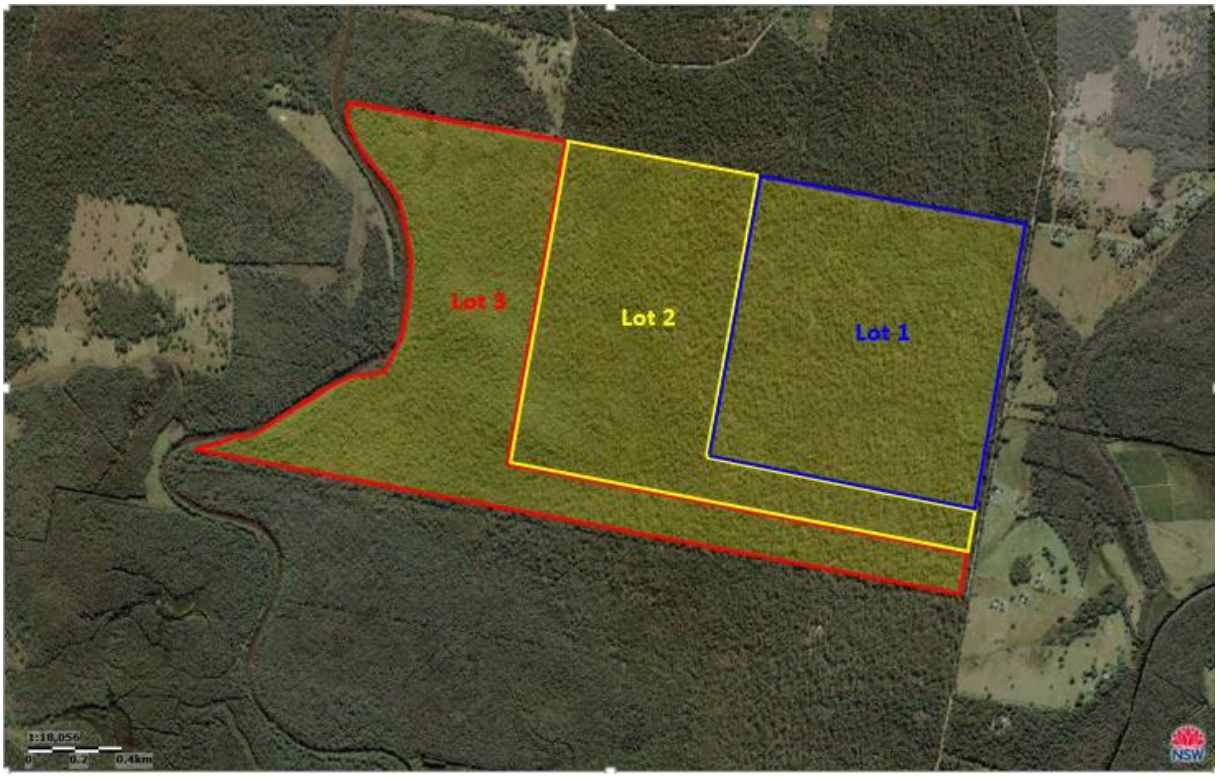


Figure 2 – Aerial View

Figure 3: Aerial View Close Up showing the Proposed Lots



1.4 Development Proposal and History

The subject site is 445ha in size.

From the site inspections it appears that the block has been used for logging purposes with some areas of the lot subjected to heavy logging.

It is proposed to subdivide Lot 1 into a three lot subdivision to be known as Lot 1, Lot 2 and Lot 3.

The subdivision layout can be seen in **Appendix 1**.

2.0 BUSHFIRE HAZARD ASSESSMENT

2.1 Assessment Methodology

Several factors need to be considered in determining the bushfire hazard.

These factors are slope, vegetation type, and distance from hazard, access/egress and fire weather.

Each of these factors has been reviewed in determining the bushfire protection measures which are applicable to the subject site and proposed development.

The assessment of slope and vegetation being carried out in accordance with Appendix 2 and Appendix 3 of NSW Rural Fire Service, *Planning for Bushfire Protection*, 2006 and Section 2 of AS 3959 - 2009.

2.2 Slope Assessment

Slope is a major factor to consider when assessing the bushfire risk.

The slopes affecting the proposed dwelling were measured using a Suunto PM-5/360 PC Clinometer.

The hazard vegetation on adjacent land was also identified and the slopes within the vegetation measured.

The following table shows the results:

Table 1 – Hazard Vegetation Slopes

Proposed Lot 1	Hazard Aspect	Slope	Upslope/Downslope or Flat
	North	0°	Flat/Upslope
	East	0°	Flat/Upslope
	South	0°	Flat/Upslope
	West	0°	Flat/Upslope

Proposed Lot 2	Hazard Aspect	Slope	Upslope/Downslope or Flat
	North	0°	Flat/Upslope
	East	0°	Flat/Upslope
	South	0°	Flat/Upslope
	West	0°	Flat/Upslope

Proposed Lot 3	Hazard Aspect	Slope	Upslope/Downslope or Flat
	North	0°	Flat/Upslope
	East	0°	Flat/Upslope
	South	0°	Flat/Upslope
	West	0°	Flat/Upslope

2.3 Vegetation Assessment

The vegetation on and surrounding the subject site was assessed over a distance of 140m. The vegetation formations were classified using the system adopted as per Keith (2004) initially for the Asset Protection Zone calculation and then converting Keith to Specht using Table A3.5.1 of Appendix 3 (2010) for assessment of the Bushfire Attack Level.

2.3.1 Vegetation on and Adjoining/Adjacent to the Subject Lot

The block is predominantly Dry Sclerophyll Forest, however the block also contains pockets of Wet Sclerophyll Forest and Swamp Forest.

To the east the lot fronts Beranghi Road then across the road there is farmland for grazing which for the purpose of this report will be considered grassland.

A full vegetation assessment was completed in the ecological assessment and these details have been included in the Bushfire Management Plan.

In regard to the proposed lots 1, 2 and 3 there is to be proposed a 200 metre x 200 metre APZ to the front of each lot adjoining Beranghi Road. To the north, south and west there is forest. To the east the lots front Beranghi Road then across the road is farm land which for the purpose of this report will be considered grassland.

The following table details the hazards for the proposed lots:

Table 2 – Hazard Vegetation

Proposed Lot 1	Hazard Aspect	Vegetation
	North	Forest
	East	Grassland
	South	Forest
	West	Forest

Proposed Lot 2	Hazard Aspect	Vegetation
	North	Forest
	East	Grassland
	South	Forest
	West	Forest

Proposed Lot 3	Hazard Aspect	Vegetation
	North	Forest
	East	Grassland
	South	Forest
	West	Forest

2.4 Hazard

The hazards are located to the north, south, east and west.

The hazard vegetation can be seen in ***Figure 4*** below:

Figure 4: Hazards

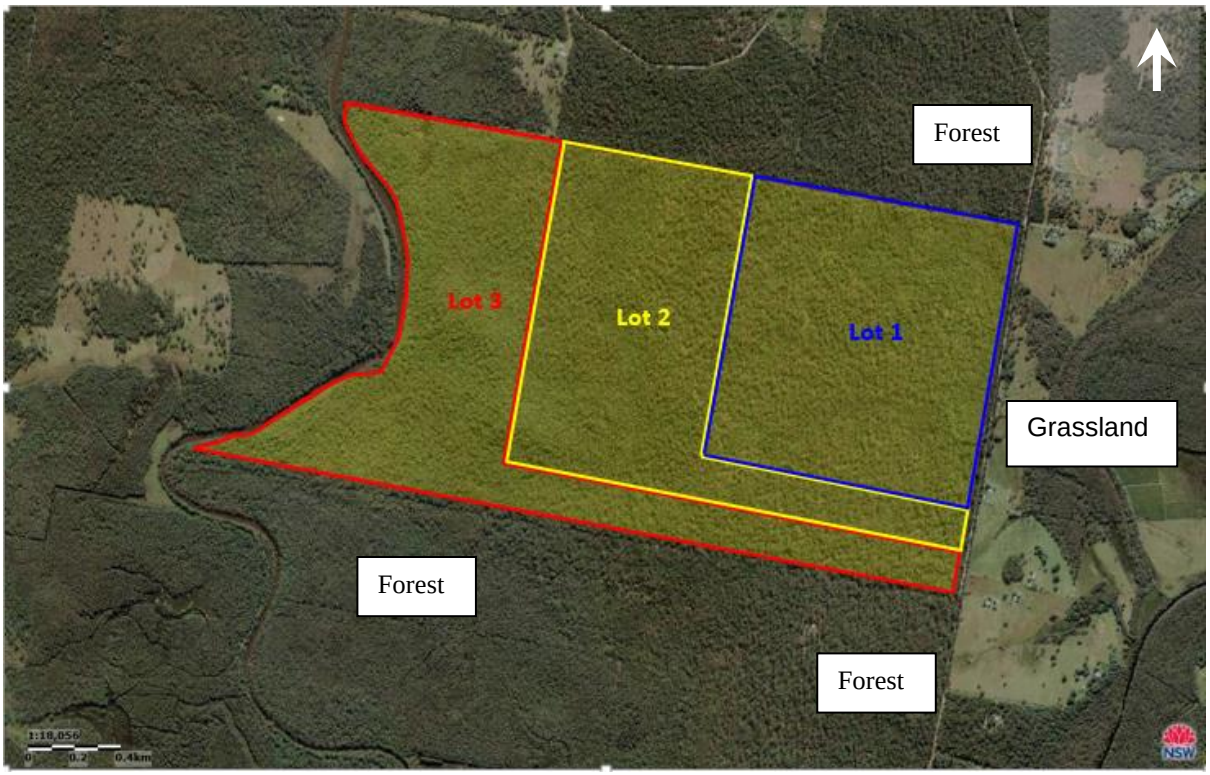


Table 3 – Summary of Hazard Characteristics

Proposed Lot 1	Hazard Aspect	Hazard	Slope	Upslope/Downslope or Flat	Distance from Subdivision to Hazard
	North	Forest	0°	Flat/Upslope	
	East	Grassland	0°	Flat/Upslope	
	South	Forest	0°	Flat/Upslope	
	West	Forest	0°	Flat/Upslope	

Proposed Lot 2	Hazard Aspect	Hazard	Slope	Upslope/Downslope or Flat	Distance from Subdivision to Hazard
	North	Forest	0°	Flat/Upslope	
	East	Grassland	0°	Flat/Upslope	
	South	Forest	0°	Flat/Upslope	
	West	Forest	0°	Flat/Upslope	
Proposed Lot 3	**Hazard Aspect**	**Hazard**	**Slope**	**Upslope/Downslope or Flat**	**Distance from Subdivision to Hazard**
	North	Forest	0°	Flat/Upslope	
	East	Grassland	0°	Flat/Upslope	
	South	Forest	0°	Flat/Upslope	
	West	Forest	0°	Flat/Upslope	

2.5 Fire Danger Index

The fire weather for the site is assumed on the worst-case scenario. In accordance with NSW Rural Fire Services, PfBP, 2006 and Table 2.1 of AS3959 - 2009, the fire weather for the site is based upon the 1:50 year fire weather scenario and has a Fire Danger Index (FDI) of 80.

3.0 BUSHFIRE THREAT REDUCTION MEASURES

3.1 NSW Rural Fire Services, *Planning for Bushfire Protection*, 2006

The following provisions of PfBP 2006 have been identified:

3.1.1 Defendable Space/Asset Protection Zone (APZ)

To ensure that the aims and objectives of NSW Rural Fire Services, PfBP, 2006, a defendable space between the asset and the hazard should be provided. The defendable space provides for, minimal separation for safe fire fighting, reduced radiant heat, reduced influence of convection driven winds, reduced ember viability and dispersal of smoke.

The proposed development is not considered to be subject to the Special Fire Protection Purpose requirements which are applicable to schools, (the proposed development is not a school).

It is recommended that the defendable space for the proposed development be based upon the minimum requirements for Asset Protection Zones as set out in NSW Rural Fire Services, *Planning for Bushfire Protection*, 2006.

Table 4 - APZ Requirements (PfBP 2006) for the Proposed Lots of the Subdivision

Lot 1

Proposed Lot 1	Hazard Aspect	Vegetation Type	Slope	IPA	OPA	Total APZ Required (IPA + OPA)	Total APZ Proposed
	North	Forest	0°	11m	10m	21m	100m
	East	Grassland	0°			8m	100m
	South	Forest	0°	11m	10m	21m	500m
	West	Forest	0°	11m	10m	21m	100m

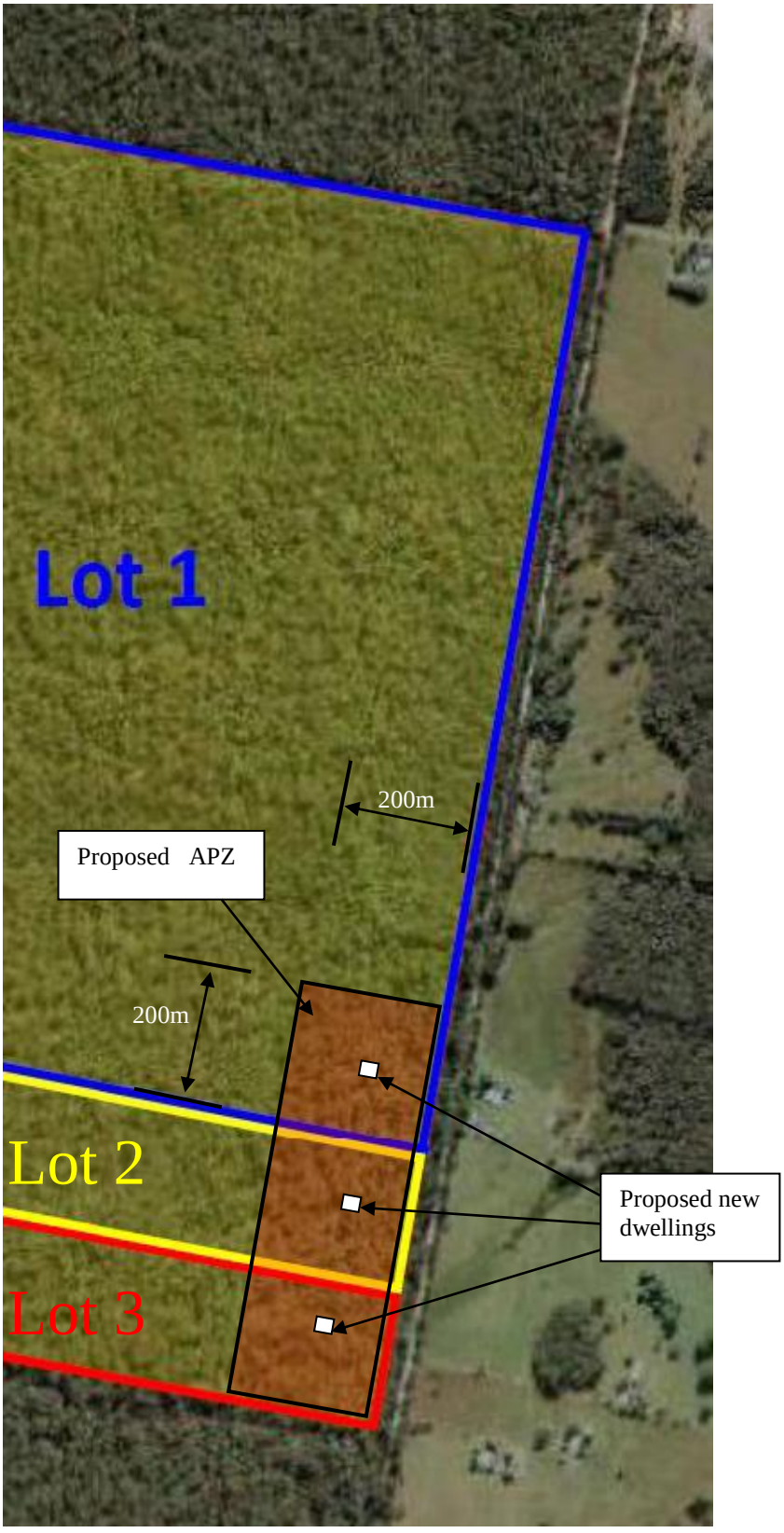
Lot 2

Proposed Lot 2	Hazard Aspect	Vegetation Type	Slope	IPA	OPA	Total APZ Required (IPA + OPA)	Total APZ Proposed
	North	Forest	0°	11m	10m	21m	300m
	East	Grassland	0°			8m	100m
	South	Forest	0°	11m	10m	21m	300m
	West	Forest	0°	11m	10m	21m	100m

Lot 3

Proposed Lot 3	Hazard Aspect	Vegetation Type	Slope	IPA	OPA	Total APZ Required (IPA + OPA)	Total APZ Proposed
	North	Forest	0°	11m	10m	21m	500m
	East	Grassland	0°			8m	100m
	South	Forest	0°	11m	10m	21m	100m
	West	Forest	0°	11m	10m	21m	100m

Proposed APZ and Dwelling Locations



See **Appendix 2** for the Asset Protection lines (i.e. BAL-29 contour lines).

3.1.2 Operational Access and Egress

Access to and egress from each of the proposed lots will be Beranghi Road.

It is considered that the relevant acceptable solutions as provided for by 4.1.3 of NSW Rural Fire Service, PfBP, 2006 are capable of being complied with and as such the intent for the provisions of services can be achieved.

3.1.3 Services - Water, Gas and Electricity

As set out in Section 4.1.3 of NSW Rural Fire Services**,** *Planning for Bushfire Protection*, 2006, developments in bushfire prone areas must maintain a water supply for fire fighting purposes.

Electricity supply is available and will be connected to the subdivision site.

Reticulated water supply is not available to the subject site. A Water Supply for Fire Fighting of 20,000 litres in accordance with Fast Fact 3/08 and Planning for Bushfire Protection, 2006 is to be provided for the dwelling (See **Appendix 3).**

Any tanks will require the following at a minimum.

- A suitable connection for firefighting purposes is made available and located within the IPA and away from the structure. A 65mm Storz outlet with a Gate or Ball valve is provided.
- Gate or Ball valve and pipes are adequate for water flow and are metal rather than plastic.
- Underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank. A hardened ground surface for truck access is supplied within 4 metres of the access hole.
- Above ground tanks are manufactured of concrete or metal and raised tanks have their stands protected. Plastic tanks are not used. Tanks on the hazard side of a building are provided with adequate shielding for the protection of fire fighters.
- All above ground water pipes external to the building are metal including and up to any taps.
- Pumps are shielded.

The use of heavy-duty hoses with wide spray nozzles is recommended with hoses able to reach all parts of any dwelling.

Bottled gas supplies are to be installed and maintained in accordance AS 1596. Metal piping is to be used. All fixed gas cylinders are to be kept clear of all flammable materials to a distance of 10m and shielded on the hazard side of the installation. If gas cylinders need to be located close to the building, the release valves are to be directed away from the building and at least 2 metres away from any combustible material so they do not act as a catalyst to combustion. Connections to and from gas cylinders are metal.

It is considered that the relevant acceptable solutions as provided for by 4.1.3 of NSW Rural Fire Services, PfBP, 2006 are capable of being complied with and as such the intent for the provision of services can be achieved.

3.1.4 Landscaping

Landscaping is a major cause of fire spreading to buildings, and therefore any landscaping proposed in conjunction with the proposed development will need consideration when planning, to produce gardens that do not contribute to the spread of a bushfire.

When planning any future landscaping surrounding any proposed building or subdivision, consideration should be given to the following:

- The choice of vegetation – consideration should be given to the flammability of the plant and the relation of their location to their flammability and on going maintenance to remove flammable fuels.
- Trees as windbreaks/firebreaks – Trees in the landscaping can be used as windbreaks and also firebreaks by trapping embers and flying debris.
- Vegetation management – Maintain a garden that does not contribute to the spread of bushfire.
- Maintenance of property – Maintenance of the property is an important factor in the prevention of losses from bushfire.

Appendix 5 of NSW Rural Fire Services, *Planning for Bushfire Protection*, 2006, contains standards that are applicable to the provision and maintenance of landscaping. Any landscaping proposed to be undertaken in conjunction with the proposed development is to comply with the principles contained in Appendix 5 of NSW Rural Fire Services, PfBP, 2006.

Compliance with Appendix 5 of NSW Rural Fire Services, PfBP, 2006, will satisfy the intent of the bush fire protection measures that are applicable to the provision of landscaping.

3.2 Construction of Buildings

3.2.1 General

The deemed-to-satisfy provisions for construction requirements are detailed in AS 3953-2009. The relevant Bushfire Attack Level and Construction Requirements have been determined in accordance with Appendix 3 (2010) of PfBP, 2006 and Section 2 of AS 3959-2009. The additional construction requirements with respect to A3.7 of Appendix 3 (2010) of PfBP (2006) are required to be added to the standards for each Bushfire Attack Level.

3.2.2 Vegetation

To complete the assessment under AS 3959-2009 the vegetation, as originally assessed in accordance with Keith, has to be converted to Specht.

The following table shows the conversion:

Table 4 – Summary of Vegetation Characteristics

Vegetation Classification – (Keith, 2004)	Vegetation Classification – (AUSLIG 1990)
Forest	Forest
Grassland	Grassland

3.2.3 AS3959 – 2009 Construction of Buildings in Bushfire Prone Areas

The following construction requirements in accordance with AS 3959 – 2009 Construction of Buildings in Bushfire Prone Areas is required for the bushfire attack categories.

Bushfire Attack Level (BAL)
BAL - LOW No construction requirements under AS 3959-2009
BAL - 12.5
BAL - 19
BAL - 29
BAL - 40
BAL - FZ

Compliance with these requirements will ensure that any new dwelling complies with the requirements of AS3959-2009 Construction of Buildings in Bushfire Prone Areas, for the siting, design and construction.

4.0 REQUIREMENTS

The following requirements are considered to be integral to this bushfire risk assessment:

1. An Asset Protection Zones as detailed in Section 3.1.1 of this report are to be provided.
2. The proposed subdivision is to comply with the relevant performance criteria/acceptable solutions as provided for by Section 4.1.3 of NSW Rural Fire Services**,** PfBP, 2006.
3. Adopt landscaping principals in accordance with Section 3.1.4 of the NSW Rural Fire Services, PfBP, 2006.

5.0 CLAUSE 44 CONSIDERATIONS

Table 5

Environmental/Heritage Feature	**Comment**
Riparian Corridor	Not considered in this report
SEPP 14 – Coastal Wetland	Not considered in this report
SEPP 26 – Littoral	Not considered in this report
SEPP 44 – Koala Habitat	Not considered in this report
Areas of geological interest	Not considered in this report
Environment protection zones	Not considered in this report
Land slip	Not considered in this report
Flood prone land	Not considered in this report
National Park Estate or other reserves	Not considered in this report
Threatened Species, populations, endangered ecological communities and critical habitat	Not considered in this report
Aboriginal Heritage	Not considered in this report

6.0 CONCLUSION

It is suggested that with the implementation of this report, and its recommendations, that the bushfire risk is manageable and will be consistent with the acceptable bushfire protection measure solutions, provided for in Section 4.3.5 of NSW Rural Fire Services, PfBP, 2006.

The report provides that the required APZ's can be achieved and that any proposed new dwelling can be constructed so as to comply with the requirements of AS 3959-2009 and Appendix 3 of PfBP, 2006, Construction of Buildings in Bushfire Prone Areas.

This report is however contingent upon the following assumptions and limitations:

Assumptions

1. For a satisfactory level of bushfire safety to be achieved, regular inspection and testing of proposed measures, building elements and methods of construction, specifically nominated in this report, is essential and is assumed in the conclusion of this assessment.

2. There are no re-vegetation plans in respect to hazard vegetation and therefore the assumed fuel loading will not alter.

3. It is assumed that the building works will comply with the DTS provisions of the BCA including the relevant requirements of Australian Standard 3959 – 2009.

4. The proposed development is constructed and maintained in accordance with the risk reduction strategy in this report.

5. The vegetation characteristics of the subject site and surrounding land remains unchanged from that observed at the time of inspection.

Limitations

1. The data, methodologies, calculations and conclusions documented within this report specifically relate to the proposed subdivision and must not be used for any other purpose.

2. A reassessment will be required to verify consistency with this assessment if there is any alterations and/or additions, or changes to the risk reduction strategy contained in this report.

Regards

Tim Mecham
Midcoast Building and Environmental

7.0 REFERENCES

NSW Rural Fire Services, ***Planning for Bushfire Protection***, 2001

NSW Rural Fire Services, ***Planning for Bushfire Protection***, 2006

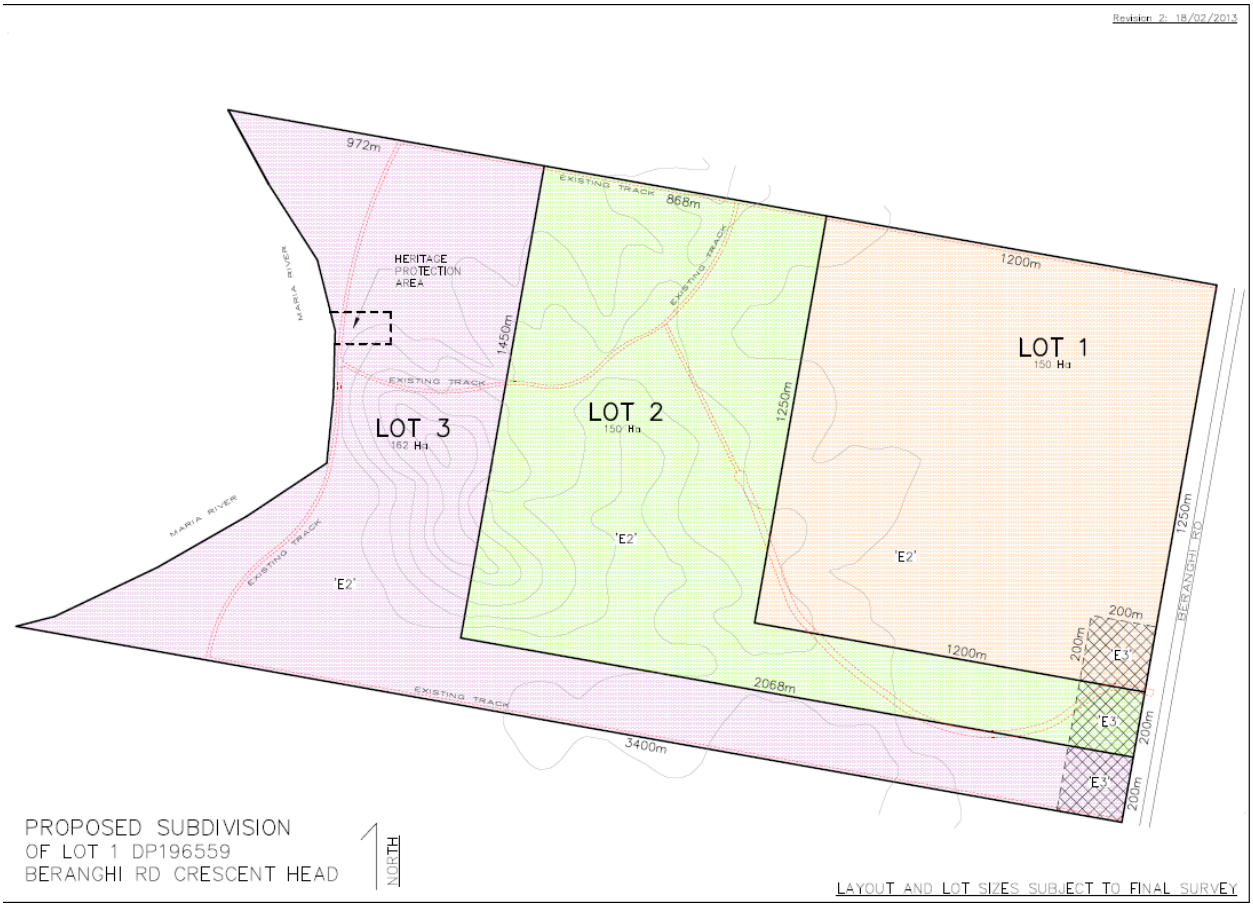
AS 3959-2009 ***Construction of Buildings in Bushfire Prone Areas***

Keith David 2004, Ocean ***Shores to Desert Dunes, The Native Vegetation of New South Wales and the ACT***, Department of Environment and Conservation

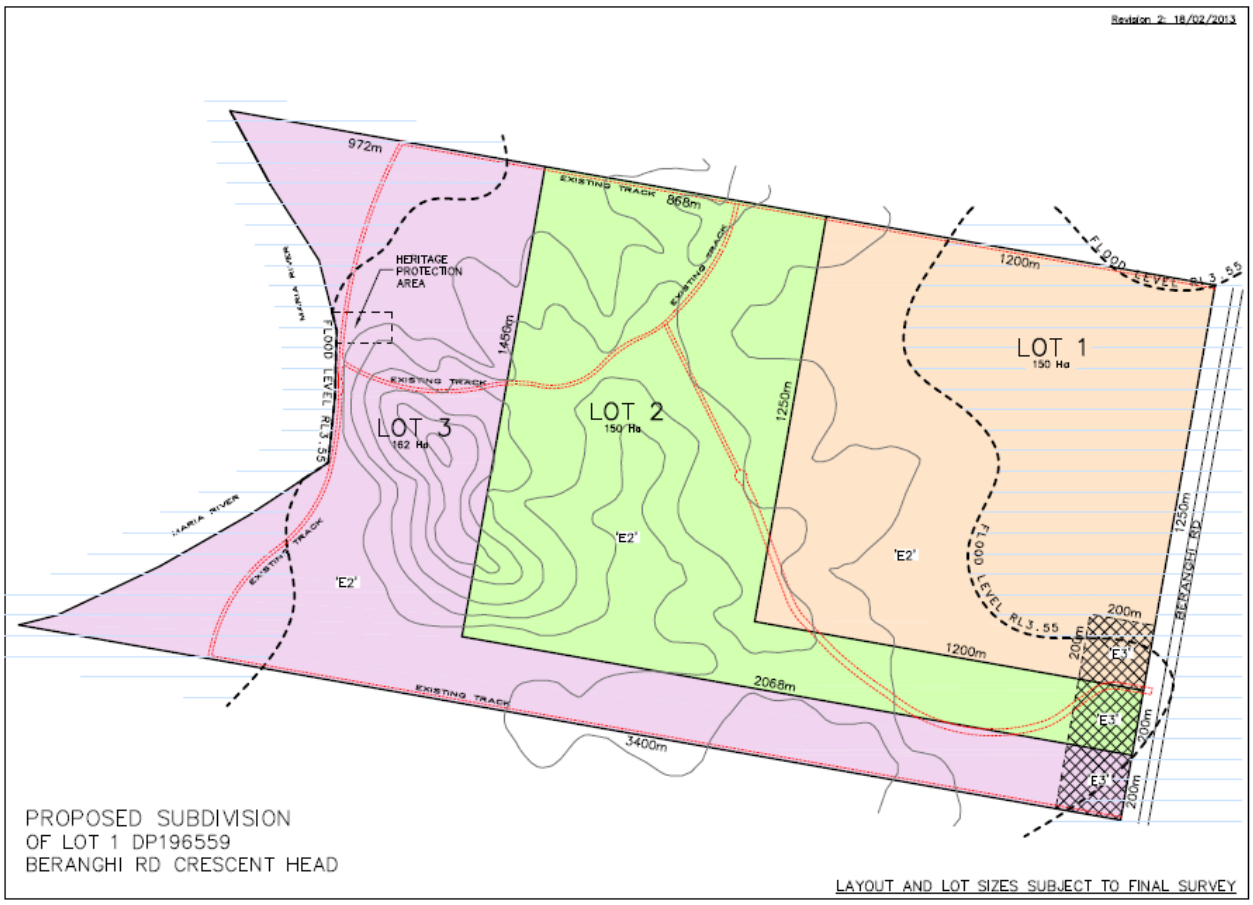
NSW State Government (1997) Rural Fires Act 1997

NSW Rural Fire Service – ***Guideline for Bushfire Prone Land Mapping 2002***

APPENDIX 1: Subdivision Layout



With Flood Levels



APPENDIX 2: BAL-29 Contour Lines

Appendix 3

NSW RURAL FIRE SERVICE

COMMUNITY RESILIENCE FAST FACTS 3/08

Water Supply for Fire Fighting Purposes

This Fast Fact clarifies the NSW Rural Fire Service (RFS) position on the requirement for water supplies for development in bush fire prone areas.

Adequate water supply is critical for effective fire fighting. Where a non reticulated water supply is provided or the reticulated water supply is deemed inadequate, an additional onsite stored supply of water for fire fighting will be required. Non reticulated water is a supply that is not piped by council or a water authority and includes rainwater, ground water or surface water.

In the past, additional water sources could take the form of a static water supply (SWS) or a dedicated water supply. The RFS has traditionally required that an alternate supply of water be 'dedicated' for fire fighting purposes in line with the provisions of *Planning for Bush Fire Protection* 2006 (PBP). Dedicated water implies that the supply shall be in the form of a tank of water and has traditionally not included swimming pools or dams. The term also implies that the supply must be isolated from other domestic water supplies and used solely for fire fighting purposes.

From a practical fire fighting point of view, any source of available water will be utilised during a bush fire event and dedicated tanks are not always the most practical option.

In light of the above and the increasing demand for sustainable and efficient use of our water resources, the RFS will no longer require water to be solely 'dedicated' for fire fighting purposes and will allow more flexibility in satisfying the water requirements of PBP. As such, water holding structures such as tanks, swimming pools and dams can be considered.

Therefore, the RFS conditions addressing water supply will no longer refer to a 'dedicated' water supply and will simply state that a supply of water shall be provided for 'fire fighting purposes'. This position will also apply to previously issued conditions referring to dedicated supplies. As such, the water source can be used for other purposes and allow for the circulation of fresh water. The onus will be on the property owner to provide suitable water supply arrangements for fire fighting that meet the RFS requirements and ensure that any water sources are maintained at the appropriate capacity (see Table 4. of PBP).

Water capacities, access (tanker or pedestrian) for fire fighters and the provision of appropriate connections should also be considered when determining if a proposed water source is suitable. Furthermore, the property owner is encouraged to place a 'SWS' sign in a visible location on the street front.

PREPARE. ACT. SURVIVE. | www.rfs.nsw.gov.au

Version 3 – February 2012

The archaeological investigation for sites of
Indigenous cultural significance on

Lot 1, DP 196559

Beranghi Road

Crescent Head, Mid-north Coast, NSW

John Appleton

ARCHAEOLOGICAL SURVEYS & REPORTS PTY LTD

JULY 2002

for

Robert Dennis & Assoc.

on behalf of

Mr M.L. Corbett of Kempsey

ASR

**This report has been compiled in 'Plain English',
but presented in a format suitable for developing policies
for the management of the cultural resources,
and as a basis for scientific reference
in future research studies.**

ARCHAEOLOGICAL SURVEYS & REPORTS Pty Ltd

Proponent

Robert Dennis & Assoc.
PO Box 61
Crescent Head 2440
02 6566 0380

on behalf of

Mr M.L. Corbett
PO Box 611
Kempsey 2440

Copies of this report to

Archaeologist
NPWS Northern Zone
PO Box 914
Coffs Harbour 2450
02 6651 5946

The Chairperson
Kempsey Local Aboriginal Land Council

Kempsey 2380
02 6742 3602

All inquiries in regard to this report should be addressed to

John Appleton
Archaeological Surveys & Reports Pty Ltd
10 Roslyn Avenue
Armidale 2350
Tel./Fax. 02 6772 6512
Mobile: 0428 651 789
Email. japples@northnet.com.au

EXECUTIVE SUMMARY

This investigation and assessment was performed for Robert Dennis & Associates, on behalf of Mr M.L. Corbett, who proposes to subdivide Lot 1, DP196559, Beranghi Road, Crescent Head.

The scope of the work was to conduct an archaeological investigation of Lot 1 with the assistance of a representative/s of the Kempsey Local Aboriginal Land Council, and to identify any Aboriginal sites and relics that might be present. The results of the investigation were to be presented in a report, which was to include an assessment of the significance of any cultural relics or places identified, an appraisal of the options and opportunities arising from the discoveries, and clear recommendations for the management of those cultural resources.

No Indigenous relics or sites were identified in the survey area, however, the Kempsey LALC have recommended that any excavations associated with the proposed subdivision should be monitored.

While the land council's recommendations are considered to be reasonable they would be difficult to implement without some defined limits and time frame. It is therefore recommended that the works to be monitored are the earthworks for any in-ground services and drainage associated with the construction of the subdivision road (which runs down the centre of the survey area – see Figure 3) and the headworks. It is suggested that the proponents should consider programming the work so that the monitoring by Kempsey LALC can be achieved in the minimum time, both for work safety and economic reasons. The developer should give the Kempsey LALC seven days notice of the commencement of works to allow them time to organise a monitor.

Although the investigation has not identified any sites of either Indigenous or heritage significance that will be impacted upon by the proposed works the proponents are advised that the following provisions should be observed:

All developers, contractors and their employees are bound by the provisions of the National Parks and Wildlife Act 1974 as amended, which was in part designed to mitigate impact to the Indigenous archaeological record.

Under the provisions of the National Parks and Wildlife Act 1974, all earthmoving contractors and operators should be instructed that in the event of any bone or stone artefacts, or discrete distributions of shell, being unearthed during earthmoving, work should cease immediately in the area of the find, and the Kempsey Local Aboriginal Land Council, and officers of the National Parks and Wildlife Service, informed of the discovery. Work should not recommence in the area of the find, until those officials have inspected the material and permission has been given to proceed. Those failing to report a discovery and those responsible for the damage or destruction occasioned by unauthorised removal or alteration to a site or to archaeological material may be prosecuted under the National Parks and Wildlife Act 1974, as amended.

In the event that a relic or item is discovered during earthworks details of the discovery should be communicated to: The Archaeologist, Northern Zone, and to The Chairperson, Kempsey Local Aboriginal Land Council (addresses at the front of this report).

TABLE OF CONTENTS

FIGURES

1. INTRODUCTION

1.1 Background to the investigation

The investigation was performed for Robert Dennis and Associates on behalf of Mr M.L. Corbett, who proposes to subdivide Lot 1, DP196559, Beranghi Road, Crescent Head.

The scope of the work was to conduct an archaeological investigation of the project area with the assistance of a representative/s of the Kempsey Local Aboriginal Land Council, and to identify any Aboriginal sites and relics that might be present. The results of the investigation were to be presented in a report, which was to include an assessment of the significance of any cultural relics or places identified, an appraisal of the options and opportunities arising from the discoveries, and clear recommendations for the management of those cultural resources.

This investigation was performed concurrently with an investigation of the project site for non-indigenous sites and relics of heritage significance. The results of that investigation are presented in a separate report, to comply with the guidelines of the Heritage Office of New South Wales.

Figure 1 is a topographical map of the general region showing the survey area, Figure 2 is an aerial photograph of the general area, and Figure 3 is the Layout Plan of the Proposed Subdivision.

1.2 The survey area

The survey area comprises all of Lot 1, DP196559, Parish of Beranghi, County of Macquarie. It is located to the west of Beranghi Road, approximately 6 km south of the junction of Beranghi Road with Crescent Head Road, which is 12 km southeast of Kempsey, and 7 km northwest of Crescent Head, on the Mid-north coast of New South Wales.

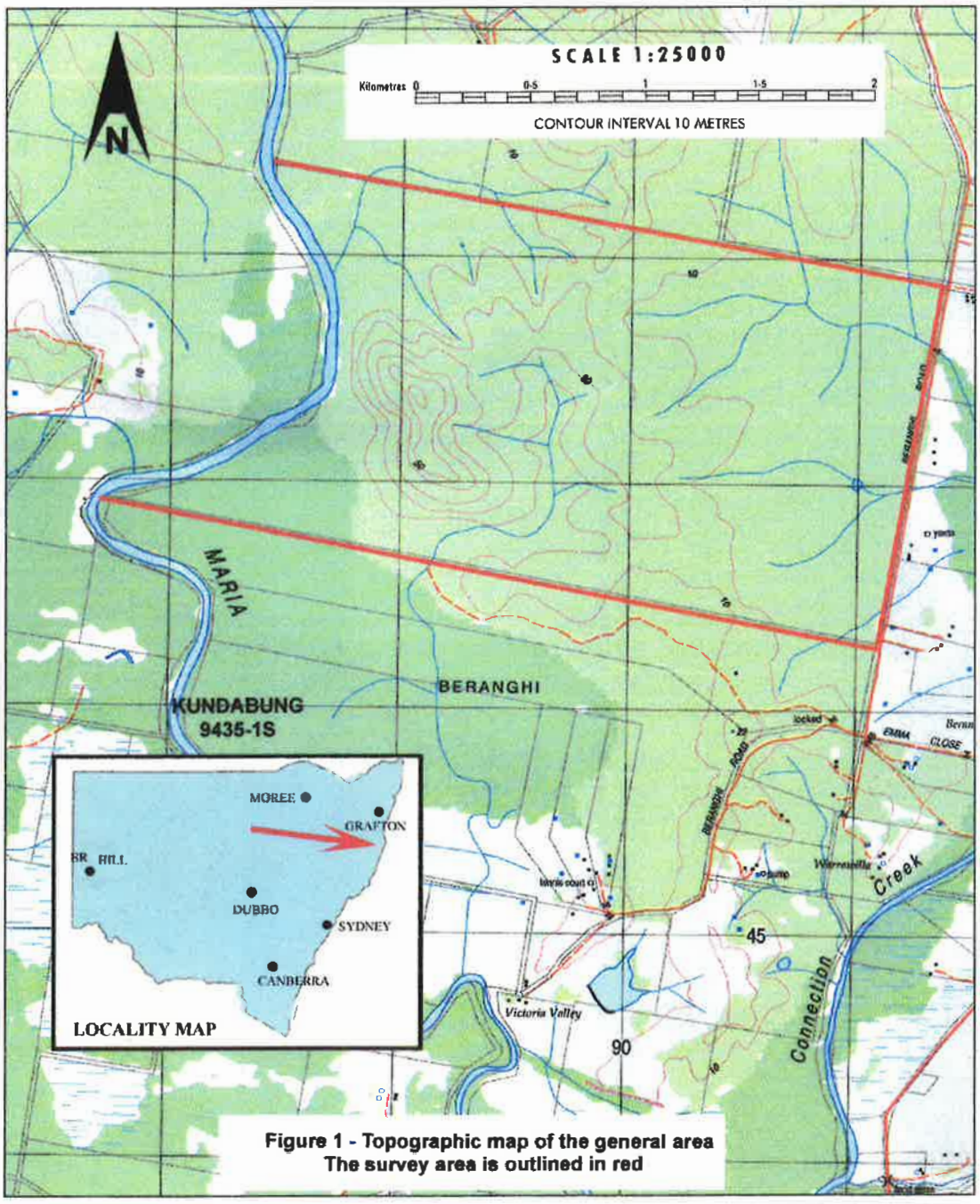


Figure 1 - Topographic map of the general area
The survey area is outlined in red

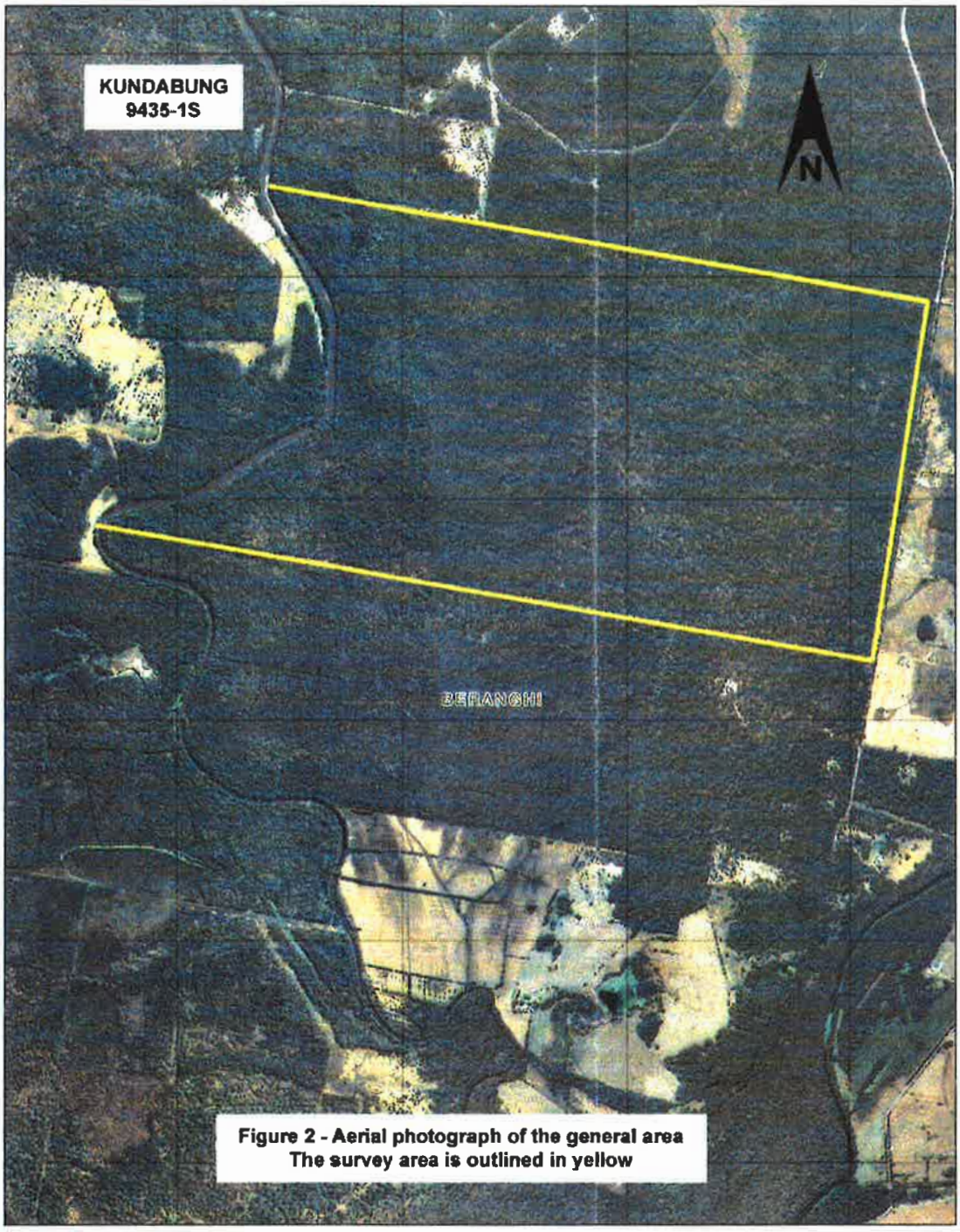


Figure 2 - Aerial photograph of the general area
The survey area is outlined in yellow

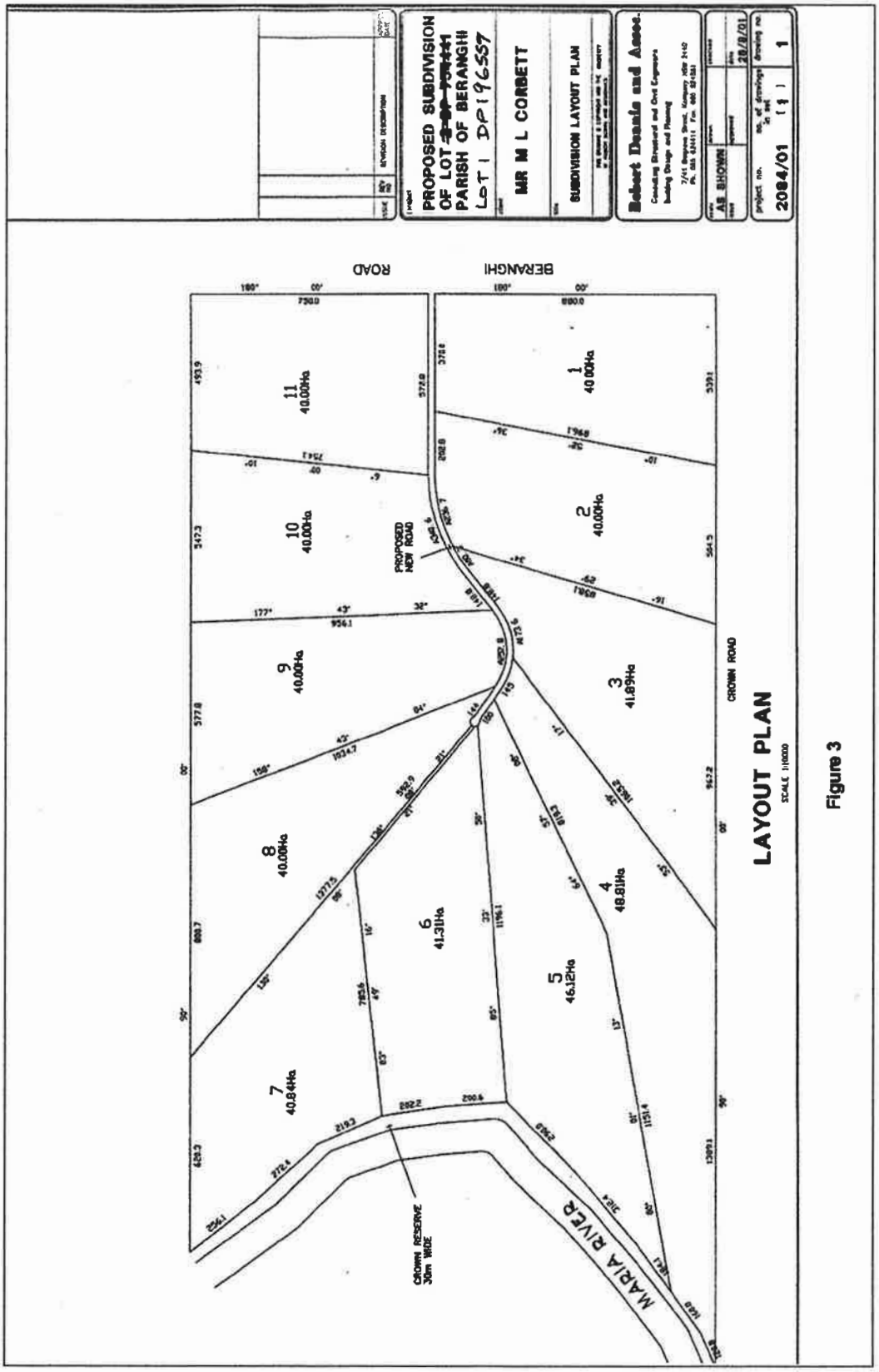

PROPOSED SUBDIVISION
OF LOT 1 DP196559
PARISH OF BERANGHI
MR M L CORBETT
SUBDIVISION LAYOUT PLAN
Robert Dennis and Assoc.
AS SHOWN
2084/01
BERANGHI ROAD
PROPOSED NEW ROAD
CROWN ROAD
MARIA RIVER
CROWN RESERVE 30m WIDE
1 40.00Ha
2 40.00Ha
3 41.89Ha
4 48.81Ha
5 46.12Ha
6 41.31Ha
7 40.84Ha
8 40.00Ha
9 40.00Ha
10 40.00Ha
11 40.00Ha
LAYOUT PLAN
SCALE 1:10000

Figure 3

The lot is delimited by straight-line boundaries to the north, east and south, meeting at right-angles, and by Maria River along its western boundary. The eastern boundary fronts Beranghi Road.

The total area of Lot 1 is 469 ha, having an eastern frontage of 1,600 m, a southern boundary of 3,400 m, and a northern boundary of 3,000 m.

1.3 Potential impact of the proposed subdivision.

The potential impact of the proposed subdivision would be to destroy any archaeological contexts that might be present in the areas impacted upon by the roadworks, site clearing, landscaping, construction, earthworks and drainage works – see Figure 3. While in the short term the impacts may be limited to the immediate areas in which any of these activities occur, there is a long-term potential for further impacts as the blocks are cleared or utilised for other activities.

As a consequence of this survey it is extremely unlikely that the same area will ever be surveyed again. Thus from an archaeological perspective, this was the only opportunity to observe and record any sites that might be present, and to propose a strategy for the management of any known or potential archaeological and/or cultural material in the future development of the area.

2. ABORIGINAL CONSULTATION

Prior to the investigation Tracey Edwards, Chairperson, Kempsey Local Aboriginal Land Council (LALC), was contacted, and she confirmed that the study area was within the Kempsey LALC management area. Tracey arranged for Lewis Kelly, Community Elder, and Vincent Smith, Sites Officer, to assist me in the investigation, which we performed on 25th July 2002.

While both men were very familiar with Aboriginal sites and associations in the Kempsey area neither of them was aware of any specific Aboriginal associations with the survey area.

Both prior to and during the survey Lewis, Vincent and I discussed the potential for particular site types to be present, and the particular environments in which they might occur. We also constantly reviewed our survey strategy, and discussed the results as we completed each section. At the conclusion of the survey we discussed the results in general, and the likely recommendations.

Following the survey I contacted Tracey and we discussed the land council's recommendations, which she informed me would be that the Kempsey LALC wanted to monitor excavations. She also advised me that she would send me a letter of confirmation but unfortunately, despite several phone calls, no correspondence confirming the recommendations had been received at the time this report was finalised (16th September).

3. THE ENVIRONMENTAL CONTEXT

Any discussion of the likely presence of Aboriginal cultural remains or of the basis why such remains might be discovered must be within the context of the environment and the resources that would have been available to any Aboriginal occupants of the area.

3.1 The general geology and topography

The study areas occurs in the southern portion of the Hastings Block, and the section of the study area from Beranghi Road to the north/south trending ridge line (parallel to the river) is part of the unit known as the Kempsey Beds. The Kempsey Beds comprise of lithic sandstone, mudstone, pebble sandstone and minor conglomerate. The river-banks comprise of Quaternary alluvial mud and swamp deposits (DMR, 1987).

The surface soils in the study area can be described as four discrete units. The low lying area adjacent to Beranghi Road is composed of swamp mud, but within a hundred metres or so the mud gives way to stoneless, dusty, weathered sandstone, which continues to about the 20 m AHD contour at the base of the eastern slopes to the ridge. From there the slopes, ridge, and western slopes generally consist of blocky, angular lithic sandstone in an organic matrix. The fourth unit occurs along the river-bank below the ridge and in the two low lying areas in the north-western and south-western corners, and comprises of heavy, dark swamp mud.

The summit of the ridge is known locally as Gordon's Hill named after Captain James Gordon, who first settled the block in the 1840s. Elevations in the study area vary from a few metres above sea level at Beranghi Road, rising to 60 m AHD on the summit of Gordon's Hill, before dipping to a few metres above sea level on the riverbank.

3.2 Vegetation

The vegetation in the study area at the time of the investigation was to a large extent an artefact of past logging activities. Low lying areas below the 10 m AHD contour along the eastern or Beranghi Road frontage were dominated by dense regrowth paperbark swamps fringed by immature swamp oaks, but the vast majority of the area between the eastern swamps and the slopes of the western ridge consisted of semi-closed to open dry sclerophyll forest, dominated by large scribbly gums, intermixed with blackbutts, tallowwoods, bloodwoods, and oaks, with an understorey of eucalypt regrowth, immature oaks and rough barked apples. The vegetation on the eastern slopes and summit of the ridge continued in the same vein, but was a more closed forest with increasing numbers of bloodwoods and tallowwoods and the regrowth on the slopes was more advanced, but thinned out to a grass understorey on the summit. The steep western slopes of the ridge contained far fewer scribbly gums but there were many large smooth barked gums and more bloodwoods. The north-western and south-western low-lying areas were dominated by mature paper bark forests.

The frequent reference to regrowth is deliberate. There were numerous tree-stumps throughout the study area that exhibited the springboard notches of the tree-fellers. While it was not clear whether all the stumps were of the same species it is probable that most of them were tallowwood and blackbutt. There were also a number of old logging tracks identifiable only by uneven ground and swathes through the canopy, as regrowth had all but obscured many of the tracks themselves.

Logging took place on the Hastings as early as 1821, when Macquarie recorded in his journal that loggers were 'procuring rose-wood and cedar' (Macquarie, cited in Vader 2002: 50-1). It has continued spasmodically for various timbers since then.

The vegetation also showed the effects of bush fires that have caused varying degrees of impact. In the paperbark areas the impact was visible as blackened bark, but in the central areas the fire had destroyed most of the understorey, which showed signs of only recent recovery – see Figure 7. Elsewhere a number of large burnt-out tree-trunks showed the effect of a forest-fire event that probably predated many of the living trees, the majority of which, with the exception of the scribbly gums, appeared to be younger than 150 years old. (the assumption was based on the size of the trees that presently grow in the convicts' quarters (see later) that would not have been there in the 1850s).

3.3 Water resources

There were no natural surface water sources in the area, other than Maria River and the swamps. While the water from Maria River was probably potable for much of the year, except after rain, and before logging and development run-off tainted the waters, there was probably always a shortage of 'good tasting' water.

As the Topographic map shows there were several natural drainage lines running to the north of the ridge, and to the south via the eastern slopes. A gully, not marked on the Topographic map, was observed on the base of the western slopes towards the south-

western corner, and might have been a source of potable water before logging reshaped the slopes.

3.4 Stone resources

As referred to previously there was very little stone in the survey area other than the blocky, angular meta-sedimentary rock in the ridge area. However the rock was very poorly silicified and entirely unsuitable as a knapping material from which to manufacture tools.

In the absence of a suitable knapping material any artefacts that might be present would have been sourced from outside the survey area.

3.5 Previous impacts.

As described above there has been significant impact to the area from logging activities. The jigging of logs down to the river in the early days when the logs were floated down river to Port Macquarie, and later towed and carried by droghers, or later still when they were hauled by oxen or tractor through the forest back to Beranghi Road, would have significantly disturbed the surface deposits.

Other less obvious impacts would have been caused to the western slopes of the ridge and creek bank during the 1840s by Captain Gordon and his bonded servants, who cleared the land for Gordon's homestead, the convicts' quarters, a vineyard and a water-race. These have now been all but obscured by regrowth and decay but nevertheless, would have had a significant impact upon any archaeological contexts where they occurred.

4. THE ARCHAEOLOGICAL RECORD

A search of the Aboriginal Heritage Information Management System (maintained by NSW NPWS) showed that no Aboriginal sites have been recorded in the survey area. See the results of the search in the appendices.

A stone arrangement (#30-3-0099) was recorded on Beranghi Mountain, 950 m to the north of the northern boundary of the study area. The map reference was taken from a 1:250,000 scale map and as a consequence is not accurate. The correct reference should be '56 490150 6549060'. An amended Site Recording Form will be forwarded with this report with NPWS. Copies of the original recording are included in the appendices.

Three sites have been recorded on Connection Creek, and other sites in the general region include an Aboriginal ceremonial ground in the Kundabung area. The map references for the site listed as the Saltwater Lake are in error – refer to the listing in the appendices.

It should be stressed that the presence of only a few sites in the general area merely reflects the fact that no previous surveys have taken place in the area. It is highly probable that other sites exist along Maria River and Connection Creek to the east, and indeed, Mrs Billie Crawford of the Kempsey Historical Society showed me a photograph of a canoe-scar tree which is located on the banks of Maria River some three kilometres upriver of the survey area, in the vicinity of the old town of Mariaville/Boat Harbour (of which nothing remains).

5. MODELS FOR SITE LOCATION

5.1 Site types and their location

In order to design an investigative strategy it is firstly necessary to develop a predictive model for site location. This is not to determine where the investigation should be conducted, but to establish a theoretical model for the distribution of archaeological material against which the effectiveness and subsequent analysis of the survey results can

be tested, compared and reasoned. The basis upon which the predictive model is derived must however be one of consideration of which archaeological material might realistically be expected to not only be present, but also detectable.

The first objective of any archaeological investigation must be to observe and record sufficient of the archaeological record that is present to be able to propose that it is representative of the record as a whole. The investigative strategy is therefore directed and designed to detect that which is representative of the record in the particular study area, and naturally, as different study areas will comprise variations in environment, vegetation, topography, etc., so the investigative strategy must be designed to best suit the circumstances. The objective must be to detect material evidence, and so it is necessary to consider the extent to which artefactual material may be present, and the degree to which it is visible or might be discovered.

There are several factors, which are likely to affect, firstly, where Aboriginal people are most likely to have been, secondly, where they have left evidence of their activities, and thirdly, the degree to which that evidence is observable in the present record.

People visited places mainly to obtain resources, and in general places that were richest in resources were more likely to have been visited by people than those places with fewer resources. Important resources were permanent water, ephemeral water, food resources, stone raw material sources, shelter (from sun, wind, and rain), and perhaps suitable surfaces for rock art, and proximity to mythological natural features. Those resources may have been a factor in the suitability of a location for particular ceremonial activities but cultural boundaries also influenced the choice of ceremonial grounds. Alternatively, sites frequently occurred along preferred access routes and particularly where that route coincided with a watercourse.

However, the attractions of such an environment frequently resulted in the archaeological record becoming discontinuous or significantly disturbed, as stock and vehicles impacted upon it in the post-European contact phase.

Frequency of visits and use of particular locations was also determined by the 'accessibility' or freedom from environmental constraints in the area. For example, whether there were alternative, preferred or easier ways to travel around or over natural barriers, be they geological, geographical, cultural, or imposed by fauna or flora, or whether they were only seasonally accessible, such as mounds on flood terraces, or the availability of water during periods of drought, or whether or not floods, fire or snow hindered access.

Few past Aboriginal activities are represented by surviving material evidence. This in part is because many activities did not leave material evidence (eg. tools were reused), but it is also because very little cultural material survived. An exception to this was shellfish, which was very durable.

The survival of material that is durable was also affected by recent European land use. Cultivation has destroyed many archaeological sites. However, cultivation can also help expose sites that might otherwise be covered. This brings us to the other important point about site distribution, which is that to a great extent site distribution recorded by archaeologists reflects the distribution of places where the ground surface is sufficiently eroded to expose artefactual material.

By far the majority of recorded sites have been stone artefact scatters or isolated stone artefacts, and in the vast majority of sites they were found in one or more of the following contexts:

i) On or adjacent to deposits containing quartz, quartzite, jasper, silcrete, chert, chalcedony, metamorphosed greywacke, and other indurated or siliceous sedimentary rocks, or redeposited fine-grained volcanics, or

ii) On river banks or adjacent to river banks where the watercourse contains river pebbles of quartz, quartzite, jasper, silcrete, chert, fine-grained volcanics, basalts, etc., and particularly at the junctions of watercourses, or

iii) On ridges and spurs overlooking watercourses or on high vantage points affording uninterrupted views of swamps, water holes, saddles, passes, and any other likely access path into the observer's area, or

iv) In the vicinity of outcrops of suitable raw material such as basalt, silcrete, chert, or other highly silicified sedimentary rock.

Other site types do occur and perhaps because of their lower and less predictable profile, are present in far greater numbers than we are aware of. People die but there are few recorded burials. One reason may be that in many instances the soils are too acid for the preservation of bone, but a far more likely reason is simply that burial frequently entailed subsurface internment, and a surface survey will only discover a burial where there has been erosion of significant disturbance to the surface deposits. As a consequence many burials have only been discovered when exposed by erosion of a sand body or river terrace. Other site types such as carved trees, scarred trees, stone arrangements, Bora rings, etc., may once have been present, but are unlikely to have survived in easily accessible country from the attention of non-indigenous people. Thus, much of what might have existed is now lost or destroyed, and the archaeological record has become biased by the post-contact utilisation of resources, and by the selective exploitation and preservation of particular environments.

Other factors which affect the degree to which sites are recorded during an investigation include the time of year at which the fieldwork is performed (the seasonality of some vegetation growth) and the conditions under which the survey is performed – (wet, dry, cold, windy, poor light, etc.).

A brief description of site types such as isolated artefacts, open scatters, camp sites, knapping floors, quarries, middens, mounds, hearths, carved trees, scarred trees, stone arrangements, Bora rings, burials, engravings, paintings, grinding grooves, occupation deposits (and PADs), and ceremonial and mythological sites is given in the appendix.

5.2 A predictive model for the study area

Based on all of the above the following model for site distribution was proposed for the study area, in which there are no shelters or overhangs, and in which, but for the Maria

River, there are very few defined gullies or streams, and which has no sources of stone suitable for knapping tools and implements.

- Isolated artefacts may be present and visible in erosion features
- Low-density artefact scatters may be present and visible in erosion features, but it is unlikely that any debitage will be visible
- There is a potential for trees more than 150 years old to exhibit scarred surfaces
- There is a potential for any trees more than 150 years old to exhibit carved surfaces

- In the absence of any shelters there will be no art sites
- There will be no engravings, or grinding grooves
- There will be no shell middens
- There will be no intact occupation deposits
- There are no known Mythological sites
- There will be no stone quarries
- There will be no visible evidence of burials
- There will be no surviving Bora rings
- There will be no surviving stone arrangements (primarily because logging would have destroyed them)

6. THE SURVEY

6.1 The survey strategy

Prior to the investigation a study of the Topographic map and of the aerial photograph (orthophoto on the reverse) made it clear that the dense vegetation would severely restrict the effectiveness of the archaeological investigation. However it was possible to identify

some tracks on the aerial photograph that might provide access through the area. Fortunately, Mr Robert Dennis had cleared old logging tracks through the forest to enable him to establish boundaries and reference points for the proposed subdivision.

Mr Dennis cleared five old tracks. One meandered the length of the survey area from Beranghi Road to the riverbank, generally following the line of the low ridge that cuts diagonally across the centre of the survey area (southeast to northwest), and crossing the northern end of the western ridge down to the riverbank. A second track generally followed the firm ground immediately above and parallel to the creek bank. A third track split from the central track to ascend to the southern end of the western ridge. A fourth track split from the central track curving towards the north-eastern corner where the proposed subdivision road will be located. The fifth short track split from the central track to run from the mid-section to the southern boundary. In addition, although they were partly obscured by regrowth, the southern and northern boundaries had previously been cleared for fence lines. In combination the tracks provided ideal transects of all land-forms and environments with the exception of the paperbark swamp in the south-western corner.

The proposed survey strategy was to walk as many of the cleared tracks as possible, as well as to survey the crest of Gordon's Hill, which being the most prominent hill along this stretch of river would have been an obvious vantage point for any Aboriginal people passing through this country.

6.2 Details of the survey

The survey was performed by myself, assisted by Lewis Kelly, Community Elder, and Vincent Smith, Sites Officer, Kempsey LALC. The survey was made on foot, in dry conditions under a clear sky, in light ideal for observing any artefactual material present and observable.

6.3 Site recording

All relevant observations as to the topography, vegetation cover, and conditions, were recorded in a field-log, and photographs taken to record the character of the survey area, and witness survey conditions.

6.4 Effectiveness of the survey technique

As described previously the dense vegetation in some areas severely restricted archaeological visibility, but the main problem was the dense carpet of leaf, bark and twig litter, which was up to 20 cm deep throughout the entire survey area. The only effective survey strategy would have been to set fire to the litter prior to the survey – neither a practical nor an environmentally sensitive solution. In such circumstances there is no cost effective technique for performing a comprehensive survey, and utilising tracks as sample transects is the most effective strategy.

The survey technique was the most appropriate one to use in the circumstances, and the results are believed to be generally representative of the archaeological record in the survey area, in which it was predicted there would be very little artefactual material. Although the tracks provided satisfactory sampling transects, the groundcover was a constraint to the overall effectiveness of the survey.

6.5 Effective coverage

The table on the following page (Figure 6) is divided into soil units, briefly described in terms of approximate 'horizontal' or map area, soil, vegetation, archaeological visibility of exposed surfaces, and the percentage of the area actually surveyed.

The table shows the effective survey coverage based on the assumption that most artefactual material if exposed and visible can be observed for up to 5 metres to either side

of the path of a walking observer. Clearly this would vary significantly between a path walked through dense vegetation, a cleared track through a forest, and a path across a claypan, and is given as a guide only. Unfortunately the fact that all three investigators walked the same cleared tracks, in some instances in both directions, meant that while the tracks were thoroughly surveyed that they only represented a four to five metre-wide transect.

While that meant that relatively little ground surface of the very large survey area was surveyed, the survey for scarred trees was far more effective, because in the area in which scarred trees were most likely to occur, that is along the river bank, the cleared track along the river bank gave good visible access. And while the survey coverage of trees elsewhere was only effective for a 20 metre wide strip to either side of the tracks the specie types were not typically associated with Aboriginal use of the bark or wood.

Note that the plan shows that some transects were surveyed from a slowly moving vehicle, and that the routes shown are representative only. In fact the central track weaves back and forth around trees gullies, and other anomalies, particularly where the track crosses the northern end of the ridge slopes, but the scale of the map is such that it is not practical to show every bend and change of direction. Similarly the soil units are approximations only, to provide a basis for comparative survey coverage.

It should be noted that approximately 30% of the survey coverage of the northern slopes and summit of the ridge were performed whilst performing the non-indigenous heritage survey (reported elsewhere) unassisted (on different site visits), but the remainder of the survey coverage shown on the map was undertaken with the Aboriginal Elder and the Kempsey LALC Sites Officer.

The photographs on the following pages show several aspects of the survey area.

Area	Description	Approx. survey area (469 ha)	Rock/soil	Vegetation	Average surface visibility	Exposures	Approx area surveyed	Average arch. visibility of exposures	Archaeology
1	Soil unit 1 Low lying swamp and drainage lines at the eastern end	Approximately 660,000 sqm	Dark swamp muds	Paperbark (regrowth)	Zero	Cleared tracks	3,000 sqm 0.5%	85%	Nil
2	Soil unit 2 Central area of gentle rises and shallow drainage lines	Approximately 2,590,000 sqm	Weathered sandstone (fine-grained sands)	Scribbly gum, tallowwood, bloodwood, casuarina, wattle and tea tree understorey	< 5 %	Cleared tracks and minor bushfire scorched ground	30,000 sqm 1.2%	90%	Nil
3	Soil unit 3 Western ridge and slopes with defined drainage lines	Approximately 470,000 sqm	Blocky, angular lithic sandstone in an organic & weathered sedimentary matrix	Smooth-barked gum, tallowwood, bloodwood, casuarina, and wattle understorey	< 10 %	Cleared tracks and gullying & minor slopewash on slopes	25,000 sqm 5.3%	20%	Nil
4	Soil unit 4 North-western paperbark swamp	Approximately 435,000 sqm	Heavy dark swamp muds	Mature paperbark, minor smooth-barked gums	Zero	Cleared tracks	7,500 sqm 1.7%	75%	Nil
5	Soil unit 4 South-western paperbark swamp	Approximately 475,000 sqm	Heavy dark swamp muds	Mature paperbark, minor smooth-barked gums	Zero	Cleared tracks	2,500 sqm 0.5%	80%	Nil
6	Creek bank, assumed to be 30 m wide average (discrete from but also the limit of Soil Unit 4)	Approximately 60,000 sqm	Heavy dark swamp muds	River gums, casuarinas, bloodwoods, dense reeds along bank	Zero	Cleared tracks	3,500 sqm 5.8%	80%	Nil

Figure 4 - Effective Survey Coverage

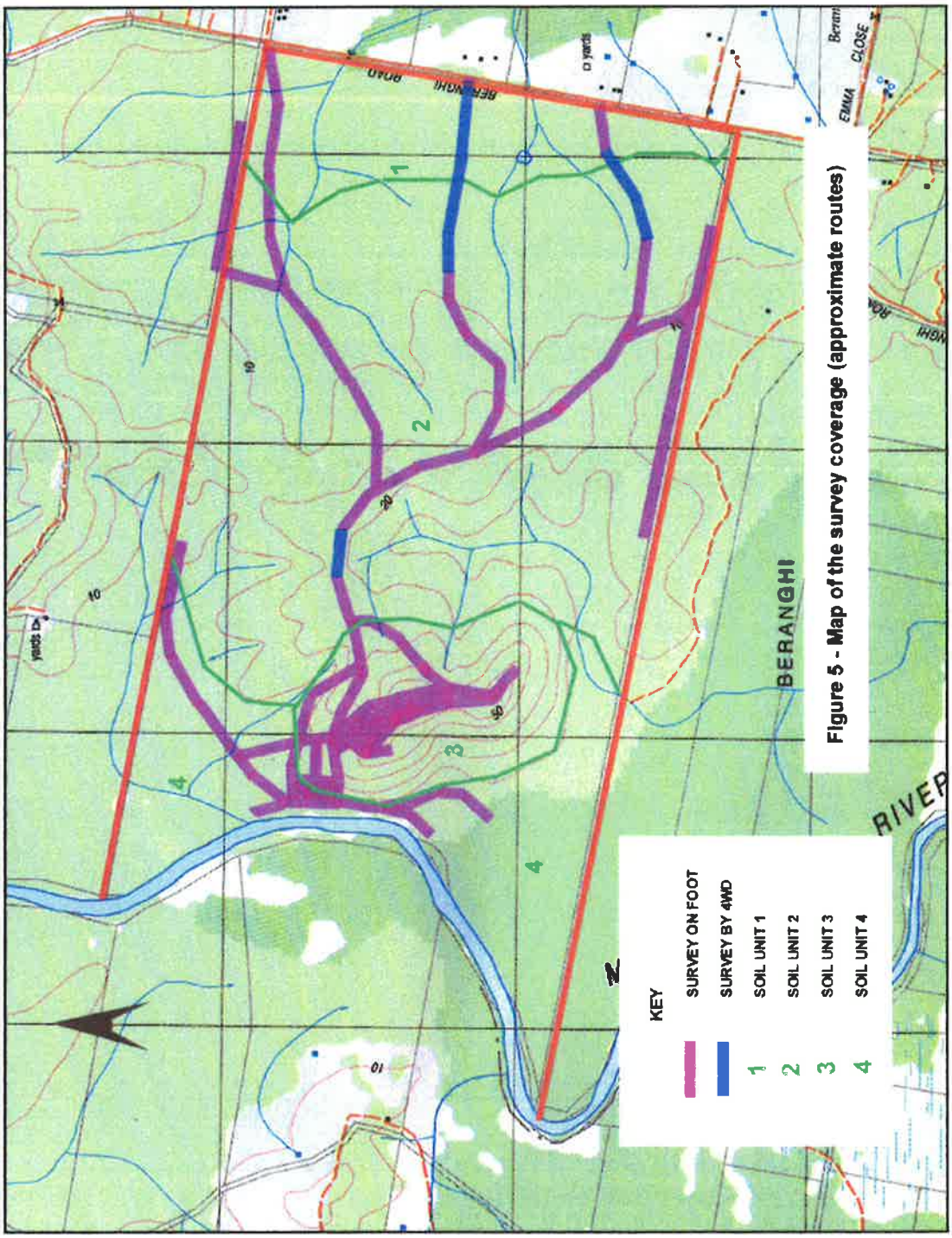


Figure 5 - Map of the survey coverage (approximate routes)

Figure 6 – Paperbark swamp typical of the eastern end of the survey area.

Figure 7 – Looking northwards in the northern central section dominated by scribbly gum. Note the tree stump and loggers springboard notch.

Figure 8 – Old track in the mid-section of the survey area, dominated by scribbly gum.

Figure 9 – Looking westwards along the southern fence line, mid-survey area.

Figure 10 –Looking westwards along the central track mid-section of the survey area.

Figure 11 –Looking south-westwards across the eastern slopes of Gordon's Hill.

Figure 12 – The upper slopes of Gordon's Hill from the east, with the summit to the right.

Figure 13 – Looking eastwards back up the central track from the riverbank.

Figure 14 – Looking northwards towards the paperbark swamp in the north-western corner of the survey area. Note the dark swamp mud.

Figure 15 – Looking southwards along the river track, across a low rise north of the south-western corner.

7. THE RESULTS

No Indigenous artefacts or sites were identified in the survey area.

8. DISCUSSION

As referred to previously, the dense groundcover was a constraint to an effective survey, however the cleared tracks provided a means of performing transect surveys across all land units, and through all environments. The surveys therefore provided an effective sample survey of the area.

The absence of artefactual material was not surprising given that there were no natural stone sources in the area suitable for knapping material. That meant that if there were any artefacts in the survey area that they would have been sourced elsewhere. That would also mean that any sites present would consist of isolated artefacts, or of micro-debitage and trimming flakes (less than 10 mm long) produced in tool maintenance, neither of which would be observed in the dusty, weathered sandstone of the tracks, or in the dense leaf, bark and twig litter, or in the swamp mud of the creek bank.

Perhaps the most likely site types that could have been expected to be present would have been scarred trees and these would have been along the creek bank. However, none were observed.

The absence of sites in the survey area does not mean that Aboriginal people were never there, in fact given that there is a canoe-scar tree further upriver it is probable that Aboriginal people frequently used Maria River, and if they did, it is also likely that they foraged along the creek bank for food. Unfortunately, neither activity, use of the river or foraging for food, is likely to leave lasting artefactual evidence.

In summary, although the survey area occurs in a region in which there is a potential for sites to occur, there is only a very low potential for the survey area to contain observable

archaeological material. If however archaeological material is present, it is likely to consist of very small isolated artefacts or isolated stone axes, and/or micro-debitage, none of which will be observed other than by chance.

9. SIGNIFICANCE ASSESSMENT

The NPWS policy to safeguard all sites, Aboriginal places, and archaeological material of significance wherever possible requires that some means of assessing the significance of the sites is necessary. This is not only for the purpose of determining whether the proposed development can proceed as proposed, but also to provide Cultural Resource Managers with the information for future management of the area.

9.1 Cultural significance

The Aboriginal or cultural significance of Aboriginal relics and sites can only be assessed by the Aboriginal community, and in particular, the Elders. It is the responsibility of the archaeologist to ensure that the Elders, or elected representatives of the Aboriginal community are advised of the survey results, and are consulted as to their knowledge and opinion of the significance of the area, and to transcribe and present those expressions in report form.

In this instance, neither Lewis Kelly nor Vincent Smith, were aware of any cultural association with the survey area. However, they stated that they believed there was some potential for sites to be present, and consequently recommended that any excavations associated with the development of the proposed subdivision should be monitored.

9.2 Research potential

In the absence of any artefactual material in a depositional context, or of known specific Aboriginal association with the survey area the research potential is assessed to be very low.

10. RECOMMENDATIONS

In the absence of any defined archaeological context or places of Indigenous cultural significance within the survey area it is recommended that there are no archaeological constraints on indigenous grounds to the proposed subdivision. However the Kempsey LALC have recommended that any excavations associated with the proposed subdivision should be monitored.

While the land council's recommendations are considered to be reasonable they would be difficult to implement without some defined limits and time frame. It is therefore recommended that the works to be monitored are the earthworks for any in-ground services and drainage associated with the construction of the subdivision road (which runs down the centre of the survey area – see Figure 3) and the headworks. It is suggested that the proponents should consider programming the work so that the monitoring by Kempsey LALC can be achieved in the minimum time, both for work safety and economic reasons. The developer should give the Kempsey LALC seven days notice of the commencement of works to allow them time to organise a monitor.

Although the investigation has not identified any sites of either Indigenous or heritage significance that will be impacted upon by the proposed works the proponents are advised that the following provisions should be observed:

> All developers, contractors and their employees are bound by the provisions of the National Parks and Wildlife Act 1974 as amended, which was in part designed to mitigate impact to the Indigenous archaeological record.

Under the provisions of the National Parks and Wildlife Act 1974, all earthmoving contractors and operators should be instructed that in the event of any bone or stone artefacts, or discrete distributions of shell, being unearthed during earthmoving, work should cease immediately in the area of the find, and the Kempsey Local Aboriginal Land Council, and officers of the National Parks and Wildlife Service, informed of the discovery. Work should not recommence in the area of the find, until those officials have inspected the material and permission has been given to proceed. Those failing to report a discovery and those responsible for the damage or destruction occasioned by unauthorised removal or alteration to a site or to archaeological material may be prosecuted under the National Parks and Wildlife Act 1974, as amended.

In the event that a relic or item is discovered during earthworks details of the discovery should be communicated to: The Archaeologist, Northern Zone, and to The Chairperson, Kempsey Local Aboriginal Land Council (addresses at the front of this report).

GENERAL GLOSSARY: The definitions that follow are for terms used in this and other reports written by the author, and do not necessarily apply to their use in different contexts.

ADZE : A modified flake with at least one steeply-retouched working edge. While all adzes are generally considered to be wood-working tools it is probable that some also served as cores and others as scrapers. Adzes with a uniform butt were frequently hafted to make a chisel-like tool, but the intended use of the adze determined the size of the adze and whether it was hafted (Flenniken and White, 1985).

ARCHAEOLOGICAL DEPOSIT :
Sediments which contain evidence of past Aboriginal use of the place, such as artefacts, hearths, burials etc.

ARTEFACT : Any object that has attributes as a consequence of human activity (Dunnell, 1971). In this report 'artefacts' has been used generally to describe pieces of stone that have been modified to produce flakes, flaked pieces, cores, hammerstones, or axes.

BACKED BLADE :
A stone tool manufactured from a flake on which one margin has been modified by the removal of small flakes to blunt the edge or margin opposite the cutting edge.

BORA GROUND :
A ceremonial site comprising of one or two connected circles composed of compacted or mounded earth, or defined by an arrangement of stones, of 2 to 30m diameter, generally used in male initiation rites.

CAMPSITE : A place at which the density of artefacts and the variety of material indicates that people 'frequently' used the place as a stopping or resting place. Such places are also likely to contain or be close to water resources, food resources, or stone material resources. In this report a campsite is used to describe artefact scatters that are associated with hearths or fireplaces, as distinct from scatters that are not associated with hearths or fireplaces, which are described as Open Scatters.

CHALCEDONY :
A form of silica (partially translucent), which occurs as linings in cavities in rocks. When banded it is known as AGATE (Department of Mines, 1973). Chalcedony is uniformly coloured and agate has curved bands or zones of varying colour (Cook & Kirk, 1991).

CHERT : Another name for sedimentary chalcedony. It occurs most frequently in limestones, or in marine sedimentary rock, or as pebbles in sedimentary rock. In its depositional context it is often concentrated in bedding planes. Chert found in deep-water limestones is formed from radiolaria and diatoms (siliceous planktonic micro-organisms) (Cook & Kirk, 1991).
Chert is a form of amorphous or extremely fine-grained silica, partially hydrous, found in concertions and beds. It is classified as a chemical sedimentary rock although it may be precipitated both organically and inorganically (Department of Mineral Resources, n.d.).

CONGLOMERATE :
Naturally cemented gravel. Conglomerate is a coarse-grained clastic sedimentary rock composed of generally rounded fragments of other rock types larger than 2 mm in diameter, set in a fine-grained matrix of sand, silt, or any of the common natural cementing materials (Department of Mineral Resources, n.d.).

CORE : A piece of stone from which flakes have been removed, that cannot otherwise be described as a retouched or modified artefact.

CORTEX : The naturally altered surface of stone – eg. the water-worn surface of river pebbles.

DEBITAGE : The small waste material observed in knapping floors. Generally, waste material is described as all those fragments having a maximum dimension of less than 10mm

FLAKE : A fragment of stone exhibiting features indicating that it has been deliberately removed from a core piece. These features are evident as:

i) Platform: Plane or point at which a blow was delivered to remove the flake.
ii) Bulb of Percussion: Convex surface that occurs on the face or ventral surface of a flake, radiating from the point of impact, produced as a consequence of the force pattern.
iii) Eraillure: see below.

Other terms:

i) Dorsal: The back or outer face of a flake as it would have been prior to removal from a core. Frequently either ridged or exhibiting negative flake scars when removed in secondary flaking, with a natural weathered cortex when removed in primary flaking.
ii) Ventral: The 'chest' or inner face of a flake as it would have been prior to removal from the core. The surface upon which the Bulb of Percussion occurs.
iii) Platform Preparation: The removal of flakes from a surface to produce a level platform. May be evidenced by retouch scars to the platform.
iv) Retouch: The removal of small flakes from an edge or margin of an artefact to modify its shape or resharpen its edge.
v) Proximal: The end of a flake closest to the striking platform.
vi) Distal: The end of a flake furthest from the striking platform.
vii) Margin: The edge of an artefact.
viii) Eraillure: A small circular to elliptical negative flake scar occurring on the surface of the bulb of percussion on flakes of very fine-grained or highly silicified material. It occurs 'naturally' as a consequence of internal forces generated at the time of flake removal.
ix) Split Cone: Occurs when the flake splits down its axis frequently removing part of the striking platform. Generally believed to be produced by faulty knapping technique, but is also probably a consequence of flawed material.
x) Transverse Snap: Occurs when a flake snaps across its axis. Generally believed to be caused by post-depositional impacts such as human or stock treadage, or vehicular traffic.

FLAKED PIECE :

A fragment of stone exhibiting flake scars indicating that it is an artefact, but not displaying diagnostic features, such as a Bulb of Percussion, Striking Platform, or an Eraillure.

GREYWACKE :

A type of sandstone, grey or greenish-grey in colour, tough and well indurated and typically poorly sorted (Clark & Cook, 1986).
A generally poorly sorted, dark sandstone containing feldspar and sand-sized rock fragments of metamorphic or volcanic rocks (Department of Mineral Resources, n.d.).
Usually a dark and coarse-grained rock compared to mudstones and siltstones that are much finer-grained and better sorted.

HOLOCENE PERIOD :

The period from 10,000 years ago to the present.

IGNEOUS ROCK :

Rock formed by the cooling and solidification of magma on or below the earth's surface (Geography Dictionary, 1985).

In situ : In its original place – as deposited.

ISOLATED ARTEFACT :

A solitary stone artefact, at least 50m from its nearest neighbour. This is based on NPWS policy that two artefacts within 50m of each other constitute a site.

KNAPPING FLOOR:

A discrete scatter of artefacts in which at least two artefacts are recognisably of the same material, and derive from the same piece of stone. Also described as a stone tool manufacturing site or floor.

LOCATION : The place at which an artefact is found, or a place identified as having either archaeological or Aboriginal significance.

MEASUREMENT :

I) Flake:
- i) Length: Measured along the percussion axis at right angles to the platform.
- ii) Width: The greatest width measured at right angles to the percussion axis.
- iii) Thickness: The greatest thickness measured at right angles to the percussion axis.

II) Flaked piece:
- i) Length: The longest dimension
- ii) Width: The greatest width measured perpendicular to the length.
- iii) Thickness: The greatest thickness measured perpendicular to the length.

III) Core:
- i) Length: The longest dimension.
- ii) Width: The greatest width measured perpendicular to the length.
- iii) Thickness: The greatest thickness measured perpendicular to the length.

MIDDEN : A refuse heap or stratum of food remains, such as mollusc shells, and other occupational debris (Dortch, 1984 – see also Meehan, 1982).

MUDSTONE : A fine-grained detrital rock, usually quite massive and well consolidated. May be black through grey to off-white, browns, reds and dark blues/greens. Frequently found in association with sandstones (Cook & Kirk, 1991).
Identification is often aided by colour variations in layering. A source for stone material tool manufacturing material found as river pebbles in creek beds, and artefacts often display a water-worn cortex.

NEGATIVE FLAKE SCAR :

A concave surface resulting from the removal of a flake, occurring on the surface of the rock from which a flake has been removed.

PLEISTOCENE PERIOD :

The period from about 10,000 years ago to 2 million years ago.

POTENTIAL ARCHAEOLOGICAL DEPOSIT (PAD) :

Synonymous with Potentially Archaeologically Sensitive : Having the potential to contain archaeological material although none is visible.

QUARTZITE :

Quartzites are formed by the regional or contact metamorphism of quartz arenites, siltstones, and flints (cherts). They are composed essentially of quartz, and usually have a fine-grained granoblastic (grains are roughly the same size) texture. Generally massive, but may sometimes show sedimentary structures (Cook & Kirk, 1991).

ROTATION :

The removal of flakes from a core by blows directed at different angles, to different platforms. May be evident on the dorsal surface of a flake as negative flake scars, which do not follow the same direction as the percussion axis of the flake. This may be confused with scars produced during core preparation.

SCAT : The solid waste material produced by an animal – dung, droppings, manure (Triggs, 1985).

SCATTER : Two or more artefacts occurring within 50 metres. Scatter may also be used in the context of 'background scatter', meaning the general distribution of artefacts across the landscape that cannot be recognised as discrete concentrations.

SILCRETE : A near surface or surface siliceous induration (Desen & Peterson, 1992).
A conglomerate consisting of surficial sand and gravel cemented into a hard mass by silica.
A siliceous duricrust (Bates & Jackson, 1980).
Crusts may form as a result of low, infrequent rainfall, on reasonably flat surfaces. These are known as duricrusts – those cemented by silica are known as silcretes (Clark & Cook, 1986), sometimes referred to locally as 'billy' (Gentilli, 1968), or 'grey billy'.
Silcrete on the northern tablelands of NSW forms at the surface contact between sediments of the Sandon Beds and the Armidale Beds with overlying basalt, where groundwater (more rich in silica than surficial water) interacts with surficial water and precipitates new quartz as the matrix to the sediments (N.D.J. Cook, Dept. of Geophysics, UNE, pers. Comm.).
In softer formations of quartz sands, groundwater has apparently been responsible for the formation of concretionary layers of silcrete. Under altered climatic conditions, the less competent beds erode away leaving concretions. Since they are often the size of old-fashioned woolsacks and are greyish and white, they are popularly known as gray billy (slang for billy goat) (Fairbridge, 1968).

SITE : A discrete area or concentration of artefactual material, place of past Aboriginal activity, or place of significance to Aboriginal people.

SOIL SCIENCE TERMS (taken from Banks, 1995, and others as referenced).

BEDROCK : Outcrop of *in situ* rock material below the soil profile.

BENCH : A strip of relatively level earth or rock breaking the continuity of a slope.

BLOWOUT : A closed depression formed in the land surface by wind eroding sands and depositing them on adjacent land.

CLAYPAN : A depression caused by the aeolian deflation of sediments, or by the presence of a prior lake.

DUNE : A ridge built up by wind action composed of sands, silts, or sand-sized aggregates of clay.

FLOODPLAIN : A large flat area, adjacent to a watercourse, characterised by frequent active erosion and aggradation by channelled and overbank stream flow.

GIBBER : A level surface covered by a thick deposit of gravel or broken siliceous pebbles, occurring in the more arid parts of the continent, thought to have been formed from the break-up of a siliceous (silcrete) surface crust, and termed gibber plains (Whittow, 1984) – see also silcrete.

GILGAI : Surface microrelief associated with soils containing shrink-swell clays. Gilgai consists of mounds and depressions, or irregularly distributed small mounds and subcircular depressions varying in size and spacing. Vertical interval usually <0.3m; horizontal interval usually 3-10m, and surface almost level.
Sometimes called 'crab-hole' soils.

GULLY : An open incised channel in the landscape generally greater than 30cm deep and characterised by moderately to very gently inclined floors and steep walls.

HUMMOCK : A small raised feature above the general ground surface.

LANDFORM ELEMENTS :
Crest : Landform element standing above all points in the adjacent terrain.
Flat : Neither a crest or a depression <3% slope.
Upper slope : Adjacent to and below a crest or flat but not a depression.
Midslope : Not adjacent to a crest, a flat or a depression.
Lower slope :Adjacent to and above a flat or a depression but not a crest.

LITHOSOLS : Shallow soils showing minimal profile development and dominated by the presence of weathering rock and rock fragments.

RILL : A small channel cut by concentrated runoff through which water flows during and immediately after rain.

RUNOFF : That portion of precipitation not immediately absorbed into or detained upon the soil and which thus becomes surface flow.

SCARP/CLIFF : A steep slope terminating a plateau or any level upland surface.

SCRUB : vegetation structure consisting of shrubs 2-8m tall.

SHEET EROSION : The removal of the upper layers of soil by raindrop splash and/or runoff.

SOIL PROFILE :
"A HORIZON" : The top layer of mineral soil. This may consist of two parts:
A_1 HORIZON: Surface soil and generally referred to as the topsoil.
A_2 HORIZON: similar in texture, but paler in colour, poorer in structure, and less fertile.

" B HORIZON" : The layer below the A Horizon. This consists of 2 parts:

B_1 HORIZON: A transitional horizon dominated by properties characteristic of the underlying B_2 horizon.

B_2 HORIZON: typically contains concentrations of silicate clay and/or iron, and/or aluminium and/or translocated organic material.

"C HORIZON" : The parent rock. Recognised by its lack of pedological development, and by the presence of remnants of geologic organization.

"R HORIZON" : Hard rock that is continuous (Charman & Murphy, 1993; 350-1).

SPUR : A ridge which projects downwards from the crest of a mountain as a water-parting (Whittow, 1984).

SUBSOIL : Sub-surface material comprising the B and C Horizons of soil with distinct profiles; often having brighter colours and higher clay contrasts.

SURFACE CONDITION :

Gravelly : Over 60% of the surface consists of gravel (2-69mm).
Hardsetting : Soil is compact and hard.
Loose : Soil that is not cohesive.
Friable : Easily crumbled or cultivated.
Self-mulching : A loose surface mulch of very small peds forms when the soil dries out.

SWALE : A linear level-floored open depression excavated by wind or formed by the build-up of two adjacent ridges.

SWAMP : Watertable at or above the ground surface for most of the year.

TERRACE : A flat or gently inclined surface bounded by a steeper ascending slope on its inner margin and a steeper descending slope on its outer margin (Whittow, 1984).

TOPSOIL : A part of the soil profile, typically the A_1 horizon, containing material that is usually darker, more fertile and better structured than the underlying layers.

UNDERSTOREY : A layer of vegetation below the main canopy layer.

BIBLIOGRAPHY

Banks, R.G. 1995. *Soil landscapes of the Curlewis 1:100,000 sheet.* Department of Conservation and Land Management.

Bates, R.L., and J.A. Jackson (Eds). 1980. *Glossary of Geology.* Second Edition. American Geological Institute, Virginia.

Clark, I.F., and B.J. Cook. 1986. *Geological Science: Perspectives of the Earth.* Australian Academy of Science, Canberra.

Cook, D., and W. Kirk. 19911. *Field Guide to the Rocks and Minerals of the World.* Kingfisher Books, London.

Department of Mineral Resources. 1987. Metallogenic Series Sheet SH 56-6, Grafton.

Department of Mineral Resources. n.d. Information Sheet : Sedimentary Rocks.

Department of Mines. 1973. *Minerals and their Characteristics.* Geological Survey of New South Wales, Number 141.

Desen, J.L., and J. Peterson. 1992. Mapping the Australian Duricrusts: can Distribution be derived from Terrain Maps. *Australian Geographical Studies*, 30(1): 87-94.

Dortch, C. 1984. *Devil's Lair: a study in prehistory.* Western Australian Museum.

Dunnell, R.C. 1971. *Systematics in prehistory.* Free Press, New York.

Fairbridge, R.W. 1968. Induration. *Encyclopaedia of Geomorphology, Encyclopaedia of Earth Science Series,* Vol. III, pp.554-55. Reinbold Book Corporation, New York.

Flenniken, J.L., and L.P. White. 1985. Australian flaked stone tools: a technological perspective. *Records of the Australian Museum*, 36: 131-51.

Gentilli, J. 1968. Duricrust. In R.W. Fairbridge (Ed.), *The Encyclopaedia of Geomorphology, Encyclopaedia of Earth Science Series,* Vol. III, pp.296-7. Reinbold Book Corporation, New York.

Geography Dictionary. 1985. Longman Group, Harlow.

Meehan, B. 1982. *Shell bed to shell midden.* Australian Institute of Aboriginal Studies, Canberra.

Murphy, B., and D.J. Eldridge. 1993. Soils of New South Wales. In P.E.V. Charman & B.W. Murphy (Eds), *Soil: Their Properties and Management.* Sydney University Press.

Simpson, B. 1966. *Rocks and Minerals.* Pergamon Press, Oxford.

Triggs, B. 1985. *Mammal tracks and signs: a fieldguide for southeastern Australia.* Oxford University Press, Melbourne.

Vader, J. 2002. *Red Gold: The Tree that Built a Nation.* New Holland Publishers, Sydney.

Walker J., & M.S. Hopkins. 1990. Vegetation. In R.C. McDonald, R.F. Isbell, J.G. Speight, J. Walker & M.S. Hopkins (Eds), *Australian Soil and Land Survey*, pp. 58-86. Inkata Press, Sydney.

Whittow, J. 1984. *Dictionary of Physical Geography*. Penguin, London.

APPENDICES

Appendix i : Site Types

Site types associated with Indigenous activities and culture

The definitions that follow are for terms used in this report, and do not necessarily apply to their use in different contexts.

Art sites are defined as places where any medium has been applied to a rock surface either as symbols, characters, drawings, paintings, or any other rendition, recognisable as not being a natural discolouration or feature. They also include markings to a rock surface, either by engraving, abrading, or pecking, and which cannot be identified as being a natural feature.

Bora rings are circles of 2-30 metres diameter of compressed earth (from repeated treading or dancing), or stone arrangements, at which men performed initiation ceremonies, and are the most frequently recorded ceremonial sites. Sometimes they occur as two rings joined by a central track in a barbel configuration. They usually occur on level or low-lying country, which is usually the first topographical unit to be cultivated, or utilised for highways and roads, but they may also occur as circular stone arrangements on elevated rock platforms and hilltops. If they are or were present then they are usually either already known and have been recorded, or they have long since been destroyed.

Carved trees are readily recognised by even the untrained observer. The carving is incised either into the outer bark, or more commonly, into the living wood after removal of a section of the bark. The designs frequently consist of 'diamond cross-cuts', but may also consist of stylised animal motifs. Previously unrecorded carved trees are still discovered in relatively remote or inaccessible areas. Carved trees frequently occur near burial sites and/or Bora rings, but in some regions they may have been tribal boundary markers.

Fish traps may occur either in rivers or on seashores. They are recognisable as unnaturally formed stone arrangements that were constructed to trap fish (or eels or turtles) carried into the enclosure in deep water, and which are left stranded within the enclosure as the water level drops. The fish were then caught by nets, hand, or by spear.

Grinding grooves are usually observed on the surfaces of large sedimentary boulders or exposed shelves and outcrops of sedimentary rock along creek banks and beds, or near water. They have been produced by Aborigines using the rock surface to shape and sharpen the edges of stone to produce ground-edged axes, or to sharpen wooden spears (the latter tend to be narrow and deep). Water was used to lubricate the surface of the rock. The grooves frequently occur as linear abraded depressions in the rock, and may each be between 10 and 50 centimetres long, up to 15 centimetres wide, and 2 to 5 centimetres deep. Some sedimentary rock surfaces may exhibit shallow ground depressions of roughly round or elliptical shape, and these are more likely to be associated with seed grinding, root crushing, or other food preparation.

Middens may be identified variously as beach, lagoon, lacustrine, or estuarine, and are most likely to be observed at or above the water line where erosion, topsoil removal, or mining has exposed the shell. The size of the midden can vary enormously, with the smallest comprising a 'one off', "dinner-time camp" (Meehan. 1982), with as few as two or three shells, or a shallow lens of only a few centimetres. The largest middens may extend for many kilometres and may comprise of a number of lenses and layers of shell and ash up to several metres deep. These large middens may be evidence of continuous exploitation of the resource over many thousands of years. Middens of fresh water mussel shell may be

found in eroding creek banks or in eroding terraces, particularly near both existing and defunct water holes.

Isolated shell or fragments may occur on any surface and in any situation. A single shell may have been discarded by a bird, but the presence of use-wear would indicate Aboriginal use of the shell as a tool, which was discarded after use. Such occurrence is likely to be where there is no immediate source of stone material suitable for tool manufacture.

Natural Mythological sites are places of significance to Aborigines, either because they are described in mythological stories or songlines, or because they were used in religious ceremonies. They may occur anywhere and while some are more predictable than others – as for example, permanent water holes, waterfalls, rock promontories, etc., others may have no particularly remarkable features. Seldom is there any recognisable artefactual evidence or anything to distinguish it from similar features in the vicinity. These sites must of necessity be identified by Aboriginal people with an association with the place.

Open sites, campsites, knapping floors, scatters, and isolated artefacts, are most likely to occur on eroded and exposed creek banks, particularly where slope wash or stock trails has removed the humic layer, or on eroded ridges and spurs, particularly near the junctions in watercourses.

Open sites are most likely to be present in greatest numbers near a source of either raw stone material, or potential food resources, or in a natural corridor between two differentially preferred environmental zones, or at the contact between two environmental zones containing different resources.

Artefacts in open scatters are likely to be manufactured from the dominant raw material available; i.e. Greywacke on greywacke-sourced soils, quartz on granite-sourced soils, silcrete and chert on relict sedimentary soils.

Artefact assemblages in open scatters are likely to consist predominantly of discard material, i.e., cores, flakes, flaked pieces, and debitage.

Artefacts exhibiting retouch scars and backing are most likely to occur in sites where secondary activity took place peripheral to the central camp site, although this is a generality and can only be observed where there is sufficient surface visibility to identify peripheral sites. Fragments of flakes with retouch or backing may occur on knapping floors indicating breakage occurring during manufacture, or maintenance areas in which damaged tools have been replaced and discarded.

Isolated artefacts are likely to be most frequently observed where the groundcover obscures all but the larger artefacts, such as cores, and large flakes, or where there is little contrast between the texture of artefactual material and the surface upon which it lies. Artefacts of materials contrasting with the matrix may be visible regardless of size; eg. quartz artefacts may be far more visible than much larger basalt artefacts against a background of dark humic terrace soils.

PADs or Potential Archaeological Deposits are deposits, usually in shelters (but they may also be identified where there are intact deposits in open areas), which although not containing any visible archaeological material, are considered likely to contain archaeological material below the surface. These 'sites' are not recorded as sites on the Aboriginal Site Register, but are identified as places that require subsurface testing to establish whether a site exists or not.

Rock shelters with art or occupation deposits, are most likely to occur where the character of the parent rock is sufficiently massive or consolidated for it to retain a structure that weathers differentially to form shelters and overhangs.

Scarred trees are perhaps the most difficult site type to determine as having been caused by deliberate removal of the bark by humans and not as a consequence of natural events; such as abrasion from falling trees or branches, natural branch attrition, fire damage, or contact from vehicles or stock. They may occur in places wherever there are tree species that produce bark suitable for tool and implement manufacture. While some scars are clearly the consequence of deliberate bark removal by Aborigines (either evidenced by stone axe marks, or identified by Knowledge Holders), some scars were made by settlers, and stockmen, and surveyors who frequently blazed trails and property boundaries by scarring the trees, and by timber men who removed a strip of bark to test the suitability of a tree for logging.

Other site types such as hearths, burials, etc., are less easily predicted, although burials are frequently associated with carved trees, and Bora rings, and hearths with campsites, shelters, and shell middens.

Appendix ii : Details of the Aboriginal Heritage Information Management System

6 August 2002

Archaeological Surveys & Reports
10 Roslyn Ave
Armidale NSW 2350

Attention:

Our Ref: AHIMS#6354
Your Ref :

Dear Sir/Madam,

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE
ABN 30 841 387 271

RE: Aboriginal sites search, Proposed Development for the Following Area Zone 56 Eastings: 484000-495000, Northings: 6543000-6553000

Reference is made to your recent enquiry in respect to whether any Aboriginal sites are registered at the above location.

A search of the National Parks and Wildlife Service's (NPWS) Aboriginal Sites Register database has shown that 8 known Aboriginal sites are currently recorded in or near the proposed development area (refer attached report for any site details & the area that was searched).

The following qualifications apply to the Aboriginal Sites Register database;

- The database only includes recorded sites.
- Large areas of New South Wales have not been the subject of systematic survey or the recording of Aboriginal history. These areas may contain sites which are not currently listed on the Aboriginal Sites Register.
- Site records come from a variety of sources and are variable in their accuracy. When a database search identifies sites in or near the area it is recommended that the exact location of the sites be determined by relocation on the ground.
- The criteria used to search the database are derived from information provided by the client and assume that this information is correct.
- This information can only be used for the purpose it was requested for not to made available to public.

You should be aware that all Aboriginal sites are protected under the *National Parks and Wildlife Act 1974,* regardless of their inclusion on the Sites Register, and it is an offence to damage or destroy them without the prior permission of the Director-General of the NPWS.

In determining development applications under the *Environmental Planning and Assessment Act 1979,* local councils must include matters relating to Aboriginal heritage in the decision making process. As part of this process, the NPWS may be asked for advice on whether an area proposed for development should be subject to Aboriginal heritage assessment. NPWS advice is broadly based on the following criteria;

1) The NPWS would normally recommend an Aboriginal heritage assessment under the following circumstances:

43 Bridge Street
PO Box 1967
Hurstville NSW
2220 Australia
Tel: (02) 9585 6444
Fax: (02) 9585 6555
www.npws.nsw.gov.au

- the Sites Register identifies sites in or near the development area, and these could be impacted during or after the development (this includes indirect impacts, such as increased run-off or sedimentation, changes in visitation, etc).

- the proposed development is likely to impact areas of bushland or undisturbed ground.

- the proposed development is likely to impact areas containing sandstone outcrops (greater than $1m^2$), rock shelters and overhangs, old growth trees, sand bodies, and ground adjacent to creeks, rivers, lakes and swamps.

- the proposed development is likely to impact an area of importance to the Aboriginal community not included in the above (eg. story places, buildings, missions, etc)

2) The NPWS would **not** normally recommend an Aboriginal heritage assessment under the following circumstances:

- the proposed development is within land previously subject to intensive ground disturbance, such as quarrying, repeated market gardening, earthworks for pipelines, roads, sports fields etc. However it should be noted that sites could still occur in these context for example, ploughing generally impacts the top 20cm of ground and there is potential that *undisturbed archaeological deposit may occur* in areas where soil depth exceeds 20cm. *Scarred trees* may be located within road reserves and adjacent sport fields, etc.

- the development is within an existing residential or industrial area, or the redevelopment of an existing building is proposed, and the above criteria (listed in section 1) do not apply.

An Aboriginal heritage assessment would provide you with information about the location and significance of sites or sensitive areas, as well as advice on appropriate management options for these areas. It is recommended that an Aboriginal heritage assessment be carried out by a person qualified in undertaking Aboriginal heritage assessments. It is also recommended that the Aboriginal community (Local Aboriginal Land Council, Tribal Council etc) is contacted and its views sought on possible impacts to Aboriginal heritage.

If the proposed development area is found to contain an Aboriginal site, reference should be made to the NPWS requirements for Aboriginal heritage under the Integrated Development Approval Process (*Environmental Planning & Assessment Amendment Act 1997*).

If you wish to discuss this further, please contact Archaeologist, Rebecca Edwards Booth (02) 66598225

Yours faithfully

Vanessa Atkins
Aboriginal Information Officer
Cultural Heritage Service Division

AHIMS
Aboriginal Heritage Information Management System

List of Sites (List)

ahims6354

Grid Reference Type = AMG Zone = 56 Easting From = 484000 Easting to = 495000 Northing From = 6543000 Northing to = 6553000 Feature Search Type = AHIMS Features

Site ID	Site Name	Grid.Ref Type	Zone	Easting	Northing	Site Features	Site Types (recorded prior to June 2001)	Recording (Primary)	Reports (Catalogue Number)
30-3-0029	Kundabung;	AMG	56	484100	6543700	CMR	Bora/Ceremonial		
30-3-0028	Kundabung Burials	AMG	56	484100	6544200	BUR,	Burial/s	Kelly,R (01-JAN-73)	
30-3-0030	Maria River;	AMG	56	490000	6549500	CMR	Bora/Ceremonial		
30-3-0099	Beranghi Mountain;Maria River;	AMG	56	490500	6548500	STA,	Stone Arrangement	Kelly,R (01-JAN-79)	
30-3-0031	Beranghi;Connection Creek;	AMG	56	491300	6545300	AFT,	Open Camp Site	Campbell, (01-JAN-68)	
30-3-0032	Beranghi;Connection Creek;	AMG	56	491600	6545500	AFT,	Open Camp Site	Campbell, (01-JAN-69)	
30-3-0033	Beranghi;Connection Creek;	AMG	56	491800	6545000	AFT,	Open Camp Site	Campbell, (01-JAN-68)	
30-3-0037	Crescent Head;Saltwater Lake;	AMG	56	~~494000~~ 497400	6550000	STA, CMR	Bora/Ceremonial Stone Arrangement		

Number of Sites :8 **Page 1 of 1** **06/08/2002 15:36:40**

Appendix iii – Site Recording for Site #30-3-0099

RK/2/NS-5/204

1. Map Name Hastings SH.56 - 14 ..... 5. Site No. 30-3-99
2. Scale 1:250,000 ..... 6. Site type Stone
3. Grid ref 59791386 (MP) 4905 5485 (MGA) ..... arrangement
4. Site name(s) Beringhi Mount Stone Arrangement ..... 7. Classification .....

8. Air photo ref .....
9. Cadastral .....
10. Land Status FREE HOLD ..... 11. .....

12. **Directions for site relocation**

This site is situated directly west between Crescent Head and Kunabung and approximatel; 8 km. south east of Kempsey. Access to this site is via the Kempsey, Crescent Head linkroad. After travelling along this road for about 9 km from Kempsey a road leads off to the right. This road is called Beringhi Road which will continue to a minor river about 3 km from the Crescent Head/Kempsey linkroad. A bush track leads off to the right. Once one has travelled a further 500 metres along this bush track a gate will appear. This site is then 90 degrees from the fenceline slightly to the left of the gate. I anticipate it would be almost impossible to miss finding this site from this point as it is located on the crest of the ridge.

13. Owner .....
Address .....
.....
Attitude .....

14. Tenant/Manager Roy Langham
Address Crescent Head Road
Ph: 660327
.....
Attitude Very pleasant and eager to protect the site.

15. **Site Description** This stone arrangement site I believe had been destroyed and is only remnant of what it was originally like when the indigenous people had used the area for ceremonies. The most distinct feature of this site is circular of mounded rocks which is an approximate height of one metre. These circles are one metre and a half in diameter with an entrance of a little less than a metre. The entrance appears to be in an easterly aspect. See photographs on following pages. This site is situated directly on the crest of the ridge. There is also an area of land which is very flat and cleared of all vegetation. The area is well grassed. This cleared area is a form of nature however consultant Arther Gill says this area of land was cleared for part of the initiation ground, however there is no evidence ther to support this statement.

16. Reasons for investigation Carrying out Aboriginal site survey.....

4. **Site name(s)** Beranghi.Mount.Stone.Arrangement..... 7. **Classification** .....

8. **Air photo ref** .....

9. **Cadastral** .....

10. **Land Status** FREE HOLD..... 11. .....

12. **Directions for site relocation**

This site is situated directly west between Crescent Head and Kunabung and approximatel 8 km. south east of Kempsey. Access to this site is via the Kempsey, Crescent Head linkroad. After travelling along this road for about 9 km from Kempsey a road leads off to the right. This road is called Beringhi Road which will continue to a minor river about 3 km from the Crescent Head/Kempsey linkroad. A bush track leads off to the right. Once one has travelled a further 500 metres along this bush track a gate will appear. This site is then 90 degrees from the fenceline slightly to the left of the gate. I anticipate it would be almost impossible to miss finding this site from this point as it is located on the crest of the ridge.

13. **Owner** ..... 14. **Tenant/Manager** Roy Langham.....

Address ..... **Address** Crescent Head Road
Ph: 660327
.....

Attitude ..... **Attitude** Very pleasant and eager to.... protect the site.

15. **Site Description** This stone arrangement site I believe had been destroyed and is only remnant of what it was originally like when the indigenous people had used the area for ceremonies. The most distinct feature of this site is circular of mounded rocks which is an approximate height of one metre. These circles are one metre and a half in diameter with an entrance of a little less than a metre. The entrance appears to be in an easterly aspect. See photographs on following pages. This site is situated directly on the crest of the ridge. There is also an area of land which is very flat and cleared of all vegetation. The area is well grassed. This cleared area is a form of nature however consultant Arther Gill says this area of land was cleared for part of the initiation ground, however there is no evidence th to support this statement.

16. **Reasons for investigation** .Carrying.out.Aboriginal.site.survey.....

17. **Condition** ..Vandalised and not very impressive but on the other hand Ray Langham... ..says.the.site.is more impressive after.the area was burnt.....

18. **Interpretation** .Precise interpretive unknown.....

19 **Visitation** I am of the opinion this site would not cater for a high visitation.....

20. **Recommendations** ..I am told..the owner of the property knows of its existence and. .is in favour of preserving the site. Therefore I would recommend a sign be..... erected there showing the penalties and possible conviction for any further

Spotted Gum. The immediate region is that of Ironstone which [illegible] sandy soil. Wildlife would be here in abundance with large marsupials being the prominant species. Birdlife here would be here in a wide variety with most east cost Passerines and Non Passerines being represented.

---

22. **Relation to other sites in locality**

It appears this site would be in association with the Bora ground at Richardson Crossing and the Bora grounds at Kundabung and the Bora ground.

---

23. **Details of artifact collections**

I am of the opinion this site was hand picked on many occasions therefore no artefacts were to be seen.

---

24. **Is plan or diagram of site attached?** **Yes/No**

25. **Are annotated photographs attached?** **Yes/No** **How many?** 1

26. **Other additions** Sketch map of area for relocation of site.

---

27. **Importance of site to Aborigines** This site does not appear to be of any significance to living Aborigines.

28. **Source of this information** Oral

---

29. **Oral sources of information** I was shown the site by Arther Gill of Bloomfield Street, South Kempsey. Arthur is of European descent.

30. **Written references** The site had been previously recorded by the Service.

---

31. **Recorded by** Ray Kelly **Filed by** Sue O'Connor

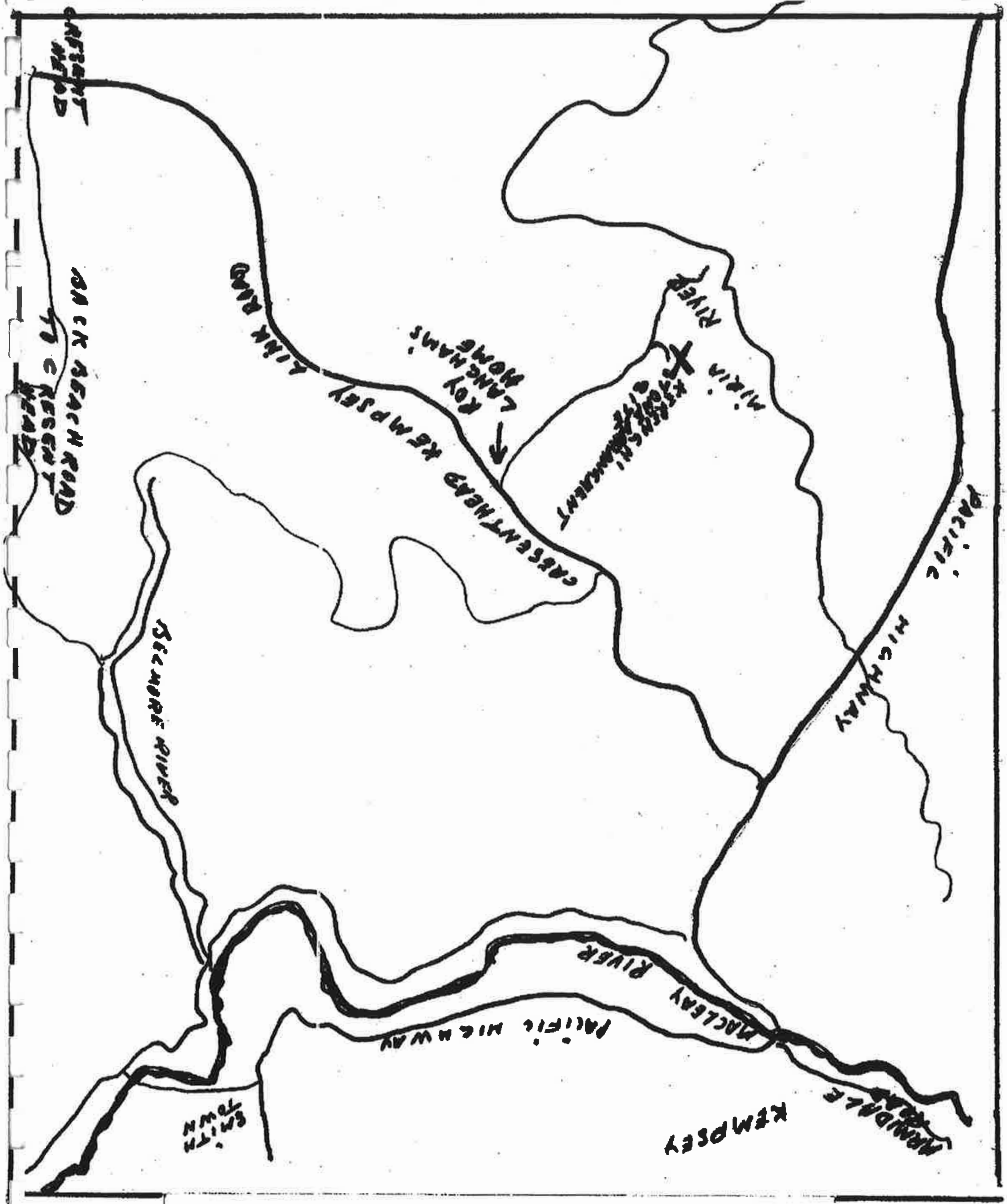
Address 234 Powell Street,
GRAFTON 2460

Date 27.4.79 **Date** 15-6-81

4 MAY 1981

-3-91


KEMPSEY
MACLEAY RIVER
MACLEAY
Frederickton
Warwick Park
Warwick Creek
Green Hill
Racecourse
Chapmans
Airport
Sherwood
Ballymore
Belgrave Falls
Oaklands
East Kempsey Swamps
Cemetery
VERGES SWAMP
PACIFIC HIGHWAY
RAILWAY
Christmas Creek
Burnt Bridge
Comfort Hill
MARIA RIVER
STATE FOREST
Maria River
Kundabung
Smiths Creek
Victoria Valley
Landing Ground
Mingaletta
Floodgates
Ruins
Numerous
STONE ARRANGEMENT SITE 90


CRESCENT HEAD
BACK BEACH ROAD TO CRESCENT HEAD
KEMPSEY LINK RD
ROY LANGHAM'S HOME
CRESCENT HEAD
BELMORE RIVER
PACIFIC HIGHWAY
MACLEAY RIVER
PACIFIC HIGHWAY
SMITH TOWN
KEMPSEY
ARMIDALE ROAD

[redacted]