Constraints and Opportunities Assessment

Subdivision of Lot 5 DP 823737, Pokolbin

Prepared by:

RPS AUSTRALIA EAST PTY LTD

PO Box 428
Hamilton NSW 2303

T: +61 2 4940 4200
F: +61 2 4961 6794
E: newcastle@rpsgroup.com.au

Client Manager: Matt Doherty
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Prepared for:

BELFORD LAND CORPORATION

C/- JBA Urban Planning Consultants
PO Box 375
North Sydney NSW 2059

T: +61 2 9956 6962
E: GKirkby@jbaurban.com.au

Disclaimers

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Summary

RPS Australia East Pty Ltd (RPS) was engaged by Belford Land Corporation (the proponent) to produce a Constraints and Opportunities Assessment (COA) for a proposed rezoning and subdivision of Lot 5 DP 823737. The COA has considered the relevant requirements under the *Environmental Planning and Assessment Act 1979* (EP&A Act) and NSW *Threatened Species Conservation Act 1995* (TSC Act). A preliminary assessment of Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) has also been conducted. RPS has conducted high level field investigations on the site in order to provide an overview of potential constraints and opportunities for the proposed rezoning and subdivision, focussing upon the potential for the site to support threatened species, populations and Endangered Ecological Communities (EECs) listed under the TSC Act 1995 and/or EPBC Act.

Key ecological features identified on the site that may represent constraints for the zoning proposal include:

- Hunter Lowland Redgum Forest EEC;
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC;
- The likely occurrence of *Eucalyptus glaucina* (Slaty Red Gum) across the site within vegetation communities and/or as paddock trees;
- Potential habitat for a range of threatened fauna species, including the identified Speckled Warbler, Large-eared Pied Bat, Eastern Freetail-bat, Little Bentwing Bat and Eastern Bentwing Bat;
- Connectivity between large patches of vegetation to the west and northeast through vegetation in the south of the site.

Given the site is proposed to have a minimum lot size of 10 hectares, opportunities exist for the avoidance of many potential impacts upon identified ecological features through strategic lot layout and design. This could allow for the retention of vegetated areas of the site and provide future opportunities to enhance natural values and increase potential habitat available for threatened flora and fauna species through:

- Implementation of weed control programs, particularly to target *Olea europea* subsp. *cuspidata* (African Olive), within the understorey of the River Oak and Swamp Oak forests;
- A targeted Noisy Miner (*Manorina melanocephala*) control program to allow for other native bird species to utilise the area;
- Revegetation of the shrub layer; and
- Strengthening the link between surrounding areas of vegetation to the west and northeast by active planting or encouraging further regrowth in the south of the site.

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Abbreviations

CHISGGBF	Central Hunter Ironbark - Spotted Gum - Grey Box Forest
COA	Constraints and Opportunities Assessment
DCP	Development Control Plan
DEC	NSW Department of Environment & Conservation (now OEH)
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (now DoE)
DoE	Commonwealth Department of Environment
EEC	Endangered Ecological Community
EPBC Act	Commonwealth *Environment Protection & Biodiversity Conservation Act 1999*
EP&A Act	NSW *Environmental Planning & Assessment Act 1979*
HBOC	Hunter Bird Observers Club
HEZ	Hunter Economic Zone (formerly known as Hunter Employment Zone)
HLRF	Hunter Lowland Redgum Forest
HSO	Harper Somers O'Sullivan Pty Ltd
JBA	JBA Urban Planning Consultants
KTP	Key Threatening Process
LEP	Local Environment Plan
LHCCREMS	Lower Hunter and Central Coast Regional Environmental Management Strategy
LHSGIF	Lower Hunter Spotted Gum – Ironbark Forest
MNES	Matters of National Environmental Significance
NPWS	NSW National Parks & Wildlife Service
OEH	NSW Office of Environment & Heritage
RPS	RPS Australia East Pty Ltd
SEPP	State Environmental Planning Policy
TSC Act	NSW *Threatened Species Conservation Act 1995*

1.0 Introduction

RPS Australia East Pty Ltd (RPS) was engaged by Belford Land Corporation (the proponent) to produce a Constraints and Opportunities Assessment (COA) for a proposed rezoning and subdivision of Lot 5 DP 823737, hereafter referred to as 'the site'. The COA will consider the relevant requirements under the *Environmental Planning and Assessment Act 1979* (EP&A Act) and NSW *Threatened Species Conservation Act 1995* (TSC Act). A preliminary assessment of Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) has also been conducted.

1.1 Site Particulars

Locality – Pokolbin

LGA – Singleton

Area – The subject site is approximately 304.9 hectares (ha) in total. The entire site is currently zoned as RU1 Primary Production under the Singleton Council LEP 2013 (See **Figure 1**).

Current Land Use – The site is currently utilised for agricultural purposes.

Geology – The majority of the site occurs on the Branxton Formation (Maitland Group) of Permian Sediments of the Hunter Valley, with the southern portion of the site influenced by Muree Sandstone (Maitland Group) and Mulbring Siltstone (Maitland Group) Formations.

Topography – The subject site occurs on lower slopes that gently drain to the northwest, east and south.

Vegetation – Regional vegetation mapping has been described for the site by Peake (2006) with adjacent areas to the south mapped by NPWS (2000). The site has largely been cleared of native vegetation, with remnant patches of vegetation consisting of open forest communities commensurate with Central Hunter Ironbark – Spotted Gum – Grey Box Forest (CHISGGB) and riparian areas of Swamp Oak Forest and River Oak Forest.

1.2 Description of the Proposal

The proposal seeks to amend the Singleton Council LEP (2013) and rezone Lot 5 DP 823737 from RU1 Primary Production to RU4 Primary Production Small Lots. The proposal seeks to reflect permitted land uses within RU4 zoned lands to the immediate south of the site. Rezoning would reduce minimum lot size to 10 hectares, permitting up to 31 lots on the site. This would allow for multiple uses for lots on site, including viticulture and tourism, while providing opportunites to conserve existing patches of remnant vegetation.

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

Dyrring
Fishers Hill
Singleton
Elderslie
Singleton Military Area
Hillsborough (North)
A43
Allandale
Maitland
B82
M15
135
Pokolbin State Forest
Kurri Kurri
B68
M1
Cessnock
Lenaghan
Werakata National Park
B89
North Channel Hunter River
B63
0 5 10
kilometres
Paynes Crossing
Ellalong
Edgeworth
Newcastle
bing
© Harris Corp, Earthstar Geographics LLC Earthstar Geographics SIO Earthstar Geographics SIO © 2014 Microsoft Corporation © AND © 2014 MapData Sciences Pty Ltd, PSMA

SCALE: 1:200,000 AT SIZE A3

Proposed Lot Layout

Legend
Site Boundary
N

0 0.5 1
kilometres

FIGURE 1: SITE LOCATION AND PROPOSED LOT LAYOUT

LOCATION: POKOLBIN

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 09/12/2014
PURPOSE: COA

LAYOUT REF: "J:\JOBS\124k\124712 Pokolbin\10 - Drafting\MapInfo Workspaces\Eco"
VERSION (PLAN BY): JS (A A3)

CLIENT: BELFORD LAND CORPORATION
JOB REF: 124712

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

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1.3 Scope of the Study

The scope of this COA is to:

- Confirm regional vegetation community mapping across the site;
- Undertake targeted searches for threatened flora and opportunistic surveys for threatened fauna; and
- Conduct habitat assessments to understand potential for threatened fauna to utilise the site.

In addition to the survey work conducted within the site, consideration has been afforded to adjacent areas in order to appreciate the environmental context of the site. This has included analysis of the connectivity (if any) between vegetation on site and surrounding areas. The above undertakings will provide a broad understanding of potential constraints and opportunities within the site to inform the planning proposal.

The report recognises the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act) as amended by the *Environmental Planning and Assessment Amendment Act 1997* (EP&AA Act). Consideration is also made with regard to any Matters of National Environmental Significance (MNES) listed federally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This report considers a number of guiding documents, including:

- Lower Hunter Central Coast Regional Flora & Fauna Survey Guidelines (LHCCREMS 2002);
- Draft Guidelines for Threatened Species Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979* (DEC 2004); and
- Matters of National Environmental Significance – Significant Impact Guidelines 1.1 (DEWHA 2009).

1.4 Qualifications and Licensing

Qualifications

This report was written by Joel Stibbard (Ecologist) BSc, and reviewed by Matt Doherty (Technical Director – Ecology) BLMC of RPS.

Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S100536 (Valid 31 December 2014);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2015);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2016); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2017).

2.0 Methodology

2.1 Desktop Survey

2.1.1 Database Searches

Desktop searches were undertaken of State and Commonwealth threatened species databases to ensure all relevant species were considered in the assessment herewith.

- Review of threatened fauna and flora records contained in the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife within a 10km radius of the subject site (November 2014); and
- Review of threatened fauna and flora records contained in the Department of Environment (DoE) Protected Matters Search within a 10km radius of the subject site (October 2014).

2.1.2 Regional Vegetation Mapping

Analysis of regional mapping that exists for the site and surrounds was conducted to provide an understanding of the vegetation communities likely to be encountered during field surveys. Two regional mapping works were found to exist for the communities that occur on the site and adjacent areas, including:

- *The Vegetation of the Central Hunter Valley, New South Wales* (Peake 2006); and
- *Vegetation Survey, Classification and Mapping: Lower Hunter and Central Coast Region* (NPWS 2000)

2.2 Field Survey

2.2.1 Targeted Flora Searches

A review of database searches for threatened species (see **Section 2.1.1**) was undertaken to provide additional understanding of the potential for threatened flora species to occur within the site. Targeted searches were subsequently conducted across the site for all potentially occurring threatened flora species.

2.2.2 Fauna Searches

A review of database searches was undertaken prior to field surveys to provide an understanding of the potential for threatened fauna species to utilise the site. Formal bird surveys, waterbody and herpetological searches, microbat echolocation recordings and nocturnal surveys (including spotlighting and forest owl call playback) were conducted to provide a broad census of fauna species inhabiting the site.

Birds were identified by direct observation, recognition of calls, and/or distinctive features such as nests, feathers, and owl regurgitation pellets, etc. Reptiles and amphibians were recorded via targeted herpetofauna searches, which involved checking under logs, rocks and dumped rubbish piles, and by call recognition (frogs) along established waterways. Opportunistic sightings of fauna species were recorded throughout the field surveys, and secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were noted. Such indicators included:

- Distinctive scats left by mammals;
- Scratch marks made by various types of arboreal animals;
- Nests made by various guilds of birds;
- Feeding scars on Eucalyptus trees made by gliders;
- Whitewash, regurgitation pellets and prey remains from owls;
- The calls of fauna;

- Skeletal material of vertebrate fauna; and
- Footprints left by mammals.

2.2.3 Vegetation Communities

For the purposes of this high level assessment, confirmation of regional vegetation mapping works for the site (see **Section 2.1.2**) was conducted via the collection of Rapid Data Points (RDPs) that identify the dominant species within each vegetation strata. The location and extent of each patch of vegetation on the site was accurately delineated during field surveys to provide a detailed understanding of vegetation coverage across the site.

2.2.4 Habitat Assessment

Recent field surveys included an assessment of the habitat that occurs across the site, predominantly focussing upon the areas of remaining vegetation.

Particular habitat features noted include:

- Hollow-bearing trees;
- Dams and Ephemeral Creeklines – which were surveyed for utilisation by amphibians and waterfowl;
- Other attributes such as presence of *Allocasuarina* spp., mistletoe, hollow/fallen timber, understorey diversity, understorey nectar were noted as potential habitat for a range of fauna species; and
- Man-made structures including abandoned buildings were identified for their potential to provide habitat for species such as reptiles and microbats.

Habitat assessment for specific threatened species known to occur, or with the potential to occur, was undertaken. This was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

2.2.5 Limitations

2.2.5.1 Seasonality

Threatened flora species should be surveyed within their respective flowering periods to ensure accurate identification. Some plant species that occur in the local area, such as cryptic species, are annuals and are present only in the seed bank for much of the year. Other plant species are perennial, but are inconspicuous or difficult to identify unless flowering and may not flower each season (e.g. orchids).

The flowering and fruiting plant species that attract some nomadic or migratory threatened species often fruit or flower in cycles spanning a number of years. Furthermore, these resources might only be accessed in some areas during years when resources more accessible to threatened fauna species fail. As a consequence, threatened species may be absent from some areas where potential habitat exists for extended periods and this might be the case for the above-mentioned opportunistic nomadic or migratory species.

2.2.5.2 Data Availability & Accuracy

The collated threatened flora and fauna species records provided by OEH Atlas of NSW Wildlife are known to vary in accuracy and reliability. This is usually due to the reliability of information provided to the NPWS for collation and/or the need to protect specific threatened species locations. During the review of threatened

species records sourced from OEH Atlas of NSW Wildlife, consideration has been given to the date and accuracy of each threatened species record in addition to an assessment of habitat suitability within the Study Area. Similarly, EPBC Protected Matters Searches provide a list of threatened species and communities that have been recorded within 10 km of the Study Area, or which have suitable habitat within the wider area, and are subject to the same inherent inaccuracy issues as the State derived databases.

In order to address these limitations in respect to data accuracy, threatened species records have only been used to provide a guide to the types of species that occur within the locality of the site. Consequently, habitat assessment and the results of surveys conducted within the site and surrounds have been used to assess the likelihood of occurrence of threatened species, populations and ecological communities to occur therein.

3.0 Results

3.1 Desktop Survey

3.1.1 Threatened Species

A review of the relevant literature combined with database searches identified the following threatened species, populations and ecological communities as being known, potentially occurring, or possibly having habitat within 10km of the site ('the locality').

Table 1 Threatened Flora and Fauna Desktop Search Results

Scientific Name	Common Name	TSC Act	EPBC Act	Key Record and Source
Flora				
Acacia bynoeana	Bynoe's Wattle	E	V	Recorded within 10km of the site[1]
Acacia pendula	Weeping Myall	E (pop.)		Recorded within 10km of the site[1]
Allocasuarina glareicola		E	E	Species or species habitat may occur within area[2]
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Species or species habitat may occur within area[2]
Cymbidium caniculatum		E (pop.)	-	Recorded within 10km of the site[1]
Eucalyptus camaldulensis	River Red Gum	E (pop.)	-	Recorded within 10km of the site[1]
Eucalyptus castrensis	Singleton Mallee	E	-	Recorded within 10km of the site[1]
Eucalyptus fracta	Broken Back Ironbark	V	-	Recorded within 10km of the site[1]
Eucalyptus glaucina	Slaty Red Gum	V	V	Recorded within 10km of the site[1]
Eucalyptus parramattensis subsp. decadens	Earp's Gum	V	V	Recorded within 10km of the site[1]
Eucalyptus pumila	Pokolbin Mallee	V	V	Recorded within 10km of the site[1]
Euphrasia arguta		CE	CE	Species or species habitat may occur within area[2]
Grevillea parviflora subsp. parviflora	-	V	V	Species or species habitat may occur within area[2]
Leionema lamprophyllum subsp. *obovatum*	Shiny Phebalium	E (pop.)	-	Recorded within 10km of the site[1]
Persoonia pauciflora	North Rothbury Persoonia	CE	CE	Recorded within 10km of the site[1]
Prasophyllum sp. Wybong	A leek-orchid	-	CE	Species or species habitat may occur within area[2]
Prostanthera cineofolia	Singleton Mint Bush	V	V	Recorded within 10km of the site[2]
Pterostylis gibbosa	Illawarra Greenhood	E	E	Species or species habitat may occur within area[2]
Rutidosis heterogama	Heath Wrinklewort	V	V	Recorded within 10km of the site[2]
Streblus pendulinus	Siah's Backbone	-	E	Species or species habitat may occur within area[2]
Thesium australe	Austral Toadflax	V	V	Species or species habitat may occur

Scientific Name	Common Name	TSC Act	EPBC Act	Key Record and Source
				within area[2]
Amphibians				
Heleioporus australiacus	Giant Burrowing Frog	V	V	Recorded within 10km of the site[1]
Litoria aurea	Green and Golden Bell Frog	E	V	Species or species habitat may occur within area[2]
Litoria littlejohni	Littlejohns Tree Frog	V	V	Species or species habitat may occur within area[2]
Reptiles				
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Species or species habitat may occur within area[2]
Birds				
Botaurus poiciloptilus	Australasian Bittern	E	E	Species or species habitat may occur within area[2]
Rostratula australis	Australian Painted Snipe	E	V	Species or species habitat may occur within area[2]
Hieraaetus morphnoides	Little Eagle	V	-	Recorded within 10km of the site[1]
Lophoictinia isura	Square-tailed Kite	V	-	Recorded within 10km of the site[2]
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Recorded within 10km of the site[1]
Glossopsitta pusilla	Little Lorikeet	V	-	Recorded within 10km of the site[1]
Lathamus discolor	Swift Parrot	E	E	Recorded within 10km of the site[1]
Ninox connivens	Barking Owl			Recorded within 10km of the site[1]
Ninox strenua	Powerful Owl	V	-	Recorded within 10km of the site[1]
Tyto novaehollandiae	Masked Owl	V	-	Recorded within 10km of the site[1]
Tyto tenebricosa	Sooty Owl	V	-	Recorded within 10km of the site[1]
Climacteris picumnus victoriae	Brown Treecreeper (eastern subsp.)	V	-	Recorded within 10km of the site[1]
Chthonicola sagittata	Speckled Warbler	V	-	Recorded within 10km of the site[1]
Dasyornis brachypterus	Eastern Bristlebird	E	E	Species or species habitat may occur within area[2]
Anthochaera phrygia	Regent Honeyeater	CE	E	Recorded within 10km of the site[1]
Epthianura albifrons	White-fronted Chat	V	-	Recorded within 10km of the site[1]
Grantiella picta	Painted Honeyeater	V	-	Recorded within 10km of the site[1]
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subsp.)	V	-	Recorded within 10km of the site[1]
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	Recorded within 10km of the site[1]
Daphoenositta chrysoptera	Varied Sittella	V	-	Recorded within 10km of the site[1]
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Recorded within 10km of the site[1]
Petroica boodang	Scarlet Robin	V	-	Recorded within 10km of the site[1]
Stagonopleura guttata	Diamond Firetail	V	-	Recorded within 10km of the site[1]

Scientific Name	Common Name	TSC Act	EPBC Act	Key Record and Source
Mammals				
Dasyurus maculatus maculatus	Spotted-tailed Quoll (SE Mainland Pop)	V	E	Recorded within 10km of the site[4]
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Recorded within 10km of the site[1]
Phascolarctos cinereus	Koala (Qld, NSW, Vic and ACT Populations)	V	V	Recorded within 10km of the site[1]
Petaurus australis	Yellow-bellied Glider	V	-	Recorded within 10km of the site[1]
Petaurus norfolcensis	Squirrel Glider	V	-	Recorded within 10km of the site[1]
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Recorded within 10km of the site[1]
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	Species or species habitat may occur within area[2]
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Recorded within 10km of the site[1]
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-	Recorded within 10km of the site[1]
Mormopterus (Micronomus) norfolkensis	Eastern Freetail-bat	V	-	Recorded within 10km of the site[1]
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Recorded within 10km of the site[1]
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Recorded within 10km of the site[1]
Miniopterus australis	Little Bentwing Bat	V	-	Recorded within 10km of the site[1]
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	V	-	Recorded within 10km of the site[1]
Myotis macropus	Southern Myotis	V	-	Recorded within 10km of the site[1]
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Recorded within 10km of the site[1]
Vespadelus troughtoni	Eastern Cave Bat	V	-	Recorded within 10km of the site[1]
Pseudonomys novaehollandiae	New Holland Mouse	-	V	Recorded within 10km of the site[1]
Pseudonomys oralis	Hastings River Mouse	E	E	Species or species habitat may occur within area[2]
Endangered Ecological Communities				
Central Hunter Grey-Box Ironbark Woodland		E	-	Recorded within 10km of the site[1]
Central Hunter Ironbark – Spotted Gum – Grey Box Forest		E	-	Recorded within 10km of the site[1] Mapped as occurring on the site[3]
Coastal Saltmarsh		E	V	Recorded within 10km of the site[1]
Freshwater Wetlands on Coastal Floodplains		E	-	Recorded within 10km of the site[1]
Hunter Floodplain Red Gum Woodland		E	-	Recorded within 10km of the site[1]
Hunter Lowland Redgum Forest		E	-	Recorded within 10km of the site[1] Mapped as occurring on the site[3]
Hunter Valley Footslopes Slaty Gum Woodland		V	-	Recorded within 10km of the site[1]
Hunter Valley Vine Thicket		E	-	Recorded within 10km of the site[4]
Hunter Valley Weeping Myall Woodland		E	CE	Recorded within 10km of the site[4]

Scientific Name	Common Name	TSC Act	EPBC Act	Key Record and Source
Kurri Sand Swamp Woodland		E	-	Recorded within 10km of the site[4]
Littoral Rainforest		E	CE	Recorded within 10km of the site[4]
Lower Hunter Spotted Gum – Ironbark Forest		E	-	Recorded within 10km of the site[1] Recorded adjacent to the site[4]
Lower Hunter Valley Dry Rainforest		V	-	Recorded within 10km of the site[1]
Lowland Rainforest		E	CE	Recorded within 10km of the site[1]
River-Flat Eucalypt Forest on Coastal Floodplains		E	-	Recorded within 10km of the site[1]
Swamp Oak Floodplain Forest		E	-	Recorded within 10km of the site[1]
Swamp Sclerophyll Forest on Coastal Floodplains		E	-	Recorded within 10km of the site[1]
Sydney Freshwater Wetlands		E	-	Recorded within 10km of the site[1]
Warkworth Sands Woodland		E	-	Recorded within 10km of the site[1]
White Box Yellow Box Blakely's Red Gum Woodland		E	CE	Recorded within 10km of the site[1]

Key:
V Vulnerable
E Endangered
CE Critically Endangered

(1) OEH (2014) *Atlas of NSW Wildlife*, NSW Office of Environment and Heritage (Accessed 6th November 2014

(2) DoE (2014) Protected Matters Search, Commonwealth Department of Environment (Accessed 24th October 2014)

(3) Peake (2006) *The Vegetation of the Central Hunter Valley, New South Wales*. Hunter-Central Rivers CMA

(4) NPWS (2000) *Vegetation Survey, Classification and Mapping: Lower Hunter and Central Coast Region*. NSW National Parks and Wildlife Service, Sydney

3.1.2 Vegetation Mapping

Large areas of the site are devoid of native vegetation and therefore do not represent any vegetation communities included in regional mapping works. Those areas of the site that include remnant vegetation have been mapped as four distinct vegetation communities (Peake 2006) including:

- Map Unit (MU) 24 – Hunter Lowlands Red Gum Forest (~0.29 ha);
- MU27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest (~66.17 ha);
- MU28 – Central Hunter Swamp Oak Forest (~14.77 ha); and
- MU30 – Hunter Valley River Oak Forest (~4.62 ha).

3.2 Field Survey

3.2.1 Site Survey Details

Table 2 Survey Dates, Times, Activities & Weather Conditions

DATE	TIME	WEATHER*	
		Temperature (°C)	*Rain (24 hrs to 9:00am)*
10 November 2014	13:00 – 23:00	17.0 – 29.7	0 mm
11 November 2014	07:30 – 16:00	15.5 – 22.7	0 mm
12 November 2014	13:00 – 23:00	14.5 – 25.5	0 mm

*Data obtained for Cessnock Weather Station (www.bom.gov.au) and Calculated as AEDT

3.2.2 Targeted Flora Searches

Targeted searches for threatened flora within potential habitat on site failed to positively identify any threatened species. However, the site contains a large contingent of Eucalypts that may include individual *Eucalyptus glaucina* (Slaty Red Gum) trees. This species can only be definitively distinguished from other closely related Red Gum species, particularly *Eucalyptus tereticornis* (Forest Red Gum), by the flower buds. The species is also known to effectively hybridise with *E. tereticornis* in nearby areas (Bell and Driscoll 2005). Extensive searches at the base of many of these trees failed to locate any flower buds, and therefore the species could not be positively identified. Broad scale mapping of the site has provided an indication of the location and density of Red Gum trees and is provided in **Figure 2**.

A full list of flora species identified on the site is provided in **Appendix 2**. Given the high level assessment conducted for this report, the flora species list is limited to the more dominant species identified on the site. A comprehensive list would be provided following future detailed ecological assessments.

3.2.3 Fauna Species

Bird surveys, waterbody searches and opportunistic encounters with fauna identified 57 species, including 38 birds, 11 microbats, 3 (additional) mammals and 5 herpetofauna species. One threatened bird species, the Speckled Warbler (*Chthonicola sagittata*), was encountered within the open forest in the south of the site. In addition, microbat echolocation recordings identified four threatened microbat species on the site including:

- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Little Bentwing Bat (*Miniopterus australis*);
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*); and
- Eastern Freetail-bat (*Mormopterus (Micronomus) norfolkensis*.

These species are all listed as Vulnerable under the TSC Act, and the Large-eared Pied Bat is also listed as Vulnerable under the EPBC Act. The locations of these records are provided in **Figure 2**.

A full list of fauna species identified on the site is provided in **Appendix 1.**

3.2.4 Vegetation Communities

The vegetation communities on the site were discovered to be significantly modified as a result of previous logging and grazing activities. Areas considered to be commensurate with remnant vegetation communities upon the basis of the canopy species were found to be largely devoid of a shrub layer or were heavily infiltrated by the exotic *Olea europea* subsp. *cuspidata* (African Olive), and the groundcover included many exotic and/or pasture species. Furthermore, species composition within the canopy of some areas of remaining vegetation is likely to have been modified as a result of selective logging activities (e.g. removal of Ironbark species for fence posts), and some homogenous patches of an individual tree species were likely to be the result of recruitment from a previously isolated paddock tree. Given the high level of disturbance of the site and the nature of the assessment, a broad classification of the vegetation communities encountered on site and their locations are provided below:

3.2.4.1 MU24 – Hunter Lowland Redgum Forest EEC

This community was mapped by Peake (2006) as occupying a small area along the northern boundary of the site. Field surveys identified the community existing in this area as a 'canopy only' extent, with the shrub layer largely absent and the groundcover heavily disturbed, and occupying approximately 2.1 hectares. The canopy was dominated by *Eucalyptus tereticornis* (Forest Red Gum), with associated individuals of *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus moluccana* (Grey Box). A highly disturbed understorey contained a low and very sparse shrub layer of *Cassinia uncata* (Sticky Cassinia) and *Sida rhombifolia* (Common Sida) and a grassy groundcover of *Cynodon dactylon* (Common Couch) and *Lolium* sp. (Ryegrass) with herb species including *Juncus usitatus* and the exotic *Senecio madagascariensis* (Fireweed) and *Plantago lanceolata* (Ribwort).

Plate 1 Hunter Lowland Redgum Forest

This community is commensurate with the Hunter Lowlands Redgum Forest EEC as listed under the TSC Act.

3.2.4.2 MU27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC

The majority of vegetation remaining on the site has been mapped as this community by Peake (2006). Field surveys identified the community in isolated patches on the mid to upper slopes and ridges in the northern and central parts of the site, and as a section of a larger, semi-contiguous patch of habitat that traverses the site in the south, occupying approximately 61.9 hectares in total. The community is dominated by *Corymbia maculata* (Spotted Gum), *Eucalyptus moluccana* (Grey Box) and *Eucalyptus fibrosa* (Red Ironbark), with a strong influence of *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus tereticornis* (Forest Red Gum) in some areas. *Eucalyptus glaucina* (Slaty Red Gum) also has potential to occur within this community.

This community has also seen substantial modification to the understorey, with signs of active removal of shrub species and mowing of the groundcover apparent. Understorey has persisted within areas of the community in the south however, and this represents the most intact vegetation remaining on the site. The shrub layer in these areas is dominated by *Bursaria spinosa* (Blackthorn), *Daviesia ulicifolia* (Gorse Bitter Pea), *Acacia* sp. and *Pultenaea spinosa* (Spiny Bush-pea). A grassy groundcover has persisted that includes native species such as *Dichelachne micrantha* (Shorthair Plumegrass), *Rytidosperma tenuius* (Wallaby Grass) and *Microlaena stipoides* (Weeping Grass). Other small patches of this community that have been subject to understorey modification include some native groundcover (particularly the presence of

Dichelachne micrantha), however does include some weedy forbs including *Senecio madagascariensis* (Fireweed), *Plantago lanceolata* (Ribwort) and the native *Dichondra repens* (Kidney Weed).

Plate 2 Central Hunter Ironbark – Spotted Gum – Grey Box Forest

Some of the gullies and lower slopes in the northern and southern extents of the site have been mapped as Central Hunter Spotted Gum – Grey Box Forest by Peake (2006) but include patches of young trees that are solely or predominantly comprised of *E. tereticornis* (and/or possibly the closely related *Eucalyptus glaucina*). These areas may have arisen as a result of regrowth from a previously isolated paddock tree, or alternatively could be representative of a pre-existing Red Gum-dominated community. Coupled with the existence of a highly modified understorey, it is difficult to ascertain the nature of the community prior to disturbance. For the purposes of this report, the areas have remained as the CHISGGBF as originally mapped, however future detailed surveys may determine that these areas broadly constitute the Hunter Lowland Redgum Forest EEC.

CHISGGBF is commensurate with the Central Hunter Ironbark – Spotted Gum – Grey Box EEC as listed under the TSC Act.

3.2.4.3 Central Hunter Swamp Oak Forest

This community occupies some of the lower slopes and highly ephemeral drainage lines that exist on the site. The community is dominated by near-homogenous stands of *Casuarina glauca* (Swamp Oak) in the canopy. Much of this community on the site included a shrub layer solely comprised of the exotic *Olea europea* subsp.*cuspidata* (African Olive), and a moist ground layer of predominantly exotic grasses and forbs including *Oplismenus aemulus* (Basket Grass), *Juncus acutus* (Sharp Rush), *Senecio madagascariensis*

(Fireweed), *Conyza sumatrensis* (Fleabane) and *Dichondra repens* (Kidney Weed). Approximately 13.6 hectares of this community exists on the site.

Patches of this community on the site were typically in the form of isolated regrowth, with several areas of the site newly mapped as this community during field surveys.

Plate 3 Central Hunter Swamp Oak Forest

This community is not considered to be commensurate with any EECs listed under State or Federal legislation.

3.2.4.4 Hunter Valley River Oak Forest

This community is restricted to a well established riparian zone that runs along Jumpup Creek in the north of the site, occupying approximately 3.1 hectares. The community has been mapped by Peake (2006) to be dominated by *Casuarina cunninghamiana* (River Oak), however the community on site was determined during field surveys to be dominated by the closely related *Casuarina glauca* (Swamp Oak). Determining the boundaries between this community and the Central Hunter Swamp Oak Forest is known to be difficult (Peake 2006), however given the location of the community and its context within the landscape, it is considered to conform to previous regional mapping as Hunter Valley River Oak Forest.

The community has been heavily infiltrated by *Olea europea* subsp. *cuspidata* (African Olive) in the shrub layer, and includes a sparse groundlayer including *Entolasia marginata* (Borded Panic), *Oplismenus aemulus* (Basket Grass) and vines including *Marsdenia rostrata* (Milk Vine).

Plate 4 Hunter Valley River Oak Forest

This community is not considered to be commensurate with any EEC listed under the TSC Act and/or the EPBC Act.

3.2.4.5 Cleared Areas

The majority of the site is comprised of non-remnant grasslands previously used for agricultural purposes. Despite the highly modified nature of the grasslands, native grasses have persisted on the site and dominate in areas, particularly along the ridges and upper slopes. This may be the result of an easing of grazing pressure on the site during recent years, which has required the mowing of large areas to reduce bushfire fuel loads. The native *Dichelachne micrantha* (Shorthair Plumegrass) dominated the ground cover in large areas, and other native species including *Rytidosperma tenuius* (Wallaby Grass), *Chloris truncata* (Windmill Grass) and *Aristida ramosa* (Purple Wiregrass) persist in areas. However, exotic species are a large component of the groundcover, particularly along the more fertile lower slopes and gullies, and include exotic grasses such as *Briza maxima* (Quaking Grass) and *Ehrharta erecta* (Panic Veldtgras) along with weedy herbs including *Cirsium vulgare* (Spear Thistle), *Centaurium erythraea* (Common Centaury), *Senecio madagascariensis* (Fireweed) and *Hypochaeris radicata* (Flatweed).

The shrublayer within the cleared areas was limited to isolated individuals of *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) and some natives including *Hakea sericea* (Needlebush). Isolated paddock trees also occurred across cleared areas that were representative of surrounding communities including *Eucalyptus tereticornis* (Forest Red Gum) and *Corymbia maculata* (Spotted Gum). The presence of the

threatened species *Eucalyptus glaucina* (Slaty Gum) among these isolated paddock trees cannot be discounted at this stage.

Plate 5 Cleared Areas

A vegetation map identifying the location of each vegetation community on site is provided in **Figure 2.**

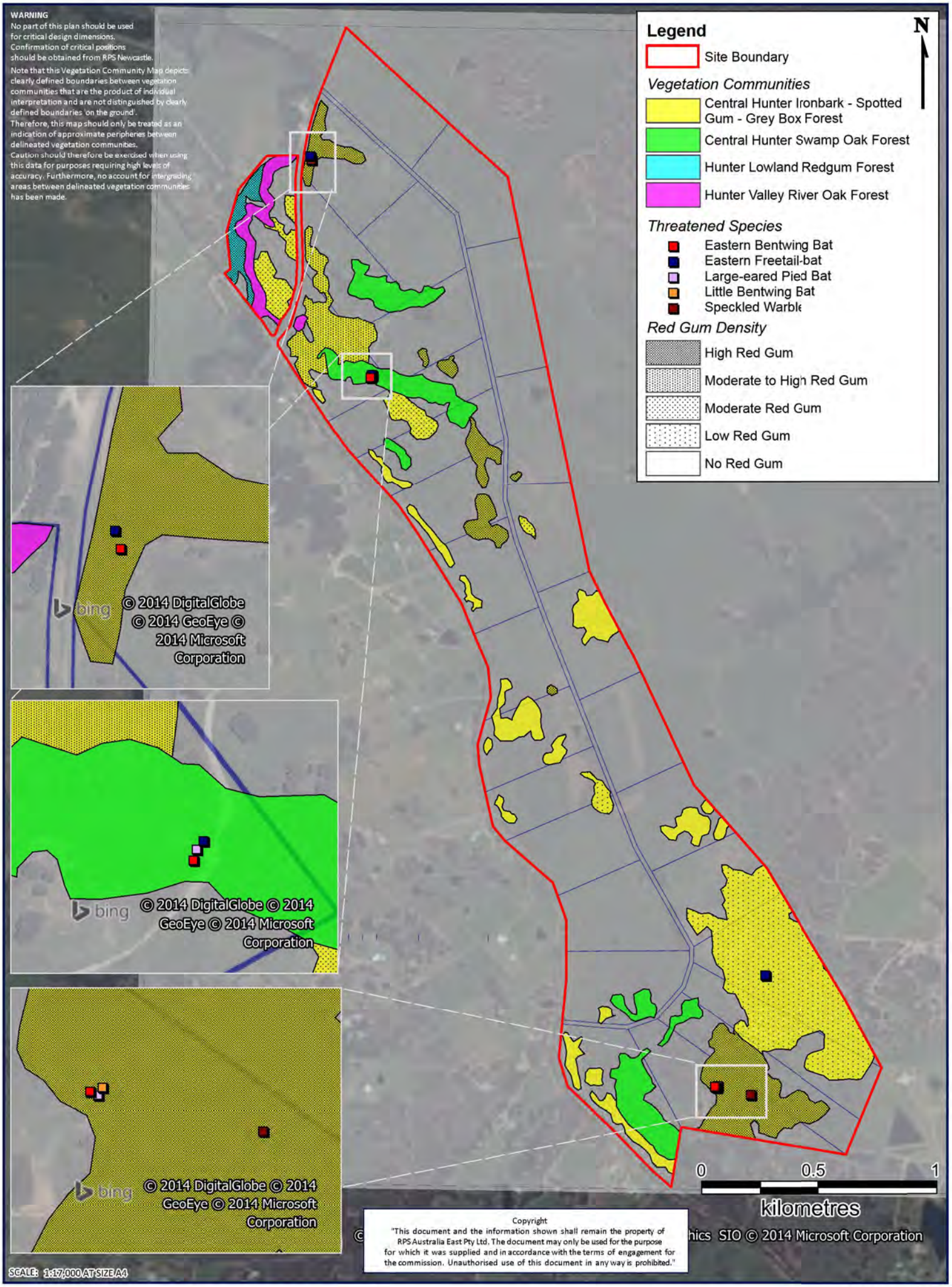

FIGURE 2: VEGETATION AND THREATENED SPECIES

LOCATION: POKOLBIN

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 09/12/2014
PURPOSE: COA

LAYOUT REF: "J:\JOBS\124k\124712 Pokolbin\10 - Drafting\MapInfo Workspaces\Eco"
VERSION (PLAN BY): JS (A A4)

CLIENT: BELFORD LAND CORPORATION
JOB REF: 124712

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

RPS

3.2.5 Fauna Habitat

The majority of the site exists in a highly disturbed state that is largely devoid of an active shrub layer, and with large areas of groundcover that is actively mown (see Plate 5 below). As a result, available habitat for fauna is considered to be extensively fragmented, particularly for terrestrial species.

Plate 6 Groundcover on Site

3.2.5.2 Terrestrial Habitat

Habitat within the site for terrestrial fauna species is limited as a result of a largely absent shrub layer and active management of the groundcover that has resulted in a paucity of ground habitat such as fallen logs and leaf litter. Suitable habitat for many reptile and terrestrial mammal guilds such as skinks and rodents is subsequently limited to the more forested areas in the southeast of the site, and the riparian areas of the Hunter Valley River Oak Forest in the north.

Remaining patches of trees and active regrowth in areas do provide limited habitat for woodland birds and micropteran bat species, and surrounding cleared areas provide a woodland/grassland ecotone that is favourable for common species such as the Rufous Whistler (*Pachycephala rufiventris*) and Yellow-faced Honeyeater (*Lichenostomus chrysops*). In addition, large areas of the grassland on site are of a sufficient height and diversity to provide suitable refuge and foraging opportunities for grassland birds such as songlarks and quails.

Some areas of the site were heavily populated by the aggressive Noisy Miner (*Manorina melanocephala*). This species is known to actively exclude many other native bird species from otherwise suitable habitats, a

process now considered to be of such significance that it is listed as a Key Threatening Process (KTP) under both the TSC Act and EPBC Act. The prevalence of this species was particularly apparent in the southeast of the site, and is likely to limit the potential for many small-to-medium-sized birds to utilise the area.

3.2.5.3 Arboreal Habitat

A lack of shrub layer and flowering canopy trees limited the availability of foraging resources for nectivorous birds and arboreal mammals to the flowering mistletoe species occurring in the forested areas of the site. This resource can be sporadic in its availability, and a low diversity of pollen-producing flora species is likely to result in a lack of pollen or nectar as a resource on the site for significant periods.

Roosting and nesting opportunities for hollow-dependent species such as possums and gliders is limited to those hollow-bearing trees identified in the southeast of the site, and a potential forest owl roost tree was observed in this area. Isolated paddock trees on the site may also provide this resource for more mobile species. No roosting habitat was identified for cave-dwelling microbat species, however the identified hollow-bearing trees do provide roosting habitat for hollow-dwelling microbats. The forested and cleared areas of the site represent potential foraging habitat for a variety of cave and hollow-dwelling microbat species, depending upon the species and proximity to forested areas.

3.2.5.4 Aquatic Habitats

Permanent aquatic habitat on the site is limited to the artificial dams on the site, whilst the River Oak Forest and small areas of Swamp Oak Forest did provide a standing water resource on the site at the time of survey. Water resources on site would represent potential foraging habitat for some microbat species, particularly those that prefer to forage above watercourses such as the threatened Large-footed Myotis (*Myotis macropus*). Several common frog species and woodland ducks were identified as utilising these resources during the survey, however a lack of aquatic flora diversity limits the potential for the site to be suitable for many aquatic species.

3.2.5.5 Connectivity

The fragmented nature of vegetation remaining on the site and surrounds limits the potential for connectivity to exist between the site and adjacent areas, however the southeastern portion of the site forms part of a tentative link with larger areas of vegetation to the west and southwest that includes Pokolbin State Forest, and to the northeast that includes Belford National Park. Tentative links also exist to additional vegetation further east that comprise the conservation lands of the Huntlee development (see RPS (2010) and **Figure 3**). Protection of these areas would allow for this link to strengthen over time as regrowth spreads and matures, and active planting and rehabilitation works in this area could speed up this process. Conversely, the removal of vegetation in the south of the site would potentially sever the connectivity that exists between these areas.

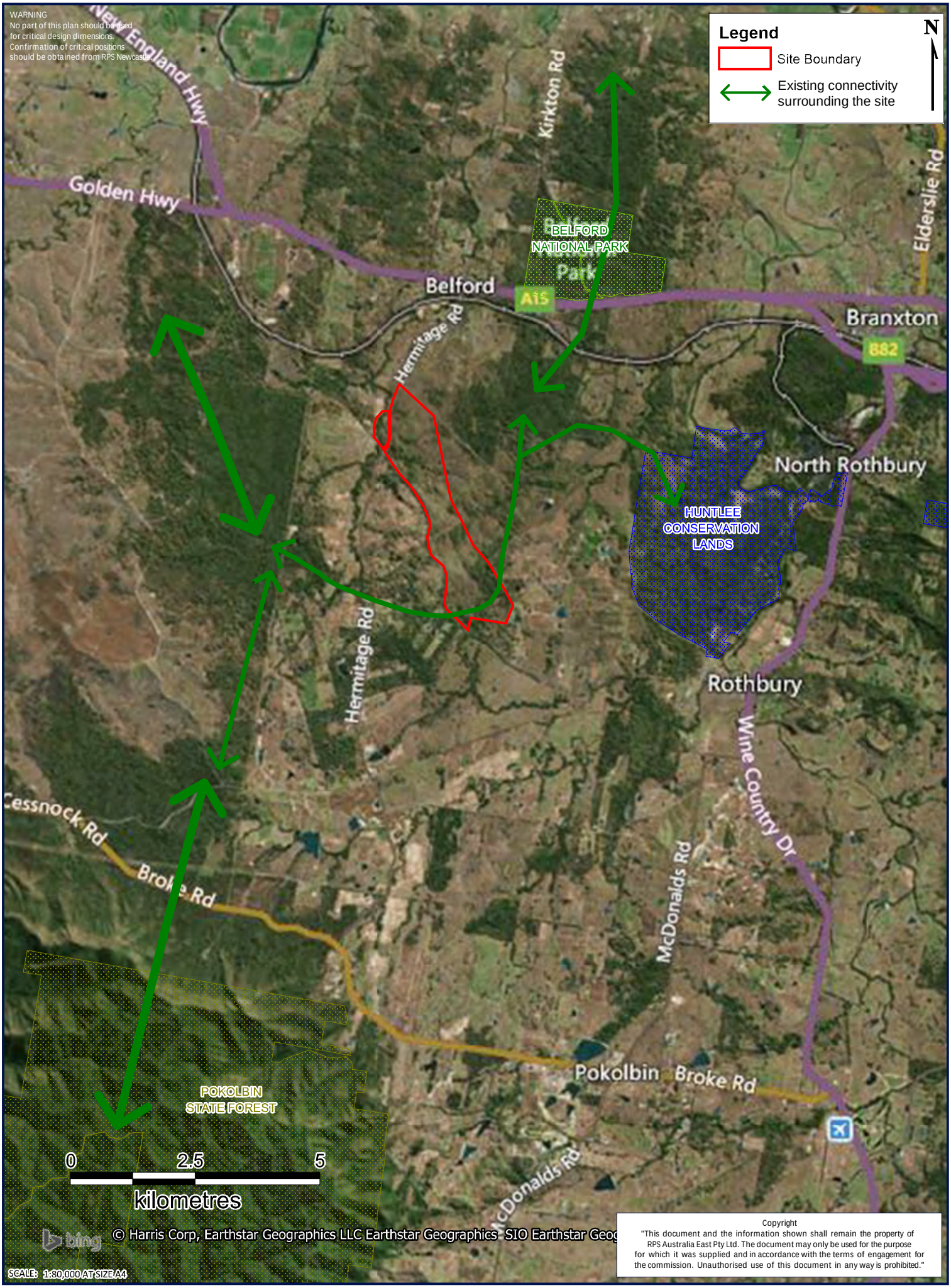

FIGURE 3: REGIONAL CONTEXT AND CONNECTIVITY

LOCATION: POKOLBIN

DATUM: GDA 94
PROJECTION: MGA ZONE 56

DATE: 09/12/2014
PURPOSE: COA

LAYOUT REF: "J:\JOBS\124k\124712 Pokolbin\10 - Drafting\MapInfo Workspaces\Eco"
VERSION (PLAN BY): A A4 (JS)

CLIENT: BELFORD LAND CORPORATION
JOB REF: 124712

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241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

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4.0 Threatened Species Likelihood of Occurrence Assessment

Section 3.1 identified threatened flora and fauna species listed under the TSC Act and/or EPBC Act that are known or predicted to occur within a 10 kilometre radius of the site. The following is an assessment of the likelihood of occurrence of those species considered to potentially occur within the site based on a comparison of the habitat requirements of each species/community and the habitat types present within the site. Endangered ecological communities observed on the site during field surveys have also been assessed below.

'**Species'** – Lists each threatened species known from the vicinity. The status of each threatened species under the TSC Act and the EPBC Act are also provided.

'**Habitat Description'** – Provides a brief account of the species and the preferred habitat attributes required for the existence/survival of each species. Reference information has been obtained from the NSW Threatened Species website (www.environment.nsw.gov.au/threatenedspecies.html) and/or Commonwealth Species Profile and Threats Database (www.environment.gov.au/cgi-bin/sprat/public/sprat.pl) unless otherwise referenced.

'Likelihood of Occurrence on Site' – Assesses the likelihood of each species to occur along or within the immediate vicinity of the subject site in terms of the aforementioned habitat description and takes into account local habitat preferences, results of current field investigations, data gained from various sources (such as OEH Atlas of NSW Wildlife, herbariums, etc.) and previously gained knowledge via fieldwork undertaken as part of other ecological assessments in the locality.

Table 3 Chance of Occurrence and Likely Level of Impact Assessments

Species	TSC Act Status	EPBC Act Status	Habitat Description	Likelihood Of Occurrence
FLORA				
Acacia bynoeana Bynoe's Wattle	E	V	Small, prostrate shrub found in low heath and open woodland, generally on loamy clays and sand. Occurs from the Lower Hunter south to Southern Highlands. Records within the sites' locality are limited to an area around North Rothbury to the west of the site RPS 2010; NSW Wildlife Atlas data).	This species was not recorded on the site during field surveys. With a lack of heathy habitat and absence of shrub layer across the majority of the site, this species is considered **unlikely** to occur.
Acacia pendula	E (pop)	-	The Hunter population of *Acacia pendula* occurs at the eastern distribution of the species' range. It occurs as far east as Warkworth and extends northwest to Muswellbrook and to the west at Wybong. The species typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations. A record exists for the species just south of Belford NP, approximately 3km north of the site.	This conspicuous species was not discovered during field surveys. It is considered **unlikely** to occur.
Cryptostylis hunteriana Leafless Tongue-orchid	V	-	A very rare leafless, saprophytic orchid, it remains underground for the majority of its lifecycle, flowering periodically, when conditions are optimal to reproduce. This species is known to occur within a range of habitats including woodlands to swamp heaths. Within the Hunter region, larger populations have been typically found in woodland dominated by *Eucalyptus racemosa* (Scribbly Gum) and prefer areas with an open grassy understorey. Is often found in association with *Cryptostylis subulata* and *C. erecta*. No records exist for the species within the sites' locality.	The species was unidentifiable during field surveys given they were conducted outside of the known flowering period. However, favourable habitat does not occur on the site and no records exist for the species within the locality. It is considered **unlikely** to occur.
Cymbidium caniculatum Hunter catchment population	E (pop.)	-	A large, epiphytic orchid that grows in the hollows and forks of eucalypts and wattles, the species has a scattered distribution across northern and eastern Australia from the Hunter River to Cape York and across to the Kimberley. The Hunter population appears to be centred in the Upper Hunter north of Singleton, but can occur as far south as Weston and Pokolbin in the Hunter Valley.	The species was not recorded during field surveys, and the disturbed nature of the site limits potential for the species to occur. Given the site lies on the extremities of the species' distribution in the Hunter, it is considered **unlikely** to occur.
Eucalyptus camaldulensis River Red Gum	E (pop.)	-	The Hunter population of River Red Gum is the only population of this species to occur in a coastal catchment. It occurs from Bylong in the west to Hinton in the east, on the banks of the Hunter River. Remaining stands occur in distinct riparian and floodplain vegetation types. A single record exists for the species within the locality, approximately 9km north of the site along the Hunter River at Glendon.	The ephemeral drainage lines and associated riparian areas are not considered to provide the distinct vegetation types that are required for the Hunter population of this species. It is considered **unlikely** to occur.
Eucalyptus castrensis Singleton Mallee	E	-	This small tree is known from a single dense stand near Singleton, with a number of small outlying stands over a 2.5km range. It occurs on a low broad ridgetop on loam over sandstone, to the south of the site around the Singleton Army Base.	The site occupies an area outside this species' known distribution, and surveys on the site failed to identify this conspicuous species. It is considered **unlikely** to occur.
Eucalyptus fracta Broken Back Ironbark	V	-	This species similarly occurs in a restricted range along a sandstone escarpment, south of the site within Pokolbin State Forest. It occurs in dry eucalypt woodland in shallow soils.	The site occupies an area outside this species' known distribution, and the steep sandstone habitat required for this species is not available on site. It is considered **unlikely** to occur.
Eucalyptus glaucina Slaty Red Gum	V	V	This Red Gum species grows in grassy woodland on deep, fertile and moist soils, and it is considered to occur within close association with the related *Eucalyptus tereticornis* (Forest Red Gum) (Hill 2002). Multiple records exist for the species surrounding the site (RPS 2010; NSW Wildlife Atlas data).	This species could not be distinguished from the closely related *Eucalyptus tereticornis* during field surveys. Given the large number of Red Gums that occur on the site within the remaining patches of vegetation and as isolated paddock trees, the species is considered **likely** to occur.
Eucalyptus parramattensis subsp. *decadens* Earp's Gum	V	V	Species grows in dry sclerophyll woodland on sandy soils, often in low damp sites. A record exists to the east of the site at Sweetwater (RPS 2010; NSW Wildlife Atlas data).	Targeted searches failed to identify the species on site and the sandy soils required do not occur. The species is therefore considered **unlikely** to occur.
Eucalyptus pumila Pokolbin Mallee	V	V	A mallee to 6m high with smooth bark that occurs near Singleton in sandy soils on very steep hills. The species occurs to the south of the site within and adjacent to Pokolbin State Forest (NSW Wildlife Atlas data).	Targeted searches failed to identify this conspicuous species and favourable habitat does not occur. It is considered **unlikely** to occur.
Grevillea parviflora subsp. *parviflora*	V	V	Occurs in light, clayey soils in woodlands. Relatively widespread within the Cessnock LGA, however no records exist for the species within the sites' locality.	Targeted surveys failed to identify this species and the extensive modification of the understorey limits the potential for it to occur. Given a lack of records in the locality, it is considered **unlikely** to occur.
Leionema lamprophyllum subsp. *obovatum* Shiny Phebalium	E (pop.)	-	A compact shrub with a Hunter catchment population west of Maitland, near Pokolbin. This population represents the north-east limit of the species. It occurs in dry eucalypt forest on exposed rocky terrain. The closest records for the species occur within Pokolbin State Forest to the south of the site.	Targeted surveys failed to identify this species and the extensive modification of the understorey limits the potential for it to occur. It is considered **unlikely** to occur.
Persoonia pauciflora North Rothbury Persoonia	CE	CE	This small spreading shrub has a highly restricted distribution around North Rothbury, as the name suggests. It is found in dry open forest or woodland in Spotted Gum – Ironbark forest communities. The population is found approximately 6km east of the site (RPS 2010).	Targeted surveys failed to identify this species and the extensive modification of the understorey limits the potential for it to occur. It is considered **unlikely** to occur.
Prostanthera cineofolia Singleton Mint Bush	V	V	Grows in open woodlands on exposed sandstone ridges. A record exists to the south-west of the sight along a roadside verge close to Broke Road.	Targeted surveys failed to identify this species and the extensive modification of the understorey limits the potential for it to occur. It is considered **unlikely** to occur.

Species	TSC Act Status	EPBC Act Status	Habitat Description	Likelihood Of Occurrence
Pterostylis gibbosa Illawarra Greenhood	E	E	Ground-dwelling orchid which grows in open forest or woodland on flat or gently sloping land with poor drainage. It is a deciduous orchid that is only visible above the ground between late summer and spring, only when soil moisture levels can sustain its growth. In the Hunter region, the species grows in open woodland dominated by *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus tereticornis* (Forest Red Gum) and *Callitris endlicheri* (Black Cypress Pine). Only five locations are known for this species, one of those being located in Milbrodale in the Hunter Valley.	Surveys on the site failed to identify this species, and the site is considered to be outside the known distribution of the species. It is considered **unlikely** to occur.
Rutidosis heterogama Heath Wrinklewort	V	V	Small Asteraceous herb rediscovered in the Hunter Region growing in disturbed areas and adjacent parcels of bushland within the Hunter Economic Zone (HEZ) and elsewhere within the Cessnock LGA. A record exists to the south of the site adjacent to Broke Road.	Targeted surveys failed to identify this species on site, however available habitat for the species does exist, particularly with the removal of grazing pressure on the site. There is **potential** for the species to occur.
Streblus pendulinus Siah's Backbone	-	V	This species occurs from Cape York Peninsula to Milton in south-eastern NSW as well as Norfolk Island. It occupies warmer rainforests, chiefly along watercourses, on the Australian mainland. No Atlas records exist within 10km of the subject site (NSW Wildlife Atlas data).	The preferred habitat for the species does not occur within the site and it is therefore considered **unlikely** to occur.
Thesium australe Austral Toadflax	V	V	A small, straggling herb to 40cm tall, this species is found in very small populations scattered across eastern NSW from the Northern to Southern Tablelands. It occurs in grassland on coastal headlands or grassy woodlands away from the coast. No records exist for the species within 10km of the site (NSW Wildlife Atlas data).	Targeted surveys failed to identify this species on site, and there is a lack of records within 10km of the site. However, habitat does exist for the species on site, and the removal of grazing practices has provided **potential** for this species to occur.
AMPHIBIANS				
Heleioporus australiacus Giant Burrowing Frog	V	V	Confined to the eastern slopes of the Great Dividing Range, this species occurs on Hawkesbury Sandstone where it burrows near water. An interesting record for the species exists for the species in an urban setting at Branxton in 2009 (NSW Wildlife Atlas data).	Available habitat for the species is considered to occur within the River Oak Forest and surrounding areas in the north of the site. There is **potential** for this species to occur in these areas.
Litoria aurea Green and Golden Bell Frog	E	V	Inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. Previously widespread within the region, but now sparsely distributed within the Lower Hunter and Central Coast areas. A relatively stable population occurs on Kooragang Island. No records exist for the species within the sites' locality (NSW Wildlife Atlas data).	The site is considered to be outside the known distribution of the species. It is considered **unlikely** to occur.
Litoria littlejohni Littlejohns Tree Frog	V	V	A pale brown frog with dark speckles which occurs along permanent rocky creeks with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. Occurs on the plateaus and eastern plains of the Great Dividing Range. Records within the Hunter region occur from within the Watagan State Forest, and no records exist within 10km of the subject site.	The site is outside the known distribution of this species and potential habitat does not exist. It is considered **unlikely** to occur.
BIRDS				
Botaurus poiciloptilus Australasian Bittern	E	E	A secretive species inhabiting permanent freshwater swamps across a wide area of south-eastern Australia. No records exist for the species within 10km of the subject site (NSW Wildlife Atlas data).	The site does not include potential habitat for the species. It is considered **unlikely** to occur.
Rostratula australis Australian Painted Snipe	E	V	A small freshwater and estuarine wader, which prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. This species has been recorded in Pambalong N.R., Ash Island and Lenaghan's Flat. No Atlas records exist for the species within 10km of the site (NSW Wildlife Atlas data).	Targeted searches failed to identify the species, and the dams on the site only represent marginal habitat for the species. It is considered **unlikely** to occur.
Hieraaetus morphnoides Little Eagle	V	-	This species can be found across most of Australia, but more commonly found near coastal to inland regions in NSW and Victoria. This species is part-migratory to nomadic and dispersive in some areas. It has been recorded at North Rothbury to the east of the site (RPS 2010; NSW Wildlife Atlas data).	Suitable habitat exists on the site and it is within the known distribution of the species. Therefore, there is **potential** for this species to occur intermittently within the site.
Lophoictinia isura Square-tailed Kite	V	-	This species is widespread throughout the mainland of Australia, and is migratory throughout its range. It is recorded mainly in coastal and sub-coastal regions, and is a spring-summer breeding migrant to south-eastern Australia. It has been recorded at North Rothbury to the east of the site (NSW Wildlife Atlas data).	Suitable habitat exists on the site and it is within the known distribution of the species. Therefore, there is **potential** for this species to occur intermittently within the site.
Calyptorhynchus lathami Glossy Black-Cockatoo	V	-	This species occurs in forests and woodlands where it forages predominantly on *Allocasuarina* cones, particularly those of *A. littoralis*, *A. torulosa* and *A. distyla*. The species requires large Eucalypt tree hollows for nesting. The species has been recorded at North Rothbury and south around Pokolbin State Forest (NSW Wildlife Atlas data).	No *Allocasuarina* feed tree species were recorded on the subject site and there is a general paucity of foraging habitat within the site. However, there is still some **potential** for this species to occur intermittently within the site.
Glossopsitta pusilla Little Lorikeet	V	-	*Glossopsitta pusilla* occurs on the coast and inland areas from Cairns to Adelaide. Commonly found in dry, open eucalypt forests and woodlands, the species can also be found in roadside vegetation and woodland remnants. It feeds on abundant flowering Eucalypts, but will also take nectar from *Melaleuca* sp. and mistletoe. Nesting takes place in hollow bearing trees. Records exist to the south of the site along Wine Country Drive and within Pokolbin State Forest (RPS 2010; NSW Wildlife Atlas data).	Suitable habitat exists on the site and it is within the known distribution of the species. It is considered **likely** to occur intermittently within the site.
Lathamus discolor Swift Parrot	E	E	This species migrates from Tasmania to mainland Australia in autumn, foraging in dry woodlands of Victoria and NSW. On the mainland, Swift Parrots are dependent on habitats that provide winter foraging resources such as nectar and lerps (sugary exudates from leaf insects). Within these habitats, Swift Parrots prefer foraging in mature trees that provide a higher quality and quantity of nectar than regrowth trees. Records exist at North Rothbury and within vegetation adjoining Cessnock Road to the south of the site (RPS 2010; NSW Wildlife Atlas data).	Suitable winter foraging habitat exists for the species within the site. Given the species has been recorded within close proximity of the site previously, it is considered **likely** to occur within the site on an intermittent basis.
Neophema pulchella	V	-	The Turquoise Parrot has a vast range that extends from Southern Queensland through to northern Victoria.	Suitable habitat exists on the site for the species. Given it has been recorded close to the site

Species	TSC Act Status	EPBC Act Status	Habitat Description	Likelihood Of Occurrence
Turquoise Parrot			It occupies eucalypt woodland edges and adjoining clearings, and requires tree hollows for nesting. It typically occurs more westerly of the site, but the species has been recorded on multiple occasions at North Rothbury to the east (RPS 2010).	previously, it is considered **likely** to occur on an intermittent basis, particularly during dry periods.
Ninox connivens Barking Owl	V	-	Occurs mainly in dry sclerophyll woodland. Nests in large Eucalypt hollows, and roosts in hollows or thick vegetation. Can be found roosting in dense *Acacia* sp. and *Casuarina* sp. or the dense clumps of Eucalypt trees. Hunts a range of prey species including birds and both terrestrial and arboreal mammals. Spasmodic Hunter Region records are largely limited to the south-western ranges and adjacent forests on the valley floor. Records exist from Ellalong, Yengo N.P. and Wybong area (HBOC records).	This species has not been recorded within the site and potential habitat for the species is limited. However, the wide distribution of the species and the availability of marginal foraging and nesting habitat have determined that there is **potential** for the species to occur on the site.
Ninox strenua Powerful Owl	V	-	The Powerful Owl occurs in coastal and adjacent ranges of eastern Australia in sclerophyll forests and woodlands where suitable prey species occur, most notably arboreal mammals and birds. The species requires large and specific tree hollow characteristics for nesting. Pairs appear to mate for life and occupy exclusive territories in the order of 1000 ha in size. Records exist for the species within Belford National Park to the north and Pokolbin State Forest to the south (NSW Wildlife Atlas data).	This species has not been recorded within the site and potential habitat for the species is limited. However, the wide distribution of the species and the availability of marginal foraging and roosting habitat have determined that there is **potential** for the species to occur on the site.
Tyto novaehollandiae Masked Owl	V	-	The Masked Owl is found in a range of habitats, but more commonly found in dry eucalypt forests and woodlands. It is a forest owl that often hunts on forest edges and roadsides. Requires large Eucalypt hollows for nesting and these hollows are also preferred for roosting sites. An Atlas record exists for the species within forested areas to the south of the site (NSW Wildlife Atlas data).	This species has not been recorded within the site and potential habitat for the species is limited. However, the wide distribution of the species and the availability of marginal foraging and roosting habitat have determined that there is **potential** for the species to occur on the site.
Tyto tenebricosa Sooty Owl	V	-	Occurs in wet Eucalypt forest and rainforest with tall emergent trees, often in easterly facing gullies, though occasionally utilises dryer forest types. Within these areas this species hunts for a range of mainly mammalian prey at all levels of the forest strata, even recorded feeding on ground (RPS ecologist pers. obs.). Roosts in tree hollow or dense canopy vegetation. The Atlas record within the vicinity occurs in woodland near Pokolbin State Forest (NSW Wildlife Atlas data).	The preferred habitat for the species does not occur on the site, and the disturbed nature of the site further diminishes the potential habitat available. It is considered **unlikely** to occur.
Climacteris picumnus victoriae Brown Treecreeper (Eastern subsp.)	V	-	The Brown Treecreeper frequents drier forests and woodlands, particularly open woodland lacking a dense understorey, and is also found in grasslands in proximity to wooded areas where there are sufficient logs, stumps and dead trees nearby. It feeds on invertebrate larvae and small insects, particularly ants, utilising hollows for roosting/nesting. It is susceptible to habitat fragmentation, appearing not to persist in remnants less than 200 ha. Multiple records exist for the species surrounding the site (RPS 2010; NSW Wildlife Atlas data).	The species was not recorded on the site and the fragmented nature of the site is not ideal for the species. However, some habitat exists for the species and there is **potential** for the species to utilise the site intermittently.
Chthonicola sagittata Speckled Warbler	V	-	Occupies Eucalypt and Cypress woodlands in drier coastal areas and on the western slopes of the Great Dividing Range. Appears unable to persist in districts where no forested fragments larger than 100 ha remain. Occurs in the central and southern Hunter Region where suitable habitat exists. Associated with extensive stands of *Bursaria spinosa* (Blackthorn) in some areas. Multiple records exist for the species surrounding the site (RPS 2010; NSW Wildlife Atlas data).	This species was recorded on the site during field surveys. It is **known** to occur.
Dasyornis brachypterus Eastern Bristlebird	E	E	Found in dense, low vegetation including heath and open woodland with a heathy understorey. It occurs in three disjunct populations within northern NSW/southern Queensland, the Jervis Bay area and around Nadgee Nature Reserve in southern NSW. No Atlas records exist within 10km of the subject site (NSW Wildlife Atlas data).	The subject site is considered to be well outside the known distribution of the species. It is therefore considered **unlikely** to occur.
Anthochaera phrygia Regent Honeyeater	CE	E	The Regent Honeyeater occurs in temperate woodlands and open forest, including forest edges. Seasonal movements appear to be dictated by the flowering of various species of *Eucalyptus* that are characteristic of the dry forests and woodlands of south-eastern Australia; the species preferring to forage on large-flowered Eucalypts. They also forage on mistletoe and *Banksia* flowers, and arthropods. Nesting occurs mainly between November and January, but breeding has been recorded in all months between July and February. Records exist for the species within forested areas to the east and west of the site (NSW Wildlife Atlas data).	Suitable habitat exists for the species within the site. Given the species has been recorded in surrounding areas, it is considered **likely** to occur within the site on an intermittent basis.
Epthianura albifrons White-fronted Chat	V	-	This insectivorous species is predominantly found in saltmarsh but also occur in open grasslands and low shrubs fringing wetlands. It occurs throughout southern Australia, with NSW populations typically occurring in the southern half of the state. A record exists from 2003 in the Pokolbin State Forest (NSW Wildlife Atlas data).	The habitat available on site is not considered ideal for the species, and surrounding records are limited. It is considered **unlikely** to occur.
Grantiella picta Painted Honeyeater	V	-	The species occurs west of the Great Dividing Range in Queensland and New South Wales through to Northern Victoria. It occurs in dry open forests and woodlands, and is strongly associated with mistletoes, upon which it feeds. A dated (1977) and isolated record exists for the species at North Rothbury to the east of the site (NSW Wildlife Atlas data).	The site is outside of the expected distribution of the species, and despite suitable habitat occurring on the site and the isolated record in the vicinity, it is considered **unlikely** to occur.
Melithreptus gularis gularis Black-chinned Honeyeater (eastern subsp.)	V	-	The eastern subspecies of the Black-chinned Honeyeater occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts along the inland slopes of the Great Dividing Range, extending to the coast between Sydney and Newcastle. Several records exist for the species within remnant vegetation at North Rothburty to the east and to the south-west of the site close to Cessnock Road (RPS 2010; NSW Wildlife Atlas data).	Suitable habitat exists for the species within the site. Given the species has been recorded within close proximity of the site previously, it is considered **likely** to occur within the site on an intermittent basis.
Pomatostomus temporalis temporalis Grey-crowned Babbler	V	-	Inhabits open Eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. The Grey-crowned Babbler may also be observed along streams in cleared areas and grassy road verges (Morcombe, 2000). A relatively common species to the region, multiple records exist for the species surrounding the site (RPS 2010; NSW Wildlife Atlas data).	Suitable habitat exists for the species within the site. Given the species has been recorded within close proximity of the site previously, it is considered **likely** to occur within the site on an intermittent basis.
Daphoenositta chrysoptera Varied Sittella	V	-	This species inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. The Varied Sittella 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. Multiple records exist for the species surrounding the site (RPS 2010;	Suitable habitat exists for the species within the subject site. Given the species has been recorded in nearby areas, it is considered **likely** to occur within the site on an intermittent basis.

Species	TSC Act Status	EPBC Act Status	Habitat Description	Likelihood Of Occurrence
			NSW Wildlife Atlas data).	
Melanodryas cucullata Hooded Robin (south-eastern form)	V	-	Although primarily known from Eucalypt forest, woodland and scrub, the Hooded Robin has also been known to use cleared paddocks with regrowth or stumps in close proximity to wooded areas. Favours areas with sparse shrub cover and fallen timber, and appears unable to persist in remnants less than 100-200 ha. A single record within the vicinity of the site occurs at Pokolbin (NSW Wildlife Atlas data).	The species was not recorded on the site and the fragmented nature of the site is not ideal for the species. However, some habitat exists for the species and there is **potential** for the species to utilise the site intermittently.
Petroica boodang Scarlet Robin	V	-	In NSW, this species occupies open forests and woodlands from the coast to the inland slopes. The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. The species has been recorded on multiple occasions at North Rothbury to the east as well as in bushland close to Cessnock road to the southwest of the site (RPS 2010; NSW Wildlife Atlas data).	Suitable habitat exists for the species within the site. Given the species has been recorded in nearby areas, it is considered **likely** to occur within the site on an intermittent basis.
Stagonopleura guttata Diamond Firetail	V	-	Ranges in Eastern Australia from the Eyre Peninsula, SA to Clermont, QLD. The Diamond Firetail occurs in a wide range of Eucalypt-dominated vegetation communities that have a grassy understorey, including woodland, open forests and mallee. Most occur on the inland slopes of the Great Dividing Range, with only small pockets near the coast (Garnett et al. 2000). The closest Atlas record for the species to the site occurs within bushland close to Cessnock Road to the south-west of the site (NSW Wildlife Atlas data).	Records for the species within the vicinity are limited and no records exist on the site. However, some suitable habitat does exist, and it is therefore considered to have **potential** to occur within the site.
MAMMALS				
Dasyurus maculatus Spotted-tailed Quoll	V	E	Found in a variety of forested habitats from sclerophyll forests, rainforests and coastal woodlands, this species creates a den in fallen hollow logs or among rocky outcrops. It generally does not occur in otherwise suitable habitats that are in close proximity to urban development. An opportunistic hunter of a variety of prey, multiple records do exist for the species in a range of fragmented landscapes surrounding the site (NSW Wildlife Atlas data).	The highly disturbed nature of the site and its proximity to urban areas greatly diminishes the potential for the species to occur on site. However, considering the existence of records in the surrounds and some potential habitat for the species in the south of the site, there is limited **potential** for the species to utilise the site.
Phascogale tapoatafa Brush-tailed Phascogale	V	-	This arboreal mammal is patchily distributed around coastal Australia, and is typically restricted to the east of the Great Dividing Range in NSW. It prefers dry, open sclerophyll forest but may also inhabit heath, swamps and rainforest and wet sclerophyll forest. One record exists for the species in an agricultural landscape at Roughit near Singleton (NSW Wildlife Atlas).	The disturbed nature of the site limits the potential for the species to occur on the site. Given a paucity of records in the surrounding areas, it is considered **unlikely** to occur.
Phascolarctos cinereus Koala (Qld, NSW, Vic and ACT Populations)	V	-	The Koala occupies Eucalypt forests and woodlands that largely comprise particular *Eucalyptus* species that are favoured by the species as feed trees. Historical records do exist for the species within the Hunter Valley (HSO 2004, NSW Wildlife Atlas data).	The species has not been recorded within the site despite targeted surveys, however the many Red Gums present on the site represent potential feed trees for the species. Despite this, given that no recent records exist for the species within the Hunter Valley and considering the disturbed nature of the site, it is considered **unlikely** to occur.
Petaurus australis Yellow-bellied Glider	V	-	The Yellow-bellied Glider is usually associated with tall, mature, wet Eucalypt forest with high rainfall and nutrient rich soils, but is also known from tall dry open forest and mature woodland. In the north of NSW they favour mixed coastal forests to dry escarpment forests and in the south they prefer moist coastal gullies to creek flats and tall montane forests. Tree hollows for nest sites are essential, as are suitable food trees in close proximity. Records within the Hunter are typically scarce (NPWS 2003), and those within the sites' locality are restricted to isolated records at Singleton and Lovedale (NSW Wildlife Atlas data).	The disturbed nature of the site and lack of preferred habitat for the species greatly diminishes the potential for the species to occur on site. It is considered **unlikely** to occur.
Petaurus norfolcensis Squirrel Glider	V	-	This species occurs in eucalypt forests and woodlands where it feeds on sap exudates and blossoms. The species relies on tree hollows for nesting sites and requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species. Multiple records exist for the species in the locality, including within connected bushland to the south-west of the site (NSW Wildlife Atlas data).	Suitable habitat exists for the species within the site, particularly in the south. Given the species has been recorded within surrounding areas, it is considered **likely** to occur within the site on an intermittent basis.
Petrogale penicillata Brush-tailed Rock Wallaby	E	V	Occurs in forests and woodlands along the Great Divide and on the western slopes in escarpment country with rocky outcrops, steep rocky slopes, gorges, boulders and isolated rocky areas. Apart from the critical rock structure, the Brush-tailed Rock Wallaby also requires adjacent vegetation types, associated types include, dense rainforest, wet sclerophyll, vine thicket, dry sclerophyll forest and open forest. Records exist from Pokolbin State Forest where it is associated with the above habitats (Atlas of NSW Wildlife).	No suitable habitat exists for the species within the site or its surrounds. It is therefore considered **unlikely** to occur.
Potorous tridactylus tridactylus Long-nosed Potoroo	V	V	Prefers cool rainforest, wet sclerophyll forest and heathland. Records exist from the Karuah vicinity (Gunninah 1997) and the Gosford LGA, with no records occurring within 10km of the subject site (NSW Wildlife Atlas data).	No suitable habitat exists within the subject site and it is outside the known distribution of the species. It is therefore considered **unlikely** to occur.
Pteropus poliocephalus Grey-headed Flying-fox	V	V	The GHFF is found over a large area of subtropical and temperate forest, sclerophyll forest and woodlands, heaths, swamps, urban gardens and cultivated crops foraging for nectar and fruits. The species is frequently observed to forage in flowering Eucalypts and seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforest that are typically located within 20 km of their food source. Records are widespread in the locality (NSW Wildlife Atlas data).	Suitable foraging habitat exists for the species within the site. Given the species has been recorded within surrounding areas, it is considered **likely** to occur within the site on an intermittent basis.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	V	-	Range of habitats from rainforest to arid shrubland, roosts in tree-hollows. A limited number of records occur in the Lower Hunter Region, with a couple of records at Pokolbin and North Rothbury (NSW Wildlife Atlas data; RPS 2010).	Suitable habitat exists for the species within the site. It is determined that the species has the **potential** to occur on an intermittent basis.
Mormopterus (Micronomus) norfolkensis Eastern Freetail-bat	V	-	This species is distributed south of Sydney extending north into south-eastern Queensland. Most records of this species have been reported from dry Eucalypt forest and woodland. It is expected that open forested areas and the cleared land adjacent to bushland, constitutes important habitat for this species, It is a predominantly tree-dwelling species, roosting in hollows or behind loose bark in mature Eucalypts. Multiple records exist for the species in areas surrounding the site (RPS 2010; NSW Wildlife Atlas data).	This species was recorded on the site during recent field surveys. It is **known** to occur.

Species	TSC Act Status	EPBC Act Status	Habitat Description	Likelihood Of Occurrence
Chalinolobus dwyeri Large-eared Pied Bat	V	V	This species forages in tall open forests and the edges of rainforest. It roosts in mine shafts and similar structures. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of Fairy Martins (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Records do exist for the species surrounding the site including within semi-connected bushland to the west of the site (NSW Wildlife Atlas data).	This species was recorded on the site during recent field surveys. It is **known** to occur.
Falsistrellus tasmaniensis Eastern False Pipistrelle	V	-	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows. Appears to locally favour upland habitats. A couple of records exist for the species in surrounding areas at Pokolbin and Rothbury (NSW Wildlife Atlas data).	Suitable habitat exists for the species within the subject site and it has been recorded nearby. It is therefore determined that the species is **likely** to occur on an intermittent basis.
Miniopterus australis Little Bentwing Bat	V	-	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests. Requires caves or similar structures for roosting habitat, although may utilise hollows. Atlas records for the species surround the site (RPS 2010; NSW Wildlife Atlas data).	This species was recorded on the site during recent field surveys. It is **known** to occur.
Miniopterus schreibersii subsp. *oceanensis* Eastern Bentwing Bat	V	-	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat. Atlas records for the species surround the site (RPS 2010; NSW Wildlife Atlas data).	This species was recorded on the site during recent field surveys. It is **known** to occur.
Myotis macropus Southern Myotis	V	-	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Although usually recorded foraging over wet areas, it also utilises a variety of wooded habitats adjacent to such areas including rainforest, wet and dry sclerophyll forest, woodland, and swamp forest. Roosts in small colonies of between 15 and several hundred individuals in caves, mines, buildings and disused railway tunnels. Records exist for the species in areas surrounding the site including along connecting River Oak Forest to the north (RPS 2010; NSW Wildlife Atlas data).	No suitable habitat for roosting was discovered on site, however foraging habitat occurs along farm dams and the Swamp Oak and River Oak forests. It is therefore determined that the species is **likely** to occur on the site intermittently.
Scoteanax rueppellii Greater Broad-nosed Bat	V	-	Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces/ecotones. This species roosts in tree hollows and is relatively widespread within the Lower Hunter Region. Records exist for the species in areas surrounding the site including along connecting River Oak Forest to the north (RPS 2010; NSW Wildlife Atlas data).	Suitable habitat exists for the species within the subject site and it has been recorded within the area previously. It is therefore determined that the species is **likely** to occupy the site on an intermittent basis.
Vespadelus troughtoni Eastern Cave Bat	V	-	A cave dweller, known from wet sclerophyll forest and tropical woodlands from the coast and Dividing Range to the drier forests of the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings. Roost sites are frequently in reasonably well-lit areas. The distribution of this species is largely to the north of the Hunter Region (Strahan 1995). The closest records exists at Pokolbin State Forest to the south and at North Rothbury to the east (RPS 2010; NSW Wildlife Atlas data).	Only marginal foraging habitat exists on the site. There is limited **potential** for the species to forage intermittently on the site.
Pseudomys novaehollandiae New Holland Mouse	-	V	This species has a patchy distribution within open woodlands, heathlands and in hind dune vegetation throughout Eastern Australia. In the Hunter, the species stronghold is in the Myall Lakes region. Several records exist for the species within extensive bushland that includes Pokolbin State Forest to the south (NSW Wildlife Atlas data).	The sandy heathland habitat preferred by the species does not occur within the site. As a result, it is considered **unlikely** to occur.
Pseudomys oralis Hastings River Mouse	E	E	A small rodent with a patchy distribution across the Great Dividing Range from the Hunter Valley to the Bunya Mountains in south-east Queensland, this species occupies a variety of dry open forest types with dense, low ground cover. It requires access to permanent shelter such as rocky outcrops and fallen logs, and water seepage zones, creeks and gullies. No records exist for the species within 10km of the site (NSW Wildlife Atlas data).	The highly disturbed nature of the site along with previous and current land use activities greatly diminishes the potential for this species to occur. It is considered **unlikely** to occur.
ENDANGERED ECOLOGICAL COMMUNITIES				
Hunter Lowland Redgum Forest in the Sydney Basin and NSW Coast Bioregions	E	-	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. Recorded from the local government areas of Maitland, Cessnock and Port Stephens (in the Sydney Basin Bioregion) and Muswellbrook and Singleton (in the NSW North Coast Bioregion) but may occur elsewhere in these bioregions. Common canopy tree species are *Eucalyptus tereticornis* (Forest Red Gum) and *E. punctata* (Grey Gum). Other frequently occurring canopy species are *Angophora costata, Corymbia maculata, E. crebra* and *E. moluccana*. The mid-storey is open and characterised by sparse shrubs such as *Breynia oblongifolia*, *Leucopogon juniperinus*, *Daviesia ulicifolia* and *Jacksonia scoparia.* Correlates with LHCCREMS Map Unit (MU) 19 'Hunter Lowland Redgum Forest and MU24 under Peake (2006).	A canopy-only variant of this community was **recorded** in the north of the site.
Central Hunter Ironbark – Spotted Gum – Grey Box Forest	E	-	This community occupies undulating county including low rises and slopes. It occurs in the central Hunter Valley between Maitland and Muswellbrook. It forms and open forest or woodland dominated by *Eucalyptus crebra* (Narrow-leaved Ironbark), *Corymbia maculata* (Spotted Gum), *Eucalyptus moluccana* (Grey Box). Associated species may also include *Eucalyptus fibrosa* (Red Ironbark) and *Eucalyptus tereticornis* (Forest Red Gum) among others. The shrub layer varies from sparse to moderately dense and commonly includes *Daviesia ulicifolia* (Gorse Bitter Pea), *Pultenaea spinosa* (Grey Bush Pea) and *Breynia oblongifolia* (Coffee Bush).The community correlates with LHCCREMS MU 18 and MU 27 (Peake 2006).	A canopy-only variant of this community was **recorded** in patches throughout the site, whilst a partially intact representation of the whole community exists as a large patch in the south.

Notes: V = Vulnerable E = Endangered CE = Critically Endangered

5.0 SEPP 44 – Koala Habitat Protection

One Schedule 2 Koala Feed Tree was found to commonly occur on the site, being *Eucalyptus tereticornis* (Forest Red Gum). This species was found to occur in sufficient densities (>15%) in the far north and south of the site, as well as other isolated areas of regrowth to consitute "Potential Koala Habitat" as defined by the SEPP.

No definitive sign of Koalas has been noted on the site, and no sightings for the species have been recorded within the sites locality since 2006 (NSW Wildlife Atlas data). The absence of definitive signs of use at required intensity levels make it clear that “Core Koala Habitat” as defined by the SEPP does not exist within the subject site.

6.0 Key Constraints and Opportunities

The key ecological characteristics identified on the site include:

- Approximately 2.1 hectares of Hunter Lowland Redgum Forest EEC;
- Approximately 61.9 hectares of Central Hunter Ironbark Spotted Gum Grey Box Forest EEC;
- The likely occurrence of *Eucalyptus glaucina* (Slaty Red Gum) across the site within vegetation communities and/or as paddock trees;
- Potential habitat for a range of threatened fauna species, including the identified Speckled Warbler, Large-eared Pied Bat, Eastern Freetail-bat, Little Bentwing Bat and Eastern Bentwing Bat; and
- Connectivity between large patches of vegetation to the west and northeast through vegetation in the south of the site.

Given the site is proposed to have a minimum lot size of 10 hectares, opportunities exist for the avoidance of many potential impacts upon identified ecological features through strategic lot layout and design. This could allow for the retention of vegetated areas of the site (particularly in the north and south) and provide future opportunities to enhance natural values and increase potential habitat available for threatened flora and fauna species through:

- Implementation of weed control programs, particularly to target *Olea europea* subsp. *cuspidata* (African Olive), within the understorey of the River Oak and Swamp Oak forests;
- A targeted Noisy Miner (*Manorina melanocephala*) control program within the southern CHISGGBF to allow for other native bird species to utilise the area;
- Revegetation of the shrub layer; and
- Strengthening the link between surrounding areas of vegetation to the west and northeast by active planting or encouraging further regrowth in the south of the site.

7.0 References

Bell. S., and Driscoll, S.A.J. (2005). *Vegetation survey of "Sweetwater", North Rothbury, mid Hunter Valley, New South Wales* – Report to Harper Somers O'Sullivan

DEC (2004) *Threatened Biodiversity Survey and Assessment: Guidelines: Guidelines for Developments and Activities*. Working Draft

Department of the Environment (DoE) (2013) *EPBC Act Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance.* Australian Government Department of the Environment.

Department of the Environment (DoE) (2014) Protected Matters Search, Commonwealth Department of Environment (Accessed 24th October 2014).

DEWHA (2009) *Matters of National Environmental Significance – Significant Impact Guidelines 1.1*

Garnett, S.T. and Crowley, G.M. (2000). *The Action Plan for Australian Birds 2000*. Environment Australia.

Grey MJ et al. (1997). *Initial changes in the avian communities of remnant eucalypt woodlands following a reduction in the abundance of noisy miners, Manorina melanocephala*. Wildlife Research 24,631-648.

Gunninah Environment Consultants (1997) *Proposed Pacific Highway upgrade, Karuah NSW route selection – flora and fauna constraints*. NSW Roads and Traffic Authority.

Hill, K.D. (2002) Eucalyptus. Pp. 96-164 IN *Flora of New South Wales.* Volume 2. Revised Edition. Ed. by G.J. Harden. NSW University Press, Kensington.

HSO (2004) *Ecological Constraints Master Plan (ECMP) for the Hunter Economic Zone (HEZ)*. Draft Report.

LHCCREMS (2002) *Lower Hunter Central Coast Regional Flora & Fauna Survey Guidelines*.

Morcombe, M. (2000). *Field guide to Australian Birds*. Steve Parish Publishing.

National Parks and Wildlife Service (2000) *Vegetation Survey, Classification and Mapping: Lower Hunter and Central Coast Region*. NSW National Parks and Wildlife Service, Sydney

National Parks and Wildlife Service (2003) *Recovery Plan for the Yellow-bellied Glider (Petaurus australis*). NSW National Parks and Wildlife Service, Sydney

OEH (2014) *Atlas of NSW Wildlife*, NSW Office of Environment and Heritage (Accessed 6th November 2014).

Peake (2006) *The Vegetation of the Central Hunter Valley, New South Wales*. Hunter-Central Rivers CMA

RPS (2010) *Ecological Assessment Report – Huntlee*.

Strahan, R (Ed.) 1995. *The Mammals of Australia.* Reed Books, Chatswood, NSW

Appendix 1

Fauna Species List

Class	Family	Common Name	*Scientific Name*	TSC Act Status	EPBC Act Status
Amphibia	Myobatrachidae	Spotted Grass Frog	*Limnodynastes tasmaniensis*		
Amphibia	Hylidae	Eastern Dwarf Tree Frog	*Litoria fallax*		
Amphibia	Hylidae	Rocket Frog	*Litoria nasuta*		
Amphibia	Hylidae	Peron's Tree Frog	*Litoria peronii*		
Reptilia	Varanidae	Lace Monitor	*Varanus varius*		
Aves	Anatidae	Pacific Black Duck	*Anas superciliosa*		
Aves	Anatidae	Australian Wood Duck	*Chenonetta jubata*		
Aves	Columbidae	Common Bronzewing	*Phaps chalcoptera*		
Aves	Ardeidae	White-faced Heron	*Egretta novaehollandiae*		
Aves	Rallidae	Dusky Moorhen	*Gallinula tenebrosa*		
Aves	Psittacidae	Eastern Rosella	*Platycercus eximius*		
Aves	Cuculidae	Pallid Cuckoo	*Cacomantis pallidus*		
Aves	Cuculidae	Shining Bronze-Cuckoo	*Chalcites lucidus*		
Aves	Cuculidae	Channel-billed Cuckoo	*Scythrops novaehollandiae*		
Aves	Alcedinidae	Laughing Kookaburra	*Dacelo novaeguineae*		
Aves	Alcedinidae	Forest Kingfisher	*Todiramphus macleayii*		
Aves	Acanthizidae	Speckled Warbler	*Chthonicola sagittata*	Vulnerable	
Aves	Acanthizidae	White-throated Gerygone	*Gerygone albogularis*		
Aves	Acanthizidae	Weebill	*Smicrornis brevirostris*		
Aves	Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*		
Aves	Pardalotidae	Striated Pardalote	*Pardalotus striatus*		
Aves	Meliphagidae	Yellow-faced Honeyeater	*Lichenostomus chrysops*		
Aves	Meliphagidae	Noisy Miner	*Manorina melanocephala*		
Aves	Meliphagidae	Noisy Friarbird	*Philemon corniculatus*		
Aves	Campephagidae	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		
Aves	Campephagidae	White-winged Triller	*Lalage sueurii*		
Aves	Pachycephalidae	Grey Shrike-thrush	*Colluricincla harmonica*		
Aves	Pachycephalidae	Golden Whistler	*Pachycephala pectoralis*		
Aves	Pachycephalidae	Rufous Whistler	*Pachycephala rufiventris*		

Class	Family	Common Name	*Scientific Name*	TSC Act Status	EPBC Act Status
Aves	Oriolidae	Olive-backed Oriole	*Oriolus sagittatus*		
Aves	Artamidae	Dusky Woodswallow	*Artamus cyanopterus*		
Aves	Artamidae	White-breasted Woodswallow	*Artamus leucorynchus*		
Aves	Artamidae	Pied Butcherbird	*Cracticus nigrogularis*		
Aves	Artamidae	Australian Magpie	*Cracticus tibicen*		
Aves	Rhipiduridae	Grey Fantail	*Rhipidura albiscapa*		
Aves	Corvidae	Australian Raven	*Corvus coronoides*		
Aves	Monarchidae	Magpie-lark	*Grallina cyanoleuca*		
Aves	Corcoracidae	White-winged Chough	*Corcorax melanorhamphos*		
Aves	Petroicidae	Eastern Yellow Robin	*Eopsaltria australis*		
Aves	Petroicidae	Jacky Winter	*Microeca fascinans*		
Aves	Megaluridae	Rufous Songlark	*Cincloramphus mathewsi*		
Aves	Sturnidae	Common Myna	*Sturnus tristis**		
Aves	Motacillidae	Australian Pipit	*Anthus novaeseelandiae*		
Mammalia	Phalangeridae	Common Brushtail Possum	*Trichosurus vulpecula*		
Mammalia	Macropodidae	Eastern Grey Kangaroo	*Macropus giganteus*		
Mammalia	Macropodidae	Red-necked Wallaby	*Macropus rufogriseus*		
Mammalia	Molossidae	Eastern Freetail-bat	*Mormopterus ridei*		
Mammalia	Molossidae	East Coast Freetail-bat	*Mormopterus norfolkensis*	Vulnerable	
Mammalia	Molossidae	Little Mastiff-bat	*Mormopterus planiceps*		
Mammalia	Molossidae	White-striped Freetail-bat	*Tadarida australis*		
Mammalia	Vespertilionidae	Large-eared Pied Bat	*Chalinolobus dwyeri*	Vulnerable	Vulnerable
Mammalia	Vespertilionidae	Gould's Wattled Bat	*Chalinolobus gouldii*		
Mammalia	Vespertilionidae	Chocolate Wattled Bat	*Chalinolobus morio*		
Mammalia	Vespertilionidae	Little Bentwing-bat	*Miniopterus australis*	Vulnerable	
Mammalia	Vespertilionidae	Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable	
Mammalia	Vespertilionidae	long-eared bat	*Nyctophilus sp.*		
Mammalia	Vespertilionidae	Inland Broad-nosed Bat	*Scotorepens balstoni*		

Appendix 2

Flora Species List

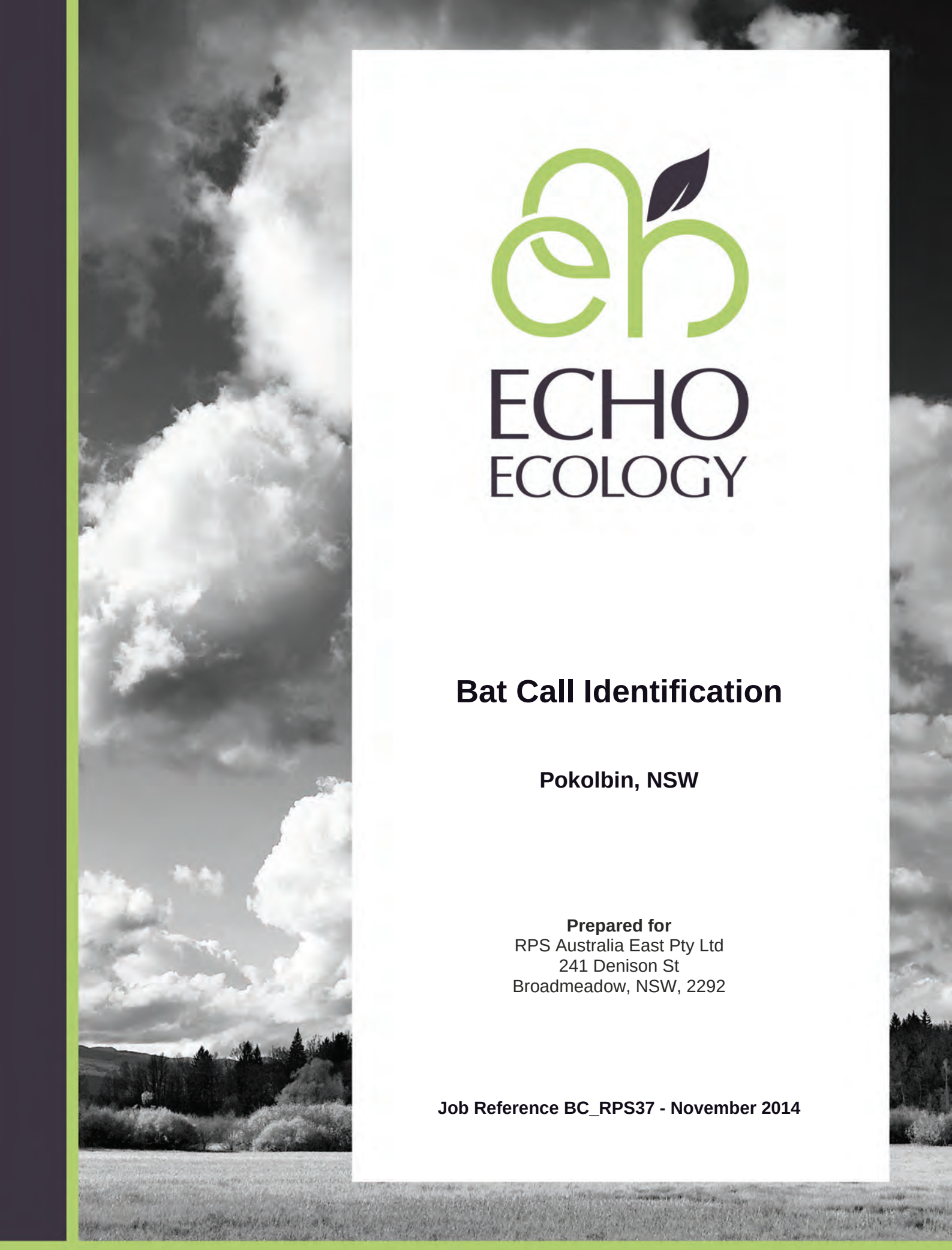
Family	Common Name	*Scientific Name*	TSC Act Status	EPBC Act Status
Fabaceae	*Acacia falcata*			
Fabaceae	*Acacia paradoxa*	Kangaroo Thorn		
Fabaceae	*Acacia parvipinnula*	Silver-stemmed Wattle		
Poaceae	*Aristida ramosa*	Purple Wiregrass		
Poaceae	*Aristida vagans*	Three-awn Speargrass		
Asteraceae	*Bidens pilosa**	Cobbler's Pegs		
Poaceae	*Bothriochloa decipiens var. decipiens*	Pitted Bluegrass, Redleg Grass		
Poaceae	*Briza maxima**	Quaking Grass		
Crassulaceae	*Bryophyllum delagoense**	Mother of Millions		
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn		
Asteraceae	*Cassinia uncata*	Sticky Cassinia		
Casuarinaceae	*Casuarina cunninghamiana subsp. cunninghamiana*	River Oak		
Casuarinaceae	*Casuarina glauca*	Swamp Oak		
Gentianaceae	*Centaurium erythraea**	Common Centaury		
Poaceae	*Chloris truncata*	Windmill Grass		
Poaceae	*Chloris ventricosa*	Tall Chloris		
Asteraceae	*Cirsium spp.**			
Asteraceae	*Cirsium vulgare**	Spear Thistle		
Myrtaceae	*Corymbia maculata*	Spotted Gum		
Asteraceae	*Conyza sumatrensis**	Tall Fleabane		
Poaceae	*Cymbopogon refractus*	Barbwire Grass		
Poaceae	*Cynodon dactylon*	Common Couch		
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea		
Phormiaceae	*Dianella spp.*			
Poaceae	*Dichelachne micrantha*	Short-hair Plume Grass		
Convolvulaceae	*Dichondra repens*	Kidney Weed		
Poaceae	*Ehrharta erecta**	Panic Veldtgrass		
Poaceae	*Elymus scaber*	Wheat Grass		
Poaceae	*Entolasia marginata*	Bordered Panic		
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark		

Family	Common Name	*Scientific Name*	TSC Act Status	EPBC Act Status
Myrtaceae	*Eucalyptus fibrosa*	Broad Leaved Ironbark		
Myrtaceae	*Eucalyptus moluccana*	Grey Box		
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum		
Moraceae	*Ficus rubiginosa*	Port Jackson Fig		
Apiaceae	*Foeniculum vulgare**	Fennel		
Asteraceae	*Gamochaeta coarctata (*syn. *spicata)**	Cudweed		
Asclepidaceae	*Gomphocarpus fruiticosus**	Narrow Leaf Cotton Bush		
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia		
Proteaceae	*Grevillea robusta*	Silky Oak		
Proteaceae	*Hakea sericea*	Needlebush		
Asteraceae	*Helichrysum spp.*			
Asteraceae	*Hypochaeris radicata**	Flatweed		
Poaceae	*Imperata cylindrica*	Blady Grass		
Poaceae	*Joycea pallida*	Silvertop Wallaby Grass		
Juncaceae	*Juncus acutus subsp. acutus**	Sharp Rush		
Juncaceae	*Juncus usitatus*	Common Rush		
Poaceae	*Lolium multiflorum**	Italian Ryegrass		
Poaceae	*Lolium spp.**	A Ryegrass		
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush		
Poaceae	*Microlaena stipoides*	Weeping Grass		
Asclepiadaceae	*Marsdenia rostrata*	Common Milk Vine		
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive		
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting		
Poaceae	*Oplismenus aemulus*	Basket Grass		
Poaceae	*Paspalum dilatatum**	Paspalum		
Plantaginaceae	*Plantago lanceolata**	Ribwort		
Fabaceae	*Pultenaea spinosa*			
Poaceae	*Rytidosperma fulvum*	Wallaby Grass		
Asteraceae	*Senecio madagascariensis**	Fireweed		
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne		

Family	Common Name	*Scientific Name*	TSC Act Status	EPBC Act Status
Solanaceae	*Solanum sp.*			
Poaceae	*Themeda australis*	Kangaroo Grass		
Anthericaceae	*Thysanotus tuberosus*	Fringed Lily		
Verbenaceae	*Verbena bonariensis**	Purpletop		

Appendix 3

Anabat Results



ECHO ECOLOGY

Bat Call Identification

Pokolbin, NSW

Prepared for
RPS Australia East Pty Ltd
241 Denison St
Broadmeadow, NSW, 2292

Job Reference BC_RPS37 - November 2014

Echo Ecology Pty Ltd ABN 73 162 118 710 • PO Box 4132 Crescent Head, NSW 2440 Australia • P: 0423 801 779 • E: info@echoecology.com.au • W: echoecology.com.au

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

This report was authored by

Dr Anna McConville
PhD, B.Env.Sc.

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1.0 INTRODUCTION

This report has been commissioned by RPS Australia East Pty Ltd to analyse bat echolocation call data (Anabat, Titley Electronics) collected from Pokolbin, NSW. Data was provided electronically to the author. This report documents the methods involved in analysing bat call data and the results obtained only.

2.0 METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW (Version 4.0r) software. The identification of calls was undertaken with reference to Pennay *et al*. (2004) and through the comparison of recorded reference calls from north-eastern NSW and the Sydney Basin. Reference calls were obtained from the NSW database and from the authors personal collection.

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

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

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

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

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

2.1 Characteristics Used to Differentiate Species

Miniopterus australis was differentiated from *Vespadelus pumilus*, by characteristic frequency or the presence of a down-sweeping tail on pulses.

Miniopterus schreibersii oceanensis was differentiated by *Vespadelus* sp. by a combination of uneven consecutive pulses and the presence of a down-sweeping tail.

Calls from *Mormopterus* sp. were differentiated by the presence of mainly flat pulses. *Mormopterus (Ozimops)* planiceps was differentiated by low characteristic frequency. *Mormopterus (Micronomus) norfolkensis* was differentiated from *Mormopterus (Ozimops) ridei* in long call sequences where pulses alternated, often with a downward sloping tail.

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

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

Nyctophilus sp. calls were identified from *Myotis macropus* by pulse intervals > 95 ms and an initial slope of < 300 OPS. *Nyctophilus geoffroyi* and *Nyctophilus gouldi* were unable to be differentiated.

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

Chalinolobus dwyeri, *Rhinolophus megaphyllus*, *Saccolaimus flaviventris*, *Tadarida australis* were differentiated from other bat species on the basis of characteristic frequency.

3.0 RESULTS

A total of 4,805 call sequences were recorded, of which 288 call sequences were able to be analysed (ie were not ‘noise’ files or bat calls of short length). Of the bat calls, 152 call sequences (53 %) were able to be confidently identified (those classified as either definite

or probable identifications) to species level (Table 3-1). Species recorded confidently within the site include:

- *Chalinolobus dwyeri* (Large-eared pied bat)
- *Chalinolobus gouldii* (Gould's wattled bat)
- *Chalinolobus morio* (Chocolate wattled bat)
- *Miniopterus australis* (Little bentwing bat)
- *Miniopterus schreibersii oceanensis* (Eastern bentwing bat)
- *Mormopterus (Micronomus) norfolkensis* (East coast free-tailed bat)
- *Mormopterus (Ozimops) ridei* (Eastern free-tailed bat)
- *Mormopterus (Ozimops) planiceps* (South-eastern free-tailed bat)
- *Nyctophilus* species (*Nyctophilus gouldi* or *Nyctophilus geoffroyi*)
- *Scotorepens balstoni* (Inland broad-nosed bat)
- *Tadarida australis* (White-striped free-tailed bat)

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

- *Falsistrellus tasmaniensis* (Eastern falsistrelle)
- *Myotis macropus* (Large-footed myotis)
- *Rhinolophus megaphyllus* (Eastern horseshoe bat)
- *Scoteanax rueppellii* (Greater broad-nosed bat)
- *Scotorepens orion* (Eastern broad-nosed bat)
- *Vespadelus darlingtoni* (Large forest bat)
- *Vespadelus pumilus* (Eastern forest bat)
- *Vespadelus regulus* (Southern forest bat)
- *Vespadelus troughtoni* (Eastern cave bat)
- *Vespadelus vulturnus* (Little forest bat)

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

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

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

IDENTIFICATION	Anabat 3 10/11/2014	Anabat 3 11/11/2014	Anabat 3 12/11/2014	Anabat 4 10/11/2014	Anabat 4 11/11/2014
DEFINITE					
Chalinolobus dwyeri	1	-	-	1	-
Chalinolobus gouldii	1	3	1	8	-
Chalinolobus morio	1	4	-	6	-
Mormopterus (Micronomus) norfolkensis	-	-	-	23	-
Mormopterus (Ozimops) ridei	-	-	-	7	-
Tadarida australis	41	1	-	8	1
PROBABLE					
Chalinolobus dwyeri	-	-	-	1	-
Chalinolobus gouldii	2	3	2	1	-
Chalinolobus morio	-	-	-	2	1
Miniopterus australis	1	-	-	-	-
Miniopterus schreibersii oceanensis	5	2	-	1	-
Mormopterus (Micronomus) norfolkensis	-	1	-	14	1
Mormopterus (Ozimops) planiceps	1	-	-	-	-
Mormopterus (Ozimops) ridei	-	-	-	6	-
Scotorepens balstoni	-	1	-	-	-
POSSIBLE					
Chalinolobus gouldii	-	-	-	1	-
Mormopterus (Micronomus) norfolkensis	-	-	-	1	-
Rhinolophus megaphyllus	-	-	1	-	-

IDENTIFICATION	Anabat 3 10/11/2014	Anabat 3 11/11/2014	Anabat 3 12/11/2014	Anabat 4 10/11/2014	Anabat 4 11/11/2014
SPECIES GROUPS					
Mormopterus (Micronomus) norfolkensis / Mormopterus (Ozimops) ridei	-	1	-	14	-
Chalinolobus gouldii / Mormopterus (Micronomus) norfolkensis / Mormopterus (Ozimops) ridei / Scotorepens balstoni	1	2	-	21	-
Chalinolobus gouldii / Mormopterus (Ozimops) planiceps	7	2	-	2	-
Chalinolobus gouldii / Mormopterus (Ozimops) ridei / Mormopterus (Ozimops) planiceps / Scotorepens balstoni	-	1	-	3	-
Chalinolobus gouldii / Scotorepens balstoni	3	1	-	2	-
Chalinolobus gouldii / Scotorepens balstoni / Scoteanax rueppellii	1	2	-	-	-
Chalinolobus morio / Vespadelus pumilus / Vespadelus vulturnus / Vespadelus troughtoni	1	3	-	9	4
Falsistrellus tasmaniensis / Scotorepens orion / Scoteanax rueppellii	4	-	1	1	-
Miniopterus australis / Vespadelus pumilus	-	-	-	2	-
Miniopterus schreibersii oceanensis / Vespadelus darlingtoni / Vespadelus regulus	10	21	3	3	-
Mormopterus (Ozimops) ridei / Mormopterus (Ozimops) planiceps	-	1	-	-	-
Myotis macropus / Nyctophilus geoffroyi / Nyctophilus gouldi	1	-	-	3	-
Nyctophilus geoffroyi / Nyctophilus gouldi	-	1	-	-	-
Vespadelus pumilus / Vespadelus vulturnus / Vespadelus troughtoni	-	-	-	2	-
UNKNOWN					
'Noise' files	4	2649	1742	12	22
Unknown	29	24	7	28	-
TOTAL	**114**	**2723**	**1757**	**182**	**29**

4.0 SAMPLE CALLS

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

Figure 4-1: *Chalinolobus dwyeri* definite call

Figure 4-2: *Chalinolobus gouldii* definite call

Figure 4-3: *Chalinolobus morio* definite call

Figure 4-4: *Miniopterus australis* probable call

Figure 4-5: *Miniopterus schreibersii oceanensis* probable call

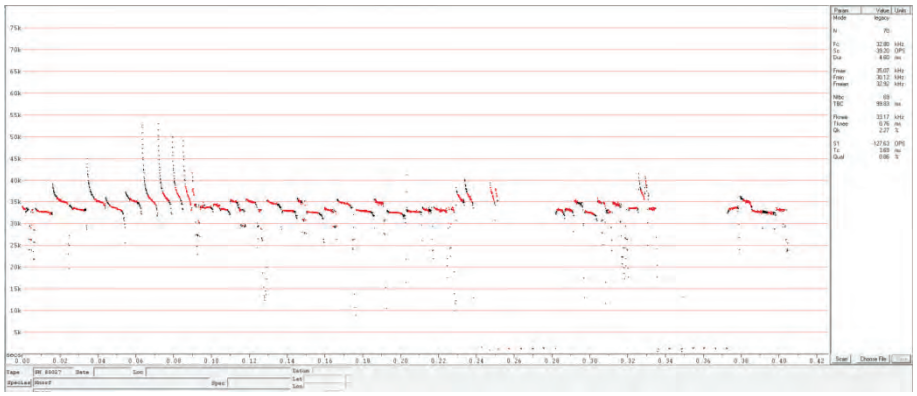

Figure 4-6: *Mormopterus (Micronomus) norfolkensis* definite call

Figure 4-7: *Mormopterus (Ozimops) planiceps* probable call

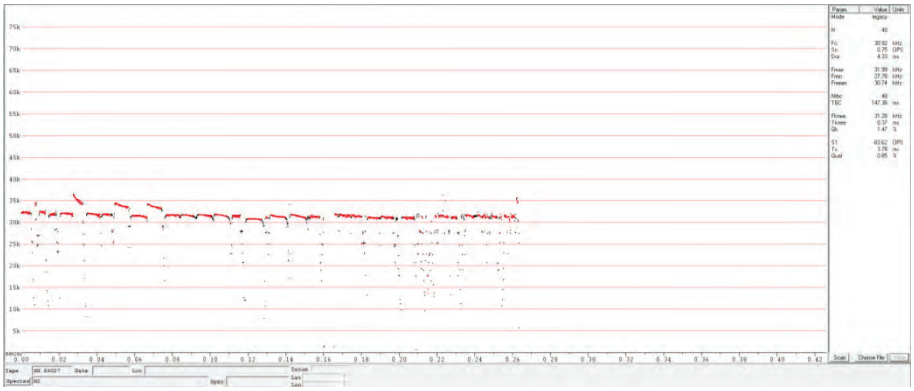

Figure 4-8: *Mormopterus (Ozimops) ridei* definite call

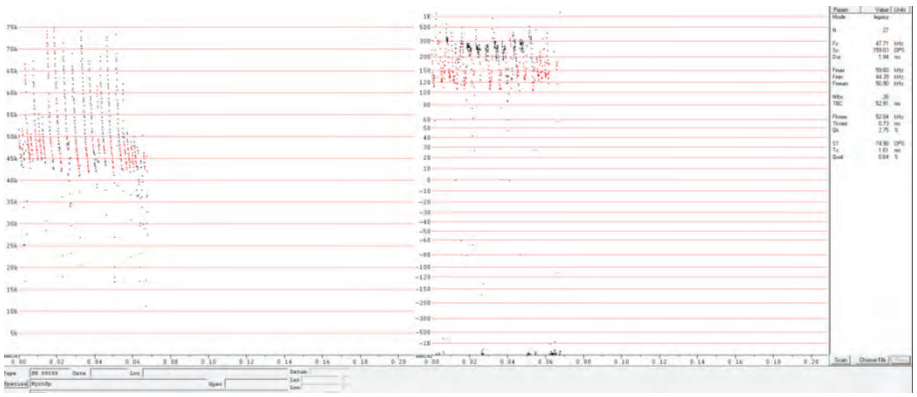

Figure 4-9: *Nyctophilus* sp. species group

Figure 4-10: *Scotorepens balstoni* probable call

Figure 4-11: *Tadarida australis* definite call

5.0 REFERENCES

Adams, M., Reardon, T.R., Baverstock, P.R. and Watts, C.H.S. (1988). Electrophoretic resolution of species boundaries in Australian Microchiroptera. IV. The Molossidae (Chiroptera). *Australian Journal of Biological Sciences* 41: 315-326.

Australasian Bat Society Incorporated (undated) *Standards for reporting bat detector surveys*, http://batcall.csu.edu.au/abs/issues/ABS_Anabat_survey_standards.pdf

Churchill, S. (2008). *Australian Bats.* Second Edition Allen & Unwin; Crows Nest, NSW.

Hoye, G.A, Law, B.S. and Lumsden, L.F. (2008). Eastern Free-tailed Bat Mormopterus sp. Pp. 493-495 in *The Mammals of Australia*: Third Edition (S. van Dyck and R. Strahan, Eds.); New Holland; Sydney.

Law, B.S., Turbill, C. and Parnaby, H. (2008). Eastern Forest Bat Vespadelus pumilus. Pp. 567-568 in *The Mammals of Australia*: Third Edition (S. van Dyck & R. Strahan; Eds.); New Holland; Sydney.

Law, B.S., Reinhold, L. and Pennay, M. (2002). Geographic variation in the echolocation calls of Vespadelus spp. (Vespertilionidae) from New South Wale and Queensland, Australia. *Acta Chiropterologica* 4: 201-215.

Pennay, M., Law, B. and Reinhold, L. (2004). *Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats*. NSW Department of Environment and Conservation, Hurstville.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001a). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Queensland Department of Natural Resources and Mines, State Forests of New South Wales, University of Southern Queensland, and New South Wales National Parks and Wildlife Service, Australia.

Reinhold, L., Herr, A., Lumsden, L., Reardon, T., Corben, C., Law, B., Prevett, P., Ford, G., Conole, L., Kutt, A., Milne, D. and Hoye, G. (2001b). Geographic variation in the echolocation calls of Gould's wattled bat *Chalinolobus gouldii*. *Australian Zoologist* 31: 618-624.

Richards, G.C., Ford, G.I. and Pennay, M. (2008). Inland Free-tailed Bat Mormopterus sp. Pp. 494-495 in *The Mammals of Australia*: Third Edition (S. van Dyck and R. Strahan, Eds.); New Holland; Sydney.

Thomas, D.W., Bell, G.P. and Fenton, M.B. (1987). Variation in echolocation call frequencies recorded from North American vespertilionid bats: a cautionary note. *Journal of Mammalogy* 68: 842-847.

Van Dyck, S. and Strahan, R. (Eds.) (2008). *The Mammals of Australia: Third Edition*. New Holland; Sydney.