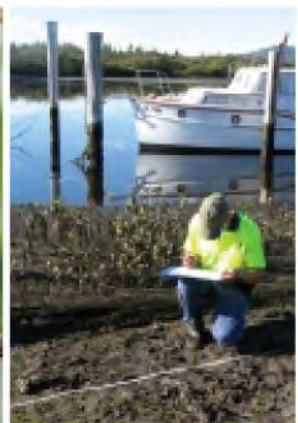


Constraints Report

223 Scenic Drive, Colongra NSW 2259

Prepared for Woolworths Pty Ltd

August 2012



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Offices in Newcastle NSW & Mackay QLD
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Constraints Report

Final Report

223 Scenic Drive, Colongra NSW 2259 | Prepared for Woolworths Ltd

Approved By	David Paull	Approved By
Position	Senior Ecologist	Position
Date	27/08/2012	Date

This report was prepared for the sole use of the proponents, their agents and any regulatory agencies involved in the development application approval process. It should not be otherwise referenced without permission.

Document Control

Version	Date	Prepared By	Reviewed By
1	9/07/2012	LF (Fauna)	DPa
		AM (Flora)	DPa
2	27/08/2012	AM / DPa	DPa



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Executive Summary

The assessment of ecological constraints within Lot 1 DP1049201 (223 Scenic Drive, Colongra) revealed that:

- 21 threatened flora species and 76 threatened fauna species are known from within 5 km of the study area. Of these, 10 threatened flora species and 25 threatened fauna species are considered likely to utilise habitat such as that found within the study area;
- 2.19 ha of woodland with a “moderate” constraint, due to:
 - 36 hollow-bearing trees were identified as occurring within the study area, some of which were observed being used by Rainbow Lorikeets for nesting and may provide habitat for a number of locally occurring threatened species;
 - One species of Koala preferred feed tree *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum) was identified as occurring within the study area. This tree species constituted more than 15% of the canopy cover and as such the wooded areas on the study area are Potential Koala Habitat under SEPP 44. Subsequent SAT tests assessment showed no sign of Koala activity and there are no records from within 5 km of the site; and
 - The study area lies on the periphery of a large expanse of bushland habitat linking the Colongra wetlands, Lake Munmorah State Conservation Area and west to Olney State Forest.
- 0.9 ha of low constraint, low condition vegetation, unsuitable for most native vertebrate fauna.
- Additional field work is recommended to clarify some of the constraints issues, particularly relating to the presence of hollow-using species and some threatened plant species which may occur on the Lot.



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1. Introduction

1.1. Scope

Kleinfelder/ecobiological was commissioned by Woolworths Ltd, to prepare a constraints assessment of flora, fauna and threatened species at 223 Scenic Drive, Colongra, NSW.

1.2. Regional Context

Colongra is a small suburb within the Wyong LGA approximately 50 km south of Newcastle and is located just in between Lake Munmorah and Budgewoi Lake. Just to the north of the study area is Colongra Power Station (**Figure 1**).

1.3. Study Area

The study area (Lot 1, DP1049201) fronts onto Scenic Drive, which runs south-east from the Pacific Highway to Budgewoi. The majority of the study area is currently vegetated, although evidence of frequent under-scrubbing is evident. Approximately one third of the study area has been cleared and no canopy level vegetation is present within this area. Site access is currently from several dirt tracks on the western boundary.

1.4. Project Description

Woolworths Ltd require a constraints report to determine the suitability of this site for Woolworths commercial purposes.

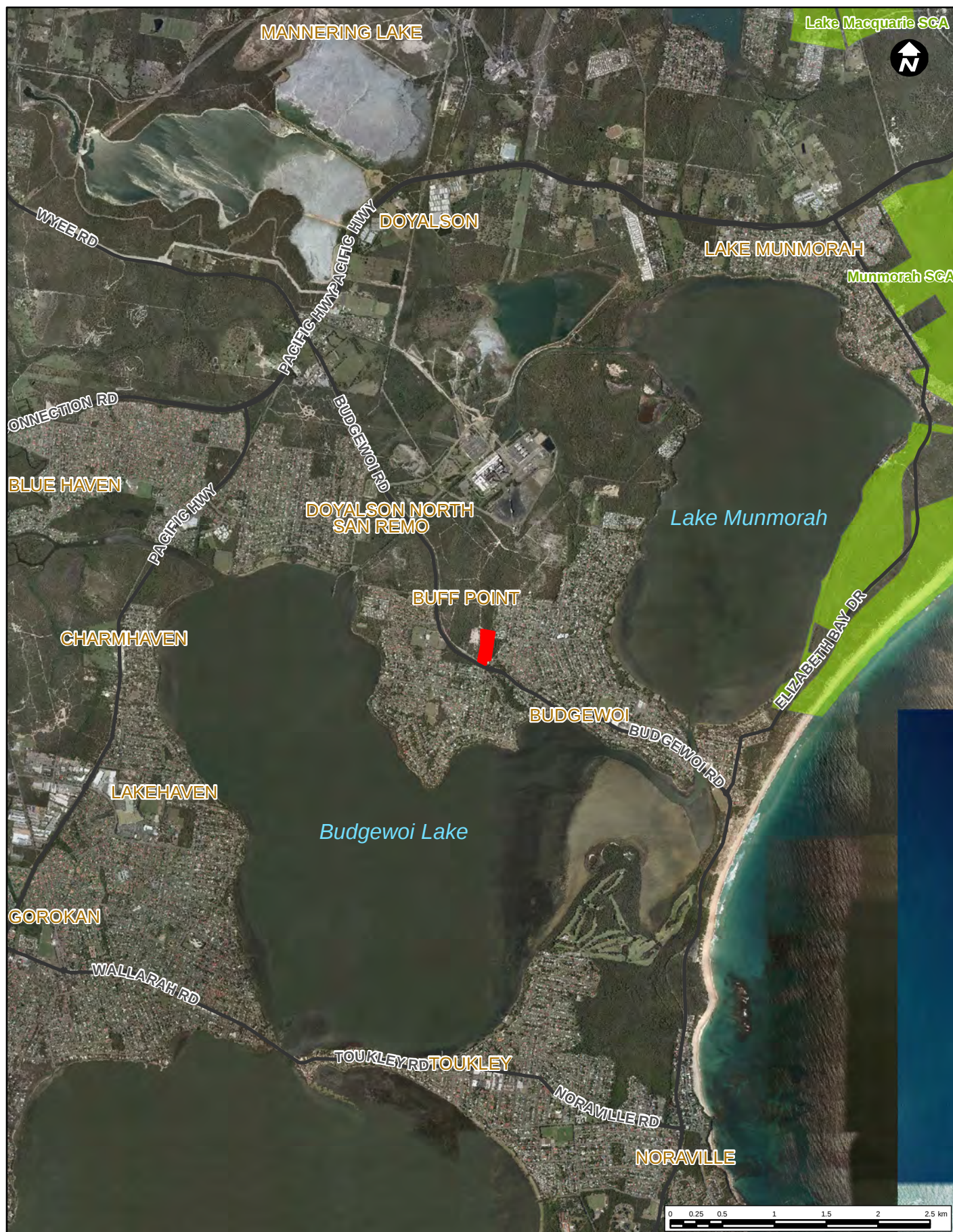


Figure 1 - Locality Map

Legend

- Study Area
- Forests NSW
- National Parks
- Major Roads



Project Ref:	179-1075
Plot Date:	10/07/2012 14:34
Revision:	001 (gayle.j)

Map Projection:

GDA 1994 MGA Zone 56

Data Sources:

LPMA - 2011
OAH - 2012
ecobiological - 2011

Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.



1.5. Legislation

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

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *NSW Threatened Species Conservation Act 1995* (TSC Act);
- *NSW Threatened Species Conservation Amendment Act 2002*;
- *National Parks and Wildlife Act 1974* (NP&W Act);
- *Environmental Planning and Assessment Act 1979* (EP&A Act);
- *Noxious Weeds Act 1993* (NW Act);
- *Native Vegetation Act 2003* (NV Act);
- *Fisheries Management Act 1994* (FM Act);
- *Water Management Act 2000* (WM Act);
- State Environment Planning Policy 44 (SEPP44) Koala Habitat Protection;
- NSW Groundwater Dependent Ecosystem Policy.

1.5.1. Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)

Under the EPBC Act assessment an approval is required for actions that are likely to have a significant impact on matters of national environmental significance. An action includes a project, development, undertaking, activity, or series of activities. When a person proposes to take an action they believe may need approval under the EPBC Act, they must refer the proposal to the Australian Government Minister for the Environment. The Act identifies eight matters of national environmental significance:

1. World Heritage properties;
2. National heritage places;
3. Wetlands of international importance (RAMSAR);
4. Listed threatened species and communities;
5. Migratory species listed under international agreements;
6. Great Barrier Reef Marine Park;
7. Commonwealth marine areas; and,
8. Nuclear actions.

Points 4 and 5 are relevant to the proposal and are assessed in section 4.

1.5.2. NSW Threatened Species Conservation Act 1995 (TSC Act)

Schedules 1 and 2 of the TSC Act contain lists of flora and fauna species and communities, which have been determined by the NSW Scientific Committee as being under threat of serious decline that could ultimately lead to extinction. Section 5A of the EP&A Act provides for a seven-part test of significance and impact to be applied to any of these listed species or



communities that are found in an area subject to proposed development. Schedule 3 of the TSC Act contains a list of 'key threatening processes' deemed to be processes that have a negative impact on threatened species, populations or communities.

1.5.3. State Environmental Planning Policy (SEPP) 44 Koala Habitat Protection

The aim of this SEPP is to, as far as possible, preserve Koala habitat in the state. SEPP 44 encourages the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

Under SEPP 44, the identification of Potential Koala habitat and Core Koala habitat is outlined. Potential Koala habitat is defined as areas of native vegetation where the tree species outlined in Table 1 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Table 1: List of SEPP 44 - Schedule 2 preferred Koala Feed Trees.

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

An assessment of potential impacts on SEPP 44 Koala habitat has been undertaken Section 4.



2. Methods

2.1. Database and Literature Review

To obtain a list of potentially occurring threatened species, populations and ecological communities that have been reported or modelled to occur from within a 25 kilometre radius of the study area, the following databases were searched:

- DECCW's Atlas of NSW Wildlife
www.wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp;
- PlantNet (www.plantnet.rbgsyd.nsw.gov.au/);
- A search of Threatened Ecological Communities listed under the TSC Act in the Central Coast Catchment Management Authority (CMA) subregion using the DECCW threatened species website
http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/search_advanced_form.aspx; and,
- SEWPAC's Protected Matters search tool
(www.environment.gov.au/erin/ert/epbc/index.html).

Based on information available concerning habitat requirements of these species, populations and ecological communities; an assessment was made as to the likelihood of any of the reported threatened species, populations and ecological communities occurring on the study area or using the habitat of the study area as an essential part of a foraging range.

2.2. Site Assessment

A site assessment was conducted on the 9th of July 2012 to compile information on the existing vegetation and potential fauna habitat within the study area.

2.2.1. Vegetation community type determination

The identification of vegetation communities was based on an assessment of dominant species present in the over-storey, mid-storey, shrub and ground layers as recorded in two 0.04 hectares (20 metres x 20 metres) floristic quadrats and rapid data points (RDP). The species identified within and surrounding the area of the study area were compared to the vegetation descriptions of Lower Hunter Central Coast Regional Environmental Management Strategy (LHCCREMS, NPWS 2000) in order to arrive at an accepted community identity.

The boundaries of each of the identified vegetation communities within the study area were mapped using a combination of rapid data points (RDP) and aerial photo interpretation



2.2.2. Habitat assessment

Ten habitat assessments (Figure 4) were undertaken within the study area. These assessments were made regarding environmental attributes within the site including vegetation structure, presence of water bodies, connectivity, hollow abundance, and leaf litter using a methodology developed by Kleinfelder/ecobiological. The following variables were measured:

Overstorey cover (%), Midstorey cover (%), Groundstorey cover (grasses) (%), Groundstorey cover (Shrubs) (%), Groundstorey cover (other) (%), Litter cover (%), bare ground (%), Exotic plant cover (%), Waterbodies (present/absent), Fallen Logs (present/absent).

2.2.3. Hollow assessment

Hollows are an important resource utilised by a variety of forest fauna. Vertebrate and invertebrate species use hollows as diurnal or nocturnal shelter sites, for rearing young, feeding, thermo-regulation and to facilitate ranging behaviour and dispersal (Gibbons & Lindenmayer 2002). Approximately 400 Australian species potentially use hollows either on a permanent or opportunistic basis. Many threatened species are obligate users, requiring the presence of hollows to survive in the landscape (Gibbons & Lindemayer 2002).

All hollows appearing within the study area were identified and classified according to the size class of the outside cavity:

- Small (0-8 cm);
- Medium (8-20 cm); and
- Large (>20 cm).

2.2.4. Koala Spot Assessment Technique (SAT test)

Under SEPP 44, the identification of Potential Koala habitat and Core Koala habitat is outlined. Potential Koala habitat is defined as areas of native vegetation where the trees of the types outlined in Table 3 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. One preferred species, *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum) represents over 15% of the canopy vegetation within the study area.

In order to determine whether the site supports Core Koala Habitat, use of the Spot Assessment Technique (SAT) (Phillips and Callaghan 2011) is required. The SAT test involves a radial assessment of Koala “activity” within the immediate area surrounding a tree of any species that is known to have been utilised by the species, or otherwise considered to be of some importance for Koala conservation and/or management purposes. In the field the technique is applied as follows:

1. Locate and uniquely mark with flagging tape a tree (the centre tree) that meets one or more of the following selection criteria:



- a. a tree of any species beneath which one or more *P. cinereus* faecal pellets have been observed and/or
 - b. a tree in which a *P. cinereus* has been observed and/or
 - c. any other tree known or considered to be potentially important for *P. cinereus*, or of interest for other assessment purposes.
2. identify and uniquely mark the 29 nearest trees to the centre tree,
 3. undertake a search for *P. cinereus* faecal pellets beneath each of the 30 marked trees based on a cursory inspection of the undisturbed ground surface within a distance of 100 centimetres around the base of each tree, followed (if no faecal pellets are initially detected) by a more thorough inspection involving disturbance of the leaf litter

In terms of search effort, an average of approximately two person minutes per tree should be dedicated to the faecal pellet search.

Six SAT assessment circles were conducted at the site (**Figure 2**), 180 trees were searched for sign of Koala activity.



Figure 2 - Survey Effort

Legend

- Study Area
- Survey Tracks
- Q Flora Quadrat
- R Rapid Data Point
- H Habitat Assessment
- Koala SAT Test



Map Projection:

GDA 1994 MGA Zone 56

Data Sources:

LPMA - 2011
ecobiological - 2011

Project Ref: 179-1075

Plot Date: 27/08/2012 13:12

Revision: 001 (gjjoyce)

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3. Results

3.1. Threatened Species Database Search

A total of 97 threatened flora and fauna have been previously recorded and/or are modelled to occur within a 25 km radius of the study area (**Table 2**), (**Figure 3**). These include 21 plants, five amphibians, two reptiles, 51 birds, one insect, 17 mammals and two reptiles. In addition, 51 migratory bird species were modelled to potentially occur in the region.

Several species (including solely marine mammals) were omitted from the search results due to the location of the study area and lack of suitable habitat.



Threatened Flora Within 5km

- *Acacia bynoeana*
- *Angophora inopina*
- *Callistemon linearifolius*
- *Chamaesyce psammogeton*
- *Clematis fawcettii*
- *Cryptostylis hunteriana*
- ★ *Diuris praecox*
- ★ *Eucalyptus camfieldii*
- ★ *Eucalyptus parramattensis subsp. parramattensis*
- ★ *Rutidosia heterogama*
- ★ *Syzygium paniculatum*
- ★ *Tetratheca juncea*

Threatened Fauna Within 5km

- ▲ Australian Fur-seal
- ▲ Barking Owl
- ▲ Black-necked Stork
- ▲ Black-tailed Godwit
- ▲ Broad-billed Sandpiper
- Curlew Sandpiper
- Diamond Firetail
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Eastern Osprey

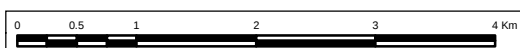
- ⊗ Giant Dragonfly
- + Glossy Black-Cockatoo
- + Gould's Petrel
- + Great Knot
- + Greater Broad-nosed Bat
- + Green Turtle
- + Grey-headed Flying-fox
- ◆ Lesser Sand-plover
- ◆ Little Bentwing-bat
- ◆ Little Lorikeet
- ◆ Little Tern
- ◆ New Zealand Fur-seal

- ◆ Pied Oystercatcher
- ◆ Regent Honeyeater
- ◆ Sooty Oystercatcher
- ◆ Southern Giant Petrel
- ◆ Southern Myotis
- ◆ Spotted-tailed Quoll
- ◆ Squirrel Glider
- ◆ Superb Fruit-Dove
- ◆ Swift Parrot
- ◆ Varied Sittella
- Wallum Froglet

Figure 3 - Threatened Species Records Within 5km

Legend

- Study Area
- 5km Search Area



Map Projection:

GDA 1994 MGA Zone 56

Data Sources:

LPMA - 2011
ecobiological - 2011

Project Ref: 179-1075

Plot Date: 10/07/2012 11:12

Revision: 001 (gayle.)

Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.



Table 2: Threatened flora, fauna and endangered populations recorded and/or modelled to occur in the study area.

Scientific Name	Common Name	Legal Status (TSC Act)	Legal Status (EPBC Act)	Source	Number of Records	Last Record	Suitable habitat
Flora							
<i>Acacia bynoeana</i>	Bynoe's Wattle	E1	V	NPWS Atlas	26	23/01/2008	Yes
<i>Angophora inopina</i>	Charmhaven Apple	V	V	NPWS Atlas	103	30/06/2011	Yes
<i>Caladenia porphyrea</i>		E1		NPWS Atlas	6	23/08/2006	Yes
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E1	V	NPWS Atlas	6	1/09/1998	Yes
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V		NPWS Atlas	8	9/09/2009	No
<i>Chamaesyce psammogeton</i>	Sand Spurge	E1		NPWS Atlas	1	31/12/1987	No
<i>Clematis fawcettii</i>	Northern Clematis	V		NPWS Atlas	1	30/06/2011	No
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	NPWS Atlas	15	22/12/2008	Yes
<i>Diuris praecox</i>	Rough Double Tail	V	V	NPWS Atlas	12	4/09/2008	Yes
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	V	NPWS Atlas	28	17/09/2010	No
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	Eucalyptus parramattensis C. Hall. subsp. parramattensis in Wyong and Lake Macquarie local government areas	E2		NPWS Atlas	53	6/10/2010	Yes
<i>Genoplesium insignis</i>	Variable Midge Orchid	E1		NPWS Atlas	2	16/09/2000	No
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	NPWS Atlas	2	27/03/2008	No
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	NPWS Atlas	41	6/10/2010	Yes
<i>Pelargonium</i> sp. <i>striatellum</i> (G. W. Carr 10345)	Omeo Stork's-bill		E	PMST			No
<i>Pultenaea glabra</i>	Smooth Bush-Pea	V		NPWS Atlas	2	3/06/1994	No
<i>Rutidosia heterogama</i>	Heath Wrinklewort	V		NPWS Atlas	120	20/09/2010	Yes
<i>Streblus pendulinus</i>	Siah's Backbone		E	PMST			No
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E1	V	NPWS Atlas	34	21/04/2010	No
<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	NPWS Atlas	432	2/12/2010	Yes
<i>Thelymitra</i> sp. <i>adorata</i>	Wyong Sun Orchid	E4		NPWS Atlas	14	26/08/2010	No
Amphibians							
<i>Crinia tinnula</i>	Wallum Froglet	V		NPWS Atlas	77	27/04/2010	No
<i>Heleioporus australiacus</i>	Giant Burrowing Frog		V	PMST	-	-	No
<i>Litoria aurea</i>	Green and Golden Bell Frog	E1	V	NPWS Atlas, PMST	1	1/01/1993	No
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog		V	PMST	-	-	No



Scientific Name	Common Name	Legal Status (TSC Act)	Legal Status (EPBC Act)	Source	Number of Records	Last Record	Suitable habitat
<i>Mixophyes iteratus</i>	Giant Barred Frog		E	PMST	-	-	No
Birds							
<i>Anthochaera phrygia</i>	Regent Honeyeater	E4	E	NPWS Atlas, PMST	11	31/05/2002	Yes - foraging
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	V		NPWS Atlas	3	31/12/2010	No
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E1	E	NPWS Atlas, PMST	1	27/09/1997	No
<i>Calidris alba</i>	Sanderling	V		NPWS Atlas	3	14/12/1989	No
<i>Calidris ferruginea</i>	Curlew Sandpiper	E1		NPWS Atlas	9	28/07/1997	No
<i>Calidris tenuirostris</i>	Great Knot	V		NPWS Atlas	2	31/12/1992	No
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V		NPWS Atlas	12	20/03/2009	No
<i>Charadrius mongolus</i>	Lesser Sand-plover	V		NPWS Atlas	2	31/12/1994	No
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		NPWS Atlas	16	27/11/2008	Yes - foraging
<i>Dasyornis brachypterus</i>	Eastern Bristlebird		E	PMST	-	-	No
<i>Diomedea exulans antipodensis</i>	Antipodean Albatross		V	PMST	-	-	No
<i>Diomedea exulans gibsoni</i>	Gibson's Albatross		V	PMST	-	-	No
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1		NPWS Atlas	6	16/09/1994	No
<i>Epthianura albifrons</i>	White-fronted Chat	V		NPWS Atlas	1	24/08/1971	No
<i>Erythrorhynchus radiatus</i>	Red Goshawk		V	PMST	-	-	No
<i>Fregetta grallaria grallaria</i>	White-bellied Storm-Petrel (Tasman Sea), Whitebellied Storm-Petrel (Australasian)		V	PMST	-	-	No
<i>Glossopsitta pusilla</i>	Little Lorikeet	V		NPWS Atlas	12	18/08/2009	Yes - foraging
<i>Gygis alba</i>	White Tern	V		NPWS Atlas	2	5/05/1996	No
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V		NPWS Atlas	31	28/12/1999	No
<i>Haematopus longirostris</i>	Pied Oystercatcher	E1		NPWS Atlas	12	25/04/2009	No
<i>Hieraaetus morphnoides</i>	Little Eagle	V		NPWS Atlas	1	21/11/2003	No
<i>Ixobrychus flavicollis</i>	Black Bittern	V		NPWS Atlas	3	12/04/1993	No
<i>Lathamus discolor</i>	Swift Parrot	E1	E	NPWS Atlas, PMST	72	28/04/2011	Yes - foraging
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V		NPWS Atlas	2	14/01/1977	No
<i>Limosa limosa</i>	Black-tailed Godwit	V		NPWS Atlas	1	26/04/1999	No
<i>Macronectes giganteus</i>	Southern Giant Petrel	E1	E	NPWS Atlas, PMST	3	25/12/2007	No
<i>Macronectes halli</i>	Northern Giant Petrel		V	PMST	-	-	No
<i>Neophema pulchella</i>	Turquoise Parrot	V		NPWS Atlas	-	4/09/1966	No



Scientific Name	Common Name	Legal Status (TSC Act)	Legal Status (EPBC Act)	Source	Number of Records	Last Record	Suitable habitat
<i>Ninox connivens</i>	Barking Owl	V		NPWS Atlas	2	9/03/2009	Yes – roosting and foraging
<i>Ninox strenua</i>	Powerful Owl	V		NPWS Atlas	13	25/11/2008	Yes – roosting and foraging
<i>Pandion cristatus</i>	Eastern Osprey	V		NPWS Atlas	9	20/11/2008	No
<i>Petroica boodang</i>	Scarlet Robin	V		NPWS Atlas	1	23/02/1996	No
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V		NPWS Atlas	1	21/01/1986	No
<i>Pterodroma neglecta neglecta</i>	Kermadec Petrel (western)		V	PMST	-	-	No
<i>Pterodroma leucoptera leucoptera</i>	Gould's Petrel	V		NPWS Atlas	1	6/04/1981	No
<i>Pterodroma solandri</i>	Providence Petrel	V		NPWS Atlas	2	1/01/1989	No
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V		NPWS Atlas	1	29/05/2008	No
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V		NPWS Atlas	3	23/05/1996	No
<i>Puffinus assimilis</i>	Little Shearwater	V		NPWS Atlas	1	16/01/1997	No
<i>Rostratula australis</i>	Australian Painted Snipe		V	PMST	-	-	No
<i>Stagonopleura guttata</i>	Diamond Firetail	V		NPWS Atlas	1	22/01/1991	No
<i>Sternula albifrons</i>	Little Tern	E1		NPWS Atlas	14	30/07/2007	No
<i>Sternula nereis nereis</i>	Fairy Tern		V	PMST	-	-	No
<i>Thalassarche bulleri</i>	Buller's Albatross		V	PMST	-	-	No
<i>Thalassarche cauta cauta</i>	Shy Albatross		V	PMST	-	-	No
<i>Thalassarche cauta salvini</i>	Salvin's Albatross		V	PMST	-	-	No
<i>Thalassarche cauta steadi</i>	White-capped Albatross		V	PMST	-	-	No
<i>Thalassarche melanophris</i>	Black-browed Albatross	V		NPWS Atlas	4	27/06/1999	No
<i>Thalassarche melanophris impavida</i>	Campbell Albatross		V	PMST	-	-	No
<i>Tyto novaehollandiae</i>	Masked Owl	V		NPWS Atlas	9	30/03/2008	Yes – roosting and foraging
<i>Tyto tenebricosa</i>	Sooty Owl	V		NPWS Atlas	3	19/01/2007	Yes – marginal roosting and foraging
Insecta							
<i>Petalura gigantea</i>	Giant Dragonfly	E1		NPWS Atlas	1	15/12/2006	Yes
Mammals							



Scientific Name	Common Name	Legal Status (TSC Act)	Legal Status (EPBC Act)	Source	Number of Records	Last Record	Suitable habitat
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V		NPWS Atlas	1	18/05/2005	Yes - roosting and foraging
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	NPWS Atlas, PMST	-	13/04/2004	Yes - foraging
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	NPWS Atlas, PMST	5	1/06/2010	Yes - foraging
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		NPWS Atlas	4	21/04/2010	Yes - Roosting and foraging
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (eastern)	E1		NPWS Atlas	1	8/06/1998	No
<i>Miniopterus australis</i>	Little Bentwing-bat	V		NPWS Atlas	19	21/04/2010	Yes - foraging
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V		NPWS Atlas	31	10/09/2009	Yes - foraging
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		NPWS Atlas	24	21/04/2010	Yes - roosting and foraging
<i>Myotis macropus</i>	Southern Myotis	V		NPWS Atlas	19	21/04/2010	Yes - roosting
<i>Petaurus norfolcensis</i>	Squirrel Glider	V		NPWS Atlas	90	27/08/2009	Yes - nesting and foraging
<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby		V	PMST	-	-	No
<i>Phascolarctos cinereus</i>	Koala	V	V	NPWS Atlas, PMST	8	30/06/2006	Yes - feed trees throughout
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo		V	PMST	-	-	No
<i>Pseudomys novaehollandiae</i>	New Holland Mouse		V	PMST	-	-	No
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	NPWS Atlas, PMST	29	21/04/2010	Yes - foraging
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V		NPWS Atlas	-	19/09/2005	Yes - roosting and foraging
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		NPWS Atlas	21	21/04/2010	Yes - roosting and foraging
Reptiles							
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake		V	PMST	-	-	No
<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V		NPWS Atlas	1	15/03/2008	Yes

Source: NPWS Atlas of NSW Wildlife database (NPWS Atlas), EPBC Protected Matters Search Tool (PMST), National Herbarium of NSW spatial search tool (NSW Herbarium)

Key: V = Vulnerable, E = Endangered, EP = Endangered Population, CE = Critically Endangered, Ex = Extinct.



Table 3: Migratory Species (EPBC Act Protected Matters Search) modelled to occur in the study area.

Scientific Name	Common Name	EPBC Listed Migratory Species							
		Terrestrial	Wetland	Marine	JAMBA	CAMBA	ROKAMBA	Bonn	Suitable habitat
<i>Actitis hypoleucos</i>	Common Sandpiper		+	+	+	+	+	+	No
<i>Anthochaera phrygia</i>	Regent Honeyeater	+							Yes – suitable foraging
<i>Apus pacificus</i>	Fork-tailed Swift			+	+	+	+		No
<i>Ardea alba</i>	Great Egret		+	+	+	+			No
<i>Ardea ibis</i>	Cattle Egret		+	+	+	+			No
<i>Arenaria interpres</i>	Ruddy Turnstone		+	+	+	+	+	+	No
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper		+	+	+	+	+	+	No
<i>Calidris canutus</i>	Red Knot		+	+	+	+	+	+	No
<i>Calidris ferruginea</i>	Curlew Sandpiper		+	+	+	+	+	+	No
<i>Calidris melanotos</i>	Pectoral Sandpiper			+	+		+	+	No
<i>Calidris ruficollis</i>	Red-necked Stint		+	+	+	+	+	+	No
<i>Calidris tenuirostris</i>	Great Knot		+	+	+	+	+	+	No
<i>Charadrius bicinctus</i>	Double-banded Plover		+	+				+	No
<i>Charadrius leschenaultii</i>	Greater Sand Plover		+	+	+	+	+	+	No
<i>Charadrius mongolus</i>	Lesser sand Plover		+	+	+	+	+	+	No
<i>Charadrius ruficapillus</i>	Red-capped Plover			+					No
<i>Diomedea exulans antipodensis</i>	Antipodean Albatross			+				+	No
<i>Diomedea exulans gibsoni</i>	Gibson's Albatross			+				+	No
<i>Gallinago hardwickii</i>	Latham's Snipe		+	+	+	+	+	+	No
<i>Gallinago megala</i>	Swinhoe's Snipe			+	+	+	+	+	No
<i>Gallinago stenura</i>	Pin-tailed Snipe			+	+	+	+	+	No
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	+	+	+		+			No
<i>Heteroscelus brevipes</i>	Grey-tailed Tattler		+	+	+	+	+	+	No
<i>Himantopus himantopus</i>	Black-winged Stilt			+					No
<i>Hirundapus caudacutus</i>	White-throated Needletail	+		+	+	+	+		No
<i>Lathamus discolor</i>	Swift Parrot	+		+					Yes – suitable foraging
<i>Limicola falcinellus</i>	Broad-billed Sandpiper		+	+	+	+	+	+	No
<i>Limosa lapponica</i>	Bar-tailed Godwit		+	+	+	+	+	+	No
<i>Limosa limosa</i>	Black-tailed Godwit		+	+	+	+	+	+	No
<i>Macronektes giganteus</i>	Southern Giant Petrel			+				+	No
<i>Macronektes halli</i>	Northern Giant Petrel			+				+	No
<i>Merops ornatus</i>	Rainbow Bee-eater	+		+					No
<i>Monarcha melanopsis</i>	Black-faced Monarch			+				+	Yes – suitable foraging
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	+		+				+	No



Scientific Name	Common Name	EPBC Listed Migratory Species							
		Terrestrial	Wetland	Marine	JAMBA	CAMBA	ROKAMBA	Bonn	Suitable habitat
<i>Numenius madagascariensis</i>	Eastern Curlew		+	+	+	+	+	+	No
<i>Numenius minutus</i>	Little Curlew		+	+	+	+	+	+	No
<i>Numenius phaeopus</i>	Whimbrel		+	+	+	+	+	+	No
<i>Philomachus pugnax</i>	Ruff			+	+	+	+	+	No
<i>Pluvialis fulva</i>	Pacific Golden Plover		+	+	+	+	+	+	No
<i>Pluvialis squatarola</i>	Grey Plover		+	+	+	+	+	+	No
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet			+					No
<i>Rhipidura rufifrons</i>	Rufous Fantail	+		+				+	Yes - marginal foraging
<i>Rostratula benghalensis</i>	Painted Snipe		+	+		+			No
<i>Sterna albifrons</i>	Little Tern			+	+	+		+	No
<i>Thalassarche bulleri</i>	Buller's Albatross			+				+	No
<i>Thalassarche cauta cauta</i>	Shy Albatross			+				+	No
<i>Thalassarche cauta salvini</i>	Salvin's Albatross			+				+	No
<i>Thalassarche cauta steadi</i>	White-capped Albatross			+				+	No
<i>Thalassarche melanophrys impavida</i>	Campbell Albatross			+				+	No
<i>Tringa stagnatilis</i>	Marsh Sandpiper		+	+	+	+	+	+	No
<i>Xenus cinereus</i>	Terek Sandpiper		+	+	+	+	+	+	No

3.2. Field Survey Results

3.2.1. Flora

A total of 102 flora species were identified during surveys and subsequent identification analysis (**Appendix 1**). No threatened species were identified within the study area.

Of the flora species identified, 31 are considered exotic species. In addition, two of these species are listed as Class 4 Noxious Weeds within the Wyong LGA under the *Noxious Weeds Act 1993*; these include *Lantana camara* (Lantana) and *Chrysanthemoides monilifera* (Bitou Bush).

3.2.2. Vegetation Community Types

One native vegetation community and one exotic vegetation type were identified within the study area:

- Scribbly Gum Woodland (2.19 ha); and
- Exotic Grassland (0.8 ha).



These communities are described below and mapped in **Figure 4**. Each vegetation type has been assigned an equivalent map unit from the Lower Hunter Central Coast Regional Environmental Management Scheme (NPWS 2000) and the BioMetric Vegetation Type database (DECCW 2008).

Scribbly Gum Woodland



Plate 1: Scribbly Gum Woodland.

Corresponding Hunter, Central and Lower North Coast Vegetation Classification & Mapping Project Map Unit:

MU 31: Coastal Plains Scribbly Gum Woodland.

Vegetation Formation:

Dry Sclerophyll Forests (Shrubby sub formation).

Vegetation Class:

Sydney Coastal Dry Sclerophyll Forests

Equivalent Biometric Vegetation Type:

Scribbly Gum - Red Bloodwood heathy woodland on the coastal plains of the Central Coast, Sydney Basin.



Conservation Status:

Not listed.

Structure:

Canopy to 20 m with a shrub/grass understory.

General Description:

The dominant canopy species in this community are *Eucalyptus haemastoma* (Scribbly Gum) and *Corymbia gummifera* (Red Bloodwood). *Angophora costata* (Smooth-barked Apple) and *Eucalyptus capitellata* (Brown Stringybark) also occur frequently. *Melaleuca quinquinervia* (Broad-leaved Paperbark) occurs on the eastern side of the study area where this community adjoins the Riparian Paperbark Forest.

The midstorey and shrub layers are sparse within this community due to previous under-scrubbing. Common midstorey species include *Allocasuarina littoralis* (Black She-oak), *Leptospermum trinervium* (Flaky-barked Tea-tree), and *Callistemon linearis* (Narrow-leaved Bottlebrush). The shrub layer consists of a variety of species including *Lambertia Formosa* (Mountain Devil), *Xanthorrhoea latifolia*, *Banksia oblongifolia* (Fern-leaved Banksia), *Epacris pulchella* (Wallum Heath), *Acacia longifolia* (Sydney Golden Wattle), *Dillwynia retorta*, *Leptospermum polygalifolium* (Tantoon), and *Hakea bakeriana*.

Native grass species present include *Themeda australis* (Kangaroo Grass), *Echinopogon caespitosus* var. *caespitosus* (Bushy Hedgehog-grass), *Entolasia stricta* (Wiry Panic) and *Aristida vagans* (Threeawn Speargrass). Other native groundcover species present include *Dianella caerulea* (Blue Flax-lily), *Lomandra obliqua*, *Lomandra filiformis* (Wattle Mat-rush), *Patersonia sericea* (Silky Purple-Flag), *Ptilothrix deusta*, *Lepidosperma laterale*, *Hardenbergia violacea* (Purple Coral Pea), and *Lindsaea linearis* (Screw Fern).

A number of exotic species are also present including *Andropogon virginicus* (Whisky Grass), *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Paspalum urvillei* (Vasey Grass), and *Hypochaeris radicata* (Catsear).

Floristic / Structural Variations:

In the south-east corner of the Scribbly Gum Woodland, there is a small area where *Melaleuca quinquinervia* (Broad-leaved Paperbark) co-occurs in the overstorey with *E.haemastoma* (Scribbly Gum), *A.costata* (Smooth-barked Apple), and *Corymbia gummifera* (Red Bloodwood); the understorey also has a greater proportion of mesic species such as *Melaleuca nodosa* (Prickly-leaved Paperbark), *Breynia oblongifolia* (Coffee Bush), and *Microlaena stipoides* (Weeping Grass). This variant represents an ecotonal area between the Scribbly Gum Woodland on the upper slope and the Swamp-Mahogany – Paperbark Forest in the narrow-drainage line approx. 50m to the east. NPWS (2000) indicates that MU 42 Riparian Melaleuca Swamp Woodland and Scribbly Gum Woodland (MU 31) typically intergrade around narrow drainage lines on the Central Coast (NPWS 2000).

Comparison between quadrat and RDP data collected from this variant and the MU



31 and MU 42 map unit descriptions indicate that this area is floristically similar to both map units, but is more closely aligned to MU 31 Scribbly Gum Woodland due to the overall dominance of key canopy species (*A.costata*, *E.haemastoma*, *C.gummifera* and *E.capitellata*).

Condition:

The understorey of this community has been modified through previous clearing and under-scrubbing and the shrub layer is largely absent as a consequence. This previous disturbance and edge effects from the surrounding exotic grassland have also resulted in an abundance of exotic grasses throughout this community, particularly in the southern portion.

Distribution:

This community occurs on the low and undulating topography of the coastal plain on sedimentary geologies, particularly in the Lake Macquarie area. (DECCW 2008). Within the study area, this community is distributed across the northern portion of the site.



Exotic Grassland



Plate 2: Exotic Grassland.

Corresponding Hunter, Central and Lower North Coast Vegetation Classification & Mapping Project Map Unit:

N/A

Vegetation Formation:

Grassland.

Vegetation Class:

Grassland.

Equivalent Biometric Vegetation Type:

Nil.

Conservation Status:

Not listed.

Structure:

Grassland to 1m tall.



General Description:

This community is dominated by exotic grasses and herbs including *Andropogon virginicus* (Whisky Grass), *Pennisetum clandestinum* (Kikuyu), *Axonopus fissifolius* (Narrow-leaved Carpet Grass), *Paspalum dilatatum* (Paspalum), *Hydrocotyle bonariensis*, *Sida rhombifolia* (Paddy's Lucerne), and *Plantago lanceolata* (Lamb's Tongues). Several scattered exotic trees and shrubs also occur in this community including *Erythrina x sykesii* (Coral Tree), *Ficus elastica* (Rubber Fig), and *Lantana camara* (Lantana).

Distribution:

Within the study area, this community is situated on the southern portion of the site.

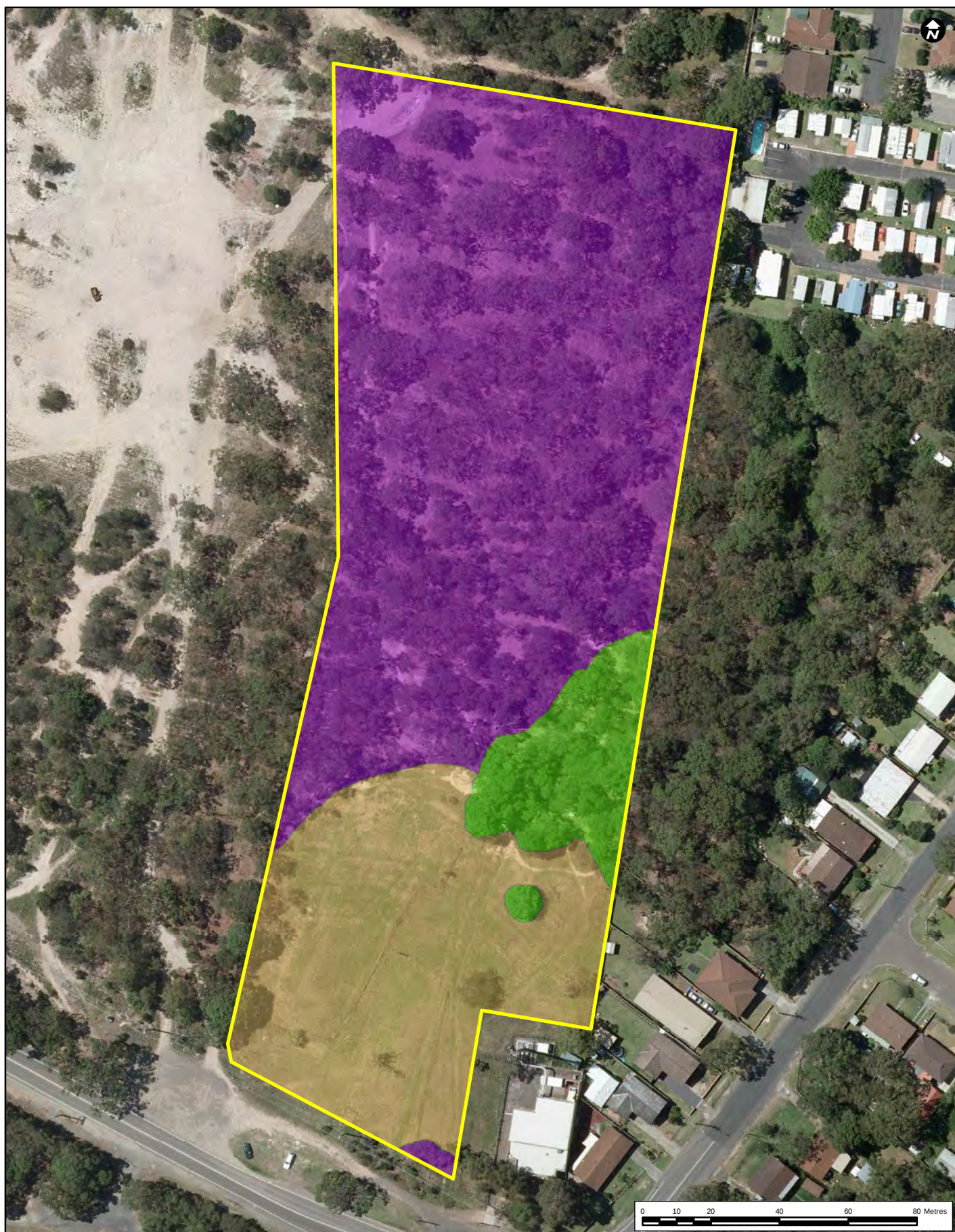


Figure 4 - Vegetation Communities
Legend

- Study Area
- Dry Forest Paperbark Ecotone
- Scribbly Gum Woodland
- Exotic Grassland



Map Projection:

GDA 1994 MGA Zone 56

Data Sources:

LPMA - 2011
ecobiological - 2011

Project Ref: 179-1075

Plot Date: 27/08/2012 09:33

Revision: 001 (gjoyce)

Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.



3.2.1. Habitat Assessment

Ten habitat assessments were undertaken across the study area to determine the quality of remnant vegetation and to identify areas of differing quality habitat (**Figure 4**).

Assessments identified the more heavily vegetated areas towards the middle and back of the study area to be of high habitat quality. Although there is a moderate level of disturbance throughout the vegetated areas (mainly from bike riders, illegal fire wood collection and under-scrubbing), this area exhibited multiple habitat layers, a high abundance of hollow bearing mature trees, scattered fallen timber, a high abundance of flowering eucalypts and high internal and external connectivity. The type and quality of this habitat has the potential to support a diverse range of native fauna species in the Colongra area. Multiple fauna species were observed using this area (Appendix 2) and many trees had scratch marks from arboreal mammals.

The boundary between the vegetated portion and the cleared portion of the study area was identified as moderate condition. Remnant trees with some hollows, some fallen timber and limited habitat layers are present; however the edge effects associated with the cleared area (increased numbers of weeds, rubbish, smaller trees) are also evident.

Plates 1 and 3 also show the habitat structure between high and low habitat value areas.

3.2.2. Hollow Assessment

Hollows are an important resource utilised by a variety of forest fauna. Vertebrate and invertebrate species use hollows as diurnal or nocturnal shelter sites, for rearing young, feeding, thermo-regulation and to facilitate ranging behaviour and dispersal (Gibbons & Lindenmayer 2002). Approximately 400 Australian species potentially use hollows either on a permanent or opportunistic basis. Many threatened species are obligate users, requiring the presence of hollows to survive in the landscape (Gibbons & Lindemayer 2002).

An assessment of hollow bearing trees during the site assessment identified 36 hollow bearing trees within the study area (**Figure 5**). Hollows being utilized by native fauna (Rainbow Lorikeets) were observed in some trees.



4. Constraints Assessment

4.1. Flora Issues

4.1.1. Threatened Species

Of the 21 threatened flora species which have previously been recorded within a 10 km radius of the study area, 10 species have potential habitat on the site. None of these species were detected during the site inspection. However, six of these species (*Acacia bynoeana*, *Caladenia porphyria*, *Caladenia tessellate*, *Cryptostylis hunteriana*, *Diuris praecox* and *Tetratheca juncea*) are unable to be detected, or difficult to detect, outside their respective flowering periods. Therefore, it is recommended that targeted searches for these species be conducted prior to any clearing of native vegetation during the appropriate seasons (see section 6).

4.2. Fauna Issues

4.2.1. Threatened Species

A number of threatened fauna species are assessed as being likely to occur within the study area due to the presence of suitable habitat.

Species which may use habitat within the study area include the Regent Honeyeater, Varied Sittella, Little Lorikeet, Swift Parrot, Barking Owl, Powerful Owl, Masked Owl, Sooty Owl, Giant Dragonfly, Eastern Pygmy-possum, Large-eared Pied Bat, Spotted-tailed Quoll, Eastern False Pipistrelle, Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail-bat, Southern Myotis, Stephens' Banded Snake, Koala, Grey-headed Flying-fox, Yellow-bellied Sheath-tail-bat, Greater Broad-nosed Bat and Squirrel Glider.

An additional two EPBC listed migratory species Black-faced Monarch and Rufous Fantail are also identified as potential users of habitat within the study area.

The relatively large number of threatened fauna species assessed as likely of using the study area is due to the high number of known records in the locality (NPWS Atlas) and the high external connectivity of the habitat within the study area to much larger habitat corridors within the area.

4.2.2. Habitat Hollows

A total of 36 trees were identified as containing habitat hollows during surveys (**Figure 5**). Although the study area was thoroughly traversed, it is still likely that some hollows were missed, so this should be taken into account.

Hollow-bearing trees are one of the most important fauna habitats within the Study area not just for their hollows but for their ability to provide insect and nectar resources for a wide range of fauna including threatened species.



It is recommended that hollow-bearing trees be retained wherever possible, and if this is unavoidable, the implementation of a nest-box programme, ecologically sensitive clearing practices and a monitoring program be undertaken to offset removed hollows.

4.3. Riparian Zones

A number of shallow, ephemeral depressions were observed within the cleared area of the study area. These appeared to be grooves cut by a turning vehicle and would appear to only fill during times of heavy rain. As such these areas are not considered “prescribed streams” they are not subject to the *Water Management Act 2000*.

4.4. SEPP 44 Koala Habitat Protection

A systematic Koala SAT assessment was conducted on the 21 August 2012. Six SAT sites were undertaken (180 trees). The main tree species present in the assessment areas were Scribbly Gum and Smooth-barked Apple.

No sign of Koalas or scats were detected.

4.5. Regional Habitat Corridors

The study area is part of a regional network of remnant vegetation that is an important movement corridor for a wide range of species throughout the Wyong and Lake Macquarie LGAs. Although the study area is located on the outer edge, the remnant trees located on the rear two-thirds of the lot lie within the corridor.

4.6. Constraints Mapping

Based on the above discussion, constraints on the site have been mapped (**Figure 5**).

- Areas of moderate constraint correspond to the area of Scribbly Gum Woodland containing hollow trees, as this area though having a disturbed understorey, may contain habitat for threatened mature tree-using species (2.19 ha).
- Areas of low constraint correspond to the cleared areas on the block with a small area of highly disturbed woodland on the southern boundary of the remnant vegetation (0.9 ha). There are no ecological impediments to the development of this area.



Figure 5 - Ecological Constraints

Legend

Study Area

H Hollow-bearing Trees

Ecological Value

Moderate

Low



Map Projection:

GDA 1994 MGA Zone 56

Data Sources:

LPMA - 2011
ecobiological - 2011

Project Ref: 179-1075

Plot Date: 27/08/2012 13:21

Revision: 001 (gjoyce)

Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.



5. Conclusion

The assessment of ecological constraints within Lot 1 DP1049201 revealed that:

- 21 threatened flora species and 76 threatened fauna species are known from within 5 km of the study area. Of these, 10 threatened flora species and 25 threatened fauna species are considered likely to utilise habitat such as that found within the study area;
- 2.19 ha of woodland with a “moderate” constraint, due to:
 - 36 hollow-bearing trees were identified as occurring within the study area, some of which were observed being used by Rainbow Lorikeets for nesting and may provide habitat for a number of locally occurring threatened species;
 - One species of Koala preferred feed tree *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum) was identified as occurring within the study area. This tree species constituted more than 15% of the canopy cover and as such the wooded areas on the study area are Preferred Koala habitat under SEPP 44. However subsequent SAT tests did not reveal any usage by Koalas; and
 - The study area lies on the periphery of a large expanse of bushland habitat linking the Colongra wetlands, Lake Munmorah State Conservation Area and west to Olney State Forest.
- 0.9 ha of low constraint, low condition vegetation, unsuitable for most native vertebrate fauna.



6. Recommendations

In order to facilitate a future development application for the site, a number of survey and assessments will be required. Below is a summary of the most important issues:

- Any loss or modification of native vegetation within the study area, including the Scribbly Gum Woodland (2.19ha) may require a suitable offset strategy. While Wyong Shire Council is the consent authority, referral to the Office of Environment and Heritage (OEH) may occur. OEH uses the BioBanking Assessment Methodology (Seidel and Briggs 2009) to determine extent and type of offsets required to offset development. Offset areas would require protection and ongoing management through appropriate management plans;
- For a development application, additional field surveys will be required to:
 - Fulfill the minimum survey requirements of the Flora and Fauna Survey Guidelines: Lower Hunter Central Coast Region (2002);
- Conduct targeted searches for threatened flora species identified as having suitable habitat within the study area which can be detected during their respective flowering periods. This could be achieved through two surveys:
 - September – October: *Caladenia porphyria*, *Caladenia tessellata*, *Diuris praecox* and *Tetratheca juncea*.
 - December – January: *Acacia bynoeana* and *Cryptostylis hunteriana*.
- Conduct targeted searches for threatened fauna species identified as having suitable habitat within the study area. In particular, hollow dependent species such as the Squirrel Glider and microchiropteran bats. Determine the location and type of hollows within the remaining areas across the site so that hollow loss may be offset accurately.



7. References

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Appendix 1: Flora species recorded within the study area

Quadrat Rating using modified Braun-Blanquet cover-abundance scale

Rating	Cover-abundance
1	< 5% cover, few individuals or sparse occurrence
2	< 5% cover, many individuals
3	5 - 25% cover
4	25 - 50% cover
5	50 - 75% cover
6	75 - 100% cover

Q1: Scribbly Gum Woodland (moist variant)

Q2: Scribbly Gum Woodland

Family	Scientific Name	Common Name	Q1	Q2
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet		2
Apiaceae	<i>Centella asiatica</i>	Indian Pennywort	2	2
Apiaceae	<i>Hydrocotyle peduncularis</i>		2	
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod		1
Asteraceae	* <i>Conyza</i> sp.		2	
Asteraceae	* <i>Hypochaeris radicata</i>	Catsear	1	
Asteraceae	* <i>Senecio madagascariensis</i>	Fireweed	1	
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-oak		1
Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort		1
Cyperaceae	<i>Carex</i> sp		1	
Cyperaceae	<i>Gahnia clarkei</i>	Tall Saw-sedge	1	1
Cyperaceae	<i>Lepidosperma laterale</i>		1	2
Cyperaceae	<i>Ptilothrix deusta</i>			3
Cyperaceae	<i>Schoenus apogon</i>	Common Bog-rush	2	
Cyperaceae	<i>Schoenus villosus</i>	Hairy Bog-rush		1
Droseraceae	<i>Drosera auriculata</i>		1	1
Ericaceae - Styphelioideae	<i>Epacris pulchella</i>	Wallum Heath	1	2
Fabaceae - Faboideae	<i>Glycine clandestina</i>		2	
Fabaceae - Mimosoideae	<i>Acacia brownii</i>	Heath Wattle		1
Fabaceae - Mimosoideae	<i>Acacia longifolia</i>		2	2
Haemodoraceae	<i>Haemodorum planifolium</i>			1
Haloragaceae	<i>Gonocarpus micranthus</i> subsp. <i>micranthus</i>		1	
Iridaceae	<i>Patersonia glabrata</i>	Leafy Purple-flag	1	2
Juncaceae	<i>Juncus usitatus</i>		1	
Lindsaeaceae	<i>Lindsaea linearis</i>	Screw Fern	2	2
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot	2	2
Lomandraceae	<i>Lomandra filiformis</i>		1	2



Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	2	1
Malvaceae	* <i>Sida rhombifolia</i>	Paddy's Lucerne	2	
Myrtaceae	<i>Angophora costata</i>	Smooth-barked Apple	3	
Myrtaceae	<i>Corymbia gummifera</i>	Red Bloodwood	2	4
Myrtaceae	<i>Eucalyptus capitellata</i>	Brown Stringybark		1
Myrtaceae	<i>Eucalyptus haemastoma</i>	Scribbly Gum		4
Myrtaceae	<i>Leptospermum polygalifolium</i>	Tantoon	2	
Myrtaceae	<i>Leptospermum trinervium</i>		2	2
Myrtaceae	<i>Leptospermum polygalifolium</i>	Lemon Scented Tea tree	2	2
Myrtaceae	<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark	3	
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	4	
Myrtaceae	<i>Melaleuca sieberi</i>		2	
Orchidaceae	<i>Caladenia catenata</i>	White Fingers	2	1
Orchidaceae	<i>Cryptostylis subulata</i>	Large Tongue Orchid	1	1
Orchidaceae	<i>Pterostylis nutans</i>	Nodding Greenhood	1	
Oxalidaceae	<i>Oxalis exilis</i>		1	
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax-lily	2	2
Phyllanthaceae	<i>Breynia oblongifolia</i>	Coffee Bush	2	
Phyllanthaceae	<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>	Cheese Tree	1	1
Phytolaccaceae	* <i>Phytolacca octandra</i>	Inkweed	1	
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum	2	1
Plantaginaceae	<i>Veronica plebeia</i>	Trailing Speedwell	2	
Plantaginaceae	* <i>Plantago lanceolata</i>	Lamb's Tongues	2	
Poaceae	* <i>Andropogon virginicus</i>	Whisky Grass	3	3
Poaceae	* <i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass	3	2
Poaceae	* <i>Ehrharta erecta</i>	Panic Veldtgrass	2	
Poaceae	* <i>Paspalum urvillei</i>	Vasey Grass		2
Poaceae	* <i>Stenotaphrum secundatum</i>	Buffalo Grass		1
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass		2
Poaceae	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass	2	
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	2	4
Poaceae	<i>Eragrostis brownii</i>	Lovegrass	3	2
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass	4	
Poaceae	<i>Themeda australis</i>	Kangaroo Grass	2	4
Proteaceae	<i>Hakea dactyloides</i>	Broad-leaved Hakea		2
Proteaceae	<i>Lambertia formosa</i>	Mountain Devil		3
Pteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Poison Rock Fern	2	
Restionaceae	<i>Lepyrodia scariosa</i>		2	3
Rubiaceae	<i>Opercularia aspera</i>	Coarse Stinkweed		1
Verbenaceae	* <i>Lantana camara</i>	Lantana	3	1
Xanthorrhoeaceae	<i>Xanthorrhoea latifolia</i> subsp. <i>latifolia</i>		3	4



Appendix 2: Opportunistic fauna species recorded within the study area

	Scientific Name	Common Name	Abundance	Comments
Birds				
1	<i>Anthochaera carunculata</i>	Red Wattlebird	2	
2	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	1	
3	<i>Corvus coronoides</i>	Australian Raven	5	
4	<i>Cracticus tibicen</i>	Australian Magpie	3	
5	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	4	
6	<i>Manorina melanocephala</i>	Noisy Miner	>10	
7	<i>Ocyphaps lophotes</i>	Crested Pigeon	2	
8	<i>Philemon corniculatus</i>	Noisy Friarbird	2	
9	<i>Platycercus elegans</i>	Crimson Rosella	5	
10	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	>20	Observed nesting
Mammals				
11	<i>Macropus giganteus</i>	Eastern Grey Kangaroo		Scats
12	<i>Oryctolagus cuniculus</i>	European Rabbit		Scats
Reptiles				
13	<i>Lampropholis delicata</i>	Garden Skink	>10	

denotes threatened species under the TSC Act 1995

^ denotes threatened species under the EPBC Act 1999

* denotes an introduced species

^M denotes a migratory species



Appendix 3: Habitat Assessments

	Habitat characteristic	Site No.									
		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	Remnant patch	N	Y	Y	Y	Y	Y	Y	Y	Y	N
2	Regrowth/old growth	A	R	O	O	O	O	O	O	O	R
3	% Bare ground	0	30	15	10	10	5	0	10	25	0
4	Number of habitat layers	1	4	3	3	4	3	3	3	3	3
5	Ground log abundance	A	L	L	L	H	A	A	L	L	A
6	Hollow abundance	A	L	H	H	M	H	H	H	M	L
7	% Litter cover	0	20	20	40	50	20	25	10	30	0
8	% litter around tree bases	0	80	50	50	10	70	20	10	20	0
9	% Rock cover	0	0	0	0	0	0	0	0	0	0
10	% Herb grass cover	100	70	60	60	60	80	80	80	80	95
11	Dominant tree/shrub height (m)	0	10	10	10	12	10	14	14	11	14
12	Regeneration occurring	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
13	Internal connectivity	H	H	H	H	H	H	H	H	H	M
14	External connectivity	H	H	H	H	H	H	H	H	H	L
15	Nests present	N	N	Y	Y	Y	N	Y	Y	N	N
16	Trunk scratches	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
17	Invertebrate activity	L	L	A	A	A	A	A	A	A	A
18	Level of grazing	L	L	L	L	L	L	L	L	L	L
19	Sediment movement	L	L	L	L	L	L	L	L	L	L
20	Estimate ecosystem integrity	L	M	M-H	M-H	M-H	M-H	M-H	M-H	M-H	L
21	Dams present	N	N	N	N	N	N	N	N	N	N
22	Manmade wetlands	N	Y	N	N	N	N	N	N	N	N
23	Natural wetlands	N	N	N	N	N	N	N	N	N	N
24	Perennial stream present	N	N	N	N	N	N	N	N	N	N
25	Emphemeral waterbodies	N	Y	N	N	N	N	N	N	N	N
26	Source/sink landscape	SINK	SINK	SINK	SINK	SINK	SINK	SINK	SINK	SINK	SINK
26	Habitat quality/10	1	4	8	8	8	8	8	8	7	3
27	Capacity for habitat restoration-improvement	L	H	H	H	H	H	H	H	H	M
28	Overall level of constraint	LOW	MOD	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	LOW



Appendix 4: Contributions and Qualifications of Kleinfelder/ecobiological Staff

Name	Qualification	Title	Contribution
Luke Foster	M. Env Sci (wildlife ecology)	Ecologist (Mammalogist)	Habitat assessments, Report writing.
Aaron Mulcahy	B. Env Sci. & Mgmt	Botanist	Flora survey and report writing (flora)
David Paull	M.Res.Sc (Wildlife Ecology)	Senior Ecologist (Zoologist)	Report Review
Gayle Joyce	B. Sc (forestry)	GIS	Map preparation



Appendix 5: Licensing matters relating to the survey

Kleinfelder/ecobiological employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act 1974* (License Number: SL100730, Expiry: 31 March 2013) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.