

Appendix F: Fauna survey report, EcoBiological (2011)



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Fauna Survey Report:

Stratford Coal Mine, Gloucester, New South Wales.

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December 2010

Report prepared for Gloucester Coal Limited

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Executive Summary

ecobiological was commissioned by Gloucester Coal Pty Ltd to conduct fauna surveys at Stratford Coal Mine. The study area consists of a current mining operation and surrounding land currently owned and operated by Gloucester Coal Limited off Bucketts Way, Gloucester, NSW.

Field surveys of the study area were conducted between April 2007 and March 2010. The key findings are summarised below.

A total of 178 fauna species were recorded within the study area (consisting of 13 frog, 13 reptile, 121 bird and 31 mammal species). Two birds (Common Starling and Spotted Dove) and five of the mammals detected were exotic species (Rabbit, Hare, Cat, Fox and House Mouse). Eleven (11) threatened fauna species were recorded during the surveys, the Grey-crowned Babbler, Glossy Black-Cockatoo, Varied Sittella, Magpie Goose, Masked Owl, Brush-tailed Phascogale, Squirrel Glider, New Holland Mouse, Little Bentwing-bat, Eastern Bentwing-bat and the Eastern Freetail-bat.

Nine listed migratory species (EPBC listed and listed under international conventions) were detected during surveys in the study area; the Cattle Egret, Australian Reed-warbler, Black-faced Monarch, Double-banded Plover, Latham's Snipe, Fork-tailed Swift, Great Egret, Rainbow Bee-eater and the White-bellied Sea-eagle.



Definitions

Abundance – a quantification of the population of the species or community.

Arboreal – living in a tree or trees.

Aquatic – living in the water.

Distribution – the overall area in which a species is known to occur. It is not implied, and is very rarely the case, that a species occurs in all parts of the area defined by its distribution.

Diurnal – pertaining to the day. An animal that is active by day is said to be diurnal.

Habitat – an area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community and includes any biotic or abiotic component. The habitat of a species is usually far less in extent than distribution indicated on a map.

Home range – the area habitually traversed by an individual animal. It may be exclusive or overlap with the home ranges of other individuals of the same species.

Nocturnal – pertaining to the night. An animal that is active by night is said to be nocturnal.

Opportunistic – used, in reference to diet, to denote the eating of any of a wide variety of foods, depending upon their availability. In respect of reproduction, it refers to a pattern of breeding that is linked with irregular favourable conditions (particularly unpredictable rainfall in arid areas) rather than to season.

Relative Abundance – the number of individuals of each species assessed in relation to the numbers of other within each group of taxa (i.e. plants, frogs, reptiles etc.).

Riparian – pertaining to the banks of a river or stream.

Sclerophyll – pertaining to plants with tough leaves. Here used mainly to distinguish between two major types of eucalypt forest: *dry sclerophyll* forest which is open and *wet sclerophyll* forest which has a closed canopy. The two types intergrade.

Subspecies – an interbreeding population within a species, differing measurably from one or more other populations and usually geographically separate from these.

Terrestrial – living on the ground.



Abbreviations

CMA Catchment Management Authority

DECCW Department of the Environment and Climate Change and Water (now Office of Environment & Heritage)

DEWHA Department of the Environment, Water, Heritage and the Arts

DSEWPaC Department of Sustainability, Environment, Water, Population and Communities

EPBC Act *Environment Protection and Biodiversity Conservation Act 1999*

GIS Geographic Information System

ha hectares

km kilometres

LEP Local Environment Plan

NPWS National Parks and Wildlife Service

ROTAP Rare or Threatened Australian Plants

SEPP State Environmental Planning Policy

sp Species (singular)

spp Species (plural)

subsp subspecies

TSC Act *Threatened Species Conservation Act 1995*



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1. Introduction

1.1. Scope

ecobiological was commissioned by Stratford Coal Pty Ltd to conduct terrestrial fauna surveys within and surrounding the Stratford Coal Mine and Bowens Road North Coal Mine. The mines are located approximately 100 kilometres (km) north of Newcastle, New South Wales (NSW) (Figure 1).

The fauna surveys were conducted within the study area shown in Figure 2. The purpose of the surveys was to:

- Survey for terrestrial vertebrate fauna utilising recognised fauna survey techniques;
- Describe fauna habitats within the study area;
- Determine the diversity and relative abundance of terrestrial vertebrate fauna species (native and introduced) in the study area.
- Conduct targeted surveys for threatened fauna species that are considered possible occurrences within the study area or surrounds (i.e. those listed in the Schedules of the NSW Threatened Species Conservation Act 1995 (TSC Act) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)).

The fauna surveys were conducted in 2007, 2008, 2009 and 2010. This report outlines the result of field investigations.

1.2. Regional and Local Context

The study area consists of a current mining operation and surrounding land currently owned and operated by Gloucester Coal Pty Ltd off Bucketts Way, Gloucester, NSW.

The study area is situated within the NSW North Coast (NNC) bioregion, and specifically the NNC17 subregion. Both the NNC bioregion and NNC17 subregion currently have a 15.01 – 30% protection level under the National Reserve System (DSWEPaC, 2011a). The study area lies within the Bassian zoological region. At a regional and local level, the study area is situated within the boundaries of the Hunter Central Rivers Catchment Management Authority (CMA) and within the Gloucester Local Government Area.



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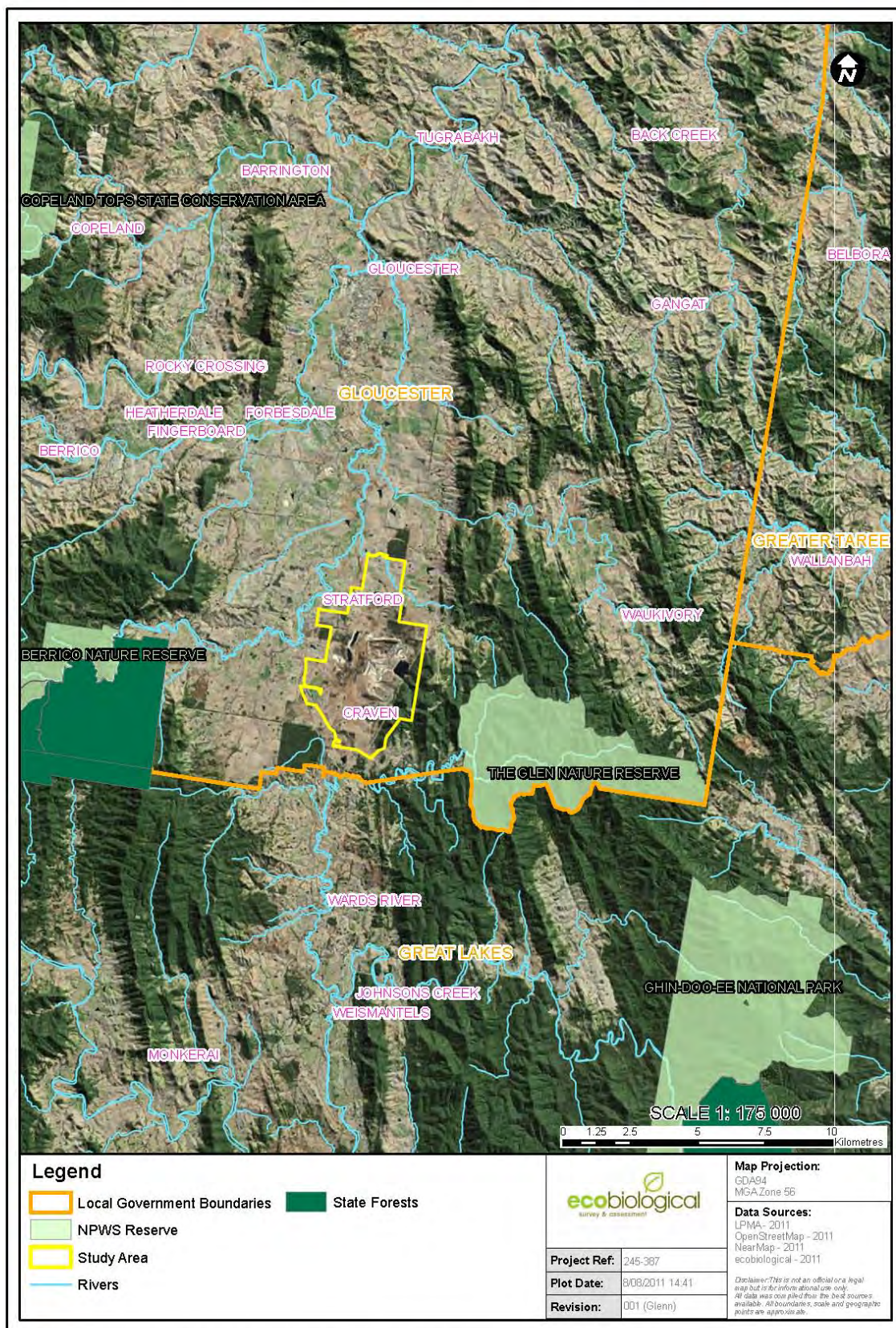


Figure 1: The location of the study area within the surrounding region.



Figure 2: Aerial photograph showing the study area and surrounding landscape.



The study area is approximately 2,081.7 ha in size and is surrounded in all directions by a combination of cleared paddocks and stands of remnant forest and regrowth. The extent of vegetation and infrastructure within and adjacent to the study area is shown in Figure 2.

1.3. Geology, Topography and Soils

The study area is comprised of five soil landscapes (not including variants) forming two broad groups, alluvial/transferral and upslope areas (Henderson, 2000).

Alluvial/transferral landscapes include:

- (a) Gloucester River (gu). The Gloucester River alluvial landscape consists of broad level alluvial plains in the Stroud-Gloucester Basin region in the northern section of the study area. Relief is <1m and slopes are <2%. Occasional small swamps and swampy oxbows occur. Soils consist of deep, imperfectly drained Yellow Chromosols (Soloths) on plains with deep, very poorly drained Redoxic Hydrosols (Gleyed Podzolic Soils) on small swampy oxbows. Regolith consists predominately of alluvial deposits derived from the surrounding Permian sedimentary and volcanic rocks.
- (b) Craven (cn) and two variants (cna) and (cnb). The Craven soil landscape is a transferral landscape, occurring in low, wide drainage depressions on Quaternary alluviums and dominates the central low lying sections of the study area. Relief is generally < 2 m, with slopes between 2-5%. It is characterised by deeply eroded gullies and cleared and remnant forest vegetation. Soils are typically Yellow Sodosols. The variant (cna) consist of low gradient alluvial fans, while the variant (cnb) is characterised as having narrow, elongated swamps in its natural condition. This landscape and its variants are prone to erosional pressures.



The upslope landscapes are comprised of:

- (a) Gloucester (go). This erosional soil landscape dominates much of the northern and western sections of the study area and is characterised as undulating low hills on Permian sediments. Relief is generally <50 m, with slopes <10% with little or no rock outcropping and cleared or remnant forest. The soils are generally various types of Yellow Soloths on side-slopes and crests with Lithosols on crest and steeper side-slopes. There is a moderate sheet and gully erosional risk with this landscape.
- (b) Wards River (wd). The Wards River erosional soil landscape is found throughout the eastern sections of the study area and is characterised by rolling low hills on sediments of the Gloucester Coal Measures in the Stroud-Gloucester Basin region. Relief is from 30 – 100m and slopes are <25%. Soils are moderately deep, imperfectly drained Brown Kurosols on well to imperfectly drained side-slopes. Moderately deep, moderately well-drained Yellow and Grey Kurosols occur on well to imperfectly drained ridges and side-slopes. Shallow to moderately deep, well drained Bleached-Leptic Tenosols on mid-slopes and crests on conglomerate. Moderately deep, well drained Brown Kurosols on upper slopes and steep mid-slopes on siltstone. This landscape has a high erosional risk with rock outcrops. It is prone to seasonal waterlogging.
- (c) Gloucester Bucketts (gb). This colluvial soil landscape occupies the highest elevation section of the study area consisting of rolling to deep hills on a Permian basic with volcanics and sediments. Relief varies considerably (60-350m) with slopes of 35 to >50%. Soils are moderately deep, well-drained lithosols with rapidly draining lithosols on upper slopes and ridges. Steep basaltic slopes have moderately deep, well-drained lithosols and unclassified soils and are characterised by rocky terrain. Hazards include mass movement and sheet erosion.



1.4. Climate

The study area is located within the temperate region of NSW which typically has wet summers and low winter rainfall, with the majority of the rainfall occurring from December through to March. The mean annual maximum temperature is 23.4 °C (range 16.4 – 29.4 °C) and the mean annual minimum temperature is 12.1 °C (range 6.5 – 17.3 °C), with peak temperatures occurring in January and February and the coolest month being June (Bureau of Meteorology, 2010).

1.5. Land Use

The majority of the land within the study area is zoned by the Gloucester Local Environmental Plan (LEP) as primary production land (Zone RU1), with a small area in the south west of the study area zoned as heavy industry (Zone IN3). The land surrounding the study area is also predominantly zoned as primary production land and contains a range of mixed land uses. The surrounding area also contains land zoned for environmental protection. In particular, directly adjacent to the study area in the south west there are two areas designated for environmental management (Zone E3), and in the south east, The Glen Nature Reserve which is zoned accordingly (Zone E1), is within 2 km of the study area (Gloucester Local Environmental Plan, 2010).

1.6. Hydrology

The impact area of the mine lies on Avondale Creek. The tributaries of this creek eventually flow into the Manning River which enters the sea near Taree. The quality of the water entering the Manning River through its tributaries is, and needs to continue to be, high due to the ecological, commercial and recreational dependence on this regional river system. The ground water in the area is predominantly held within the coal seams and within the overlying colluvium and fractured sections of overburden (AGC Woodward-Clyde Pty Ltd, 1994).



2. Survey Methods

2.1. Data Review and Weather

2.1.1. Review of Databases and Literature

A list of threatened fauna, endangered populations and migratory species recorded, or considered likely to occur, in the wider area was compiled from a number of databases and literature sources, including:

- DECCW's Atlas of NSW Wildlife (DECCW, 2010);
- Australian Museum (2010);
- DEWHA's Protected Matters search tool (DEWHA 2010a);
- Combined Australian museums' fauna database (OZCAM) (CHAFC, 2010); and
- Past ecological reports carried out in the general area (AGC Woodward Clyde 1994; Hoye and Finney 1994; Murray 1994; Hoye 1998; Alison Hunt & Associates 2009; Dowling 2000; MKES 2001; Richards 2001).

A 20 x 20 km search area centred on the study area was used as a basis for the database searches.

A series of field surveys were then conducted using the compiled list of threatened species as a guide to species potentially likely to occur in the study area. The survey was not, however, limited to the species compiled from database extracts and past consultant records. Searches were carried out in order to compile a comprehensive species list for the study area.

2.1.2. Weather Conditions and Survey Activities

The study area was surveyed throughout April and November 2007; August 2008; January to February 2009; and then again in February to March 2010. A full list of survey activities and weather conditions during the survey periods is provided in Table 1. Table 2 identifies weather conditions for the period two weeks prior to each survey period. Weather conditions were obtained from Lostock Dam weather station, courtesy of the Bureau of Meteorology.



Generally, conditions throughout the survey periods were good for the target groups, with the exception of rainfall during two of the 2010 survey period, which is not optimal for reptile activity. This was confined to three nights of rain and did not interfere with daytime reptile searches. Rain episodes are not as likely to interfere with the activity of nocturnally active species such as *Hoplocephalus* spp., and may encourage activity of such species as blind snakes and the Bandy-Bandy *Vermicella annulata* (DCP pers. obs.).

Reptile surveys were also undertaken in autumn 2007, which is outside the recommended survey period by over two weeks. However, survey conditions at this time were found to be warm and suitable for reptile activity.

Table 1: Schedule of activities and weather conditions during the survey period.

Activity	Date	T (°C) min-max	Rainfall (mm)	Cloud 8 th	Wind (km/hr)
Fauna and habitat investigation					
Fauna trapping	16 – 20/04/2007	12.2-29.6	1.6	2-8	Calm-2
	20 – 23/01/2009	15.5-34.7	nil	0-2	Calm-2
	04 - 07/02/2010	20.7-27.0	3.6	6-8	2-4
	27/09-1/10/2010	7.4-19.0	4.2	0-2	2-4
Spotlighting	23/04/2007	11.5-30.2	nil	2-8	Calm-2
	20-21/08/2008	3.5-20.3	nil	0-4	Calm-6
	04 - 07/02/2010	20.7-27.0	3.6	6-8	2-4
Anabat Call Recording	18/4/2007	16.8	nil	Clear	Calm
	19/4/2007	17.2	nil	Clear	Calm-2
	16/7/2007	7.5	nil	0-1	Calm
	17/7/2007	7.2	nil	0-1	Calm
	27/11/2007	20.4	nil	2-3	Calm - 2
	20/8/2008	14.8	nil	Clear	Calm
	21/8/2008	15.1	nil	0-2	Calm - 2
	20/1/2009	25.8	nil	Clear	2-4
	21/1/2009	27	nil	0-2	Calm
	18/3/2010	15.1	nil	0-2	2-4
Nocturnal Call Playback	23/04/2007	11.5-30.2	nil	2-8	Calm-2
	20-21/08/2008	3.5-20.3	nil	0-4	Calm-6
	04 - 07/02/2010	20.7-27.0	3.6	6-8	2-4
	27/09-1/10/2010	7.4-19.0	4.2	0-2	2-4
Bird Survey	16 - 17/04/2007	12.2-29.6	1.6	2-8	Calm-2
	27 - 28/11/2007	13.5-33.7	nil	2-4	Calm-2
	11 - 13/08/2008	5.2-18.0	nil	0-4	Calm-6
	20 - 22/01/2009	15.5-34.7	nil	0-2	Calm-2
	2 - 3/02/2010	19.0-27.3	7.8	6	2-4
	18 - 19/03/2010	11.7-28.0	nil	0-8	Calm - 4
Nocturnal Herpetological Survey	26-28/11/2007	14.7-31.4	nil	2-4	Calm-2
	20 – 21/01/2009	18.0-33.1	nil	0-2	Calm-2
	1-3/02/2010	16.4-29.3	20.4	2-6	2-4
	27/09-1/10/2010	7.4-19.0	4.2	0-2	2-4
	23/11/2010	12.5-26.5	0	4	2
Diurnal Herpetological Survey	16 – 21/04/2007	12.2-29.6	1.6	2-8	Calm-2
	20 – 21/01/2009	15.5-34.7	nil	0-2	Calm-2
	1-3/02/2010	16.4-29.3	20.4	2-6	2-4
	1-5/11/2010	10.2-25.0	65.6	0-8	2-6

Source: Bureau of Meteorology 2010.



Table 2: Weather conditions during the period two weeks prior to surveys

Dates	T (°C) min-max	Rainfall (mm)	Cloud 8 th	Wind (km/hr)
1-15/04/2007	13.0-24.5	13.8	0-8	Calm-2
15-29/11/2007	14.9-30.4	100.4	2-8	Calm-2
5-19/08/2008	6.4-17.2	20.6	2-8	2-10
5-19/01/2009	16.4-31.8	24.2	0-8	Calm -2
20/1-3/2/2010	15.5-38.6	30.8	0-8	Calm -4
13-26/09/2010	1.0-26.0	18.6	0-8	Calm-7
14-31/10/2010	9.0-28.6	60.2	0-8	Calm -9
9-22/11/2010	11.2-31.0	54.7	2-8	Calm-4

Source: Bureau of Meteorology 2010.

2.2. Fauna Survey Design

In order to meet the requirements for effort and techniques in order to undertake the survey work required within the existing Stratford study area, the following sources were used:

- DEC Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, Working Draft November (DEC 2004);
- DECC Field Survey Methods – Introduction (DECC 2009a);
- DECC Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (DECC 2009b);
- *Survey Guideline for Australia's Threatened Bats* (DEWHA 2010b);
- *Survey Guideline for Australia's Threatened Birds*(DEWHA 2010c); and
- *Survey Guideline for Australia's Threatened Frogs* (DEWHA 2010d).

It is noted that federal survey guidelines for threatened mammals and reptiles have also been released by SEWPaC (2011b, c); however, this was after the completion of fauna surveys undertaken as part of this study.

2.2.1. Stratification of Fauna Survey

Following initial field inspections, the survey site was stratified according to structural differences in the vegetation which broadly reflect differing fauna habitats:

- Derived Grasslands;
- Grassy Woodlands;
- Dry Sclerophyll Forest (shrub/grass sub-formation);
- Dry Sclerophyll Forest (shrubby sub-formation);
- Wet Sclerophyll Forest (shrubby sub-formation);
- Rainforest;
- Freshwater Wetlands; and
- Creeks.



Most of the smaller man-made water bodies (dams) at the Stratford mine site do not support habitat suitable for targeted threatened frogs, mainly because of a lack of aquatic and dam edge vegetation and therefore are not included in the stratification of fauna habitat (in accordance with the DECC 2009b methodology). A number of the larger water bodies at the mine site have been classified as “Freshwater Wetlands” despite being man-made because of suitable though marginal habitat for *Litoria aurea* and other threatened species.

Dry Sclerophyll Forest (shrubby sub-formation) stratification unit (3.8 ha) and Rainforest unit (0.8 ha) are a very small and have been omitted out of the fauna survey process.

Figures 3, 4 and 5 depict the fauna survey effort undertaken in the study.

2.2.2. Fauna Habitat Assessment

General habitat assessment

A fauna habitat assessment was conducted across the study area at all flora quadrats (ecobiological, 2010) to assess the broad habitat value of the remnant vegetation for native fauna. The attributes assessed covers those key fauna habitats as identified by DECC (2009a) including landscape connectivity, habitat structure and abundance of hollow bearing trees, fallen wood and other resource and landscape characteristics.

Habitat Hollow Survey

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, and thermo-regulation and to facilitate ranging behaviour and dispersal. 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).

Based on the Biometric data collected across all the floristic survey sites, a hollow density map was constructed according to the following categories:

- No hollows present;
- Low: <10 separate trees with hollows per ha;
- Medium: 10-20 separate trees with hollows per ha; and
- High: >20 separate trees with hollows per ha.

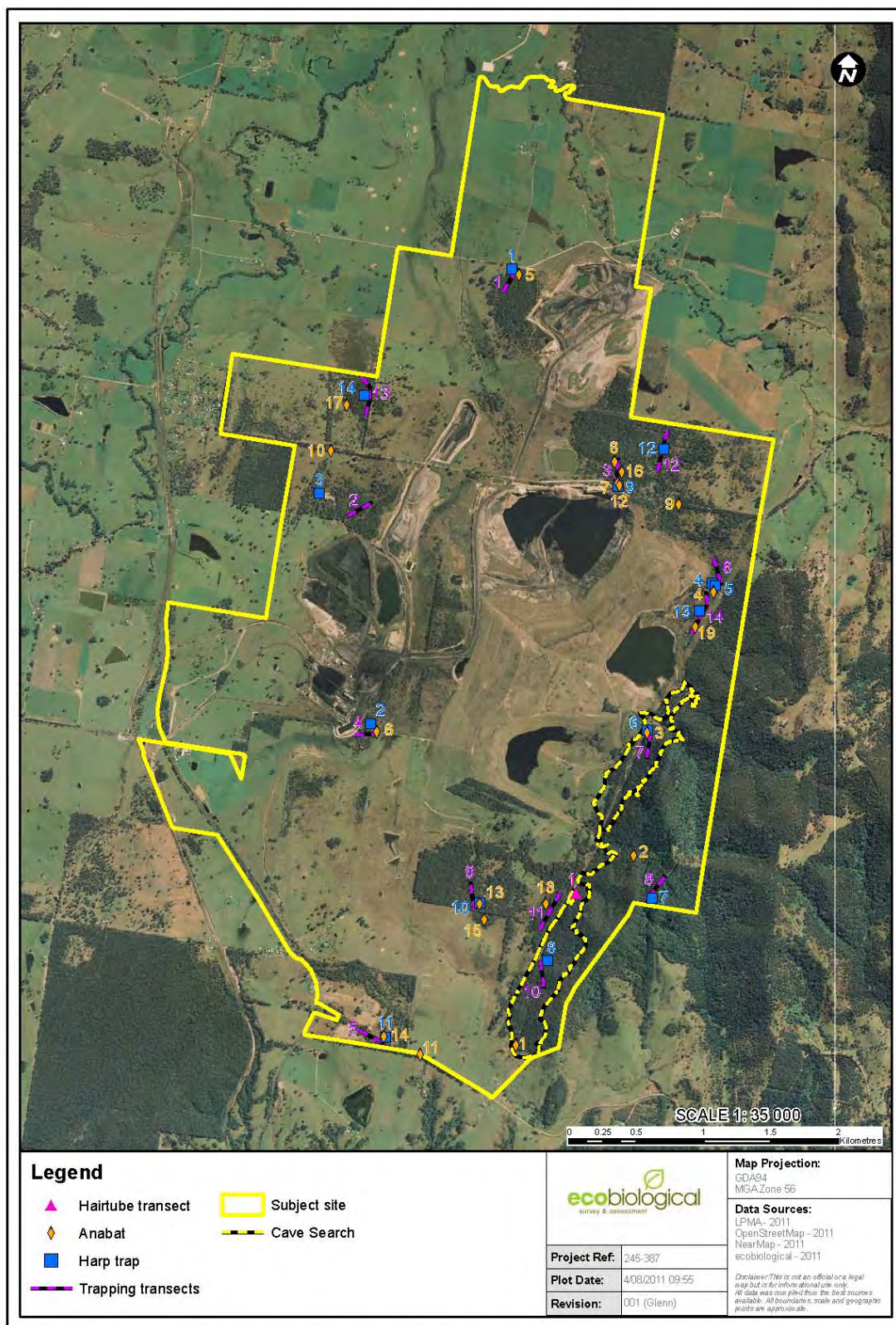


Figure 3: Aerial photograph of the study area showing the location of mammal surveys.

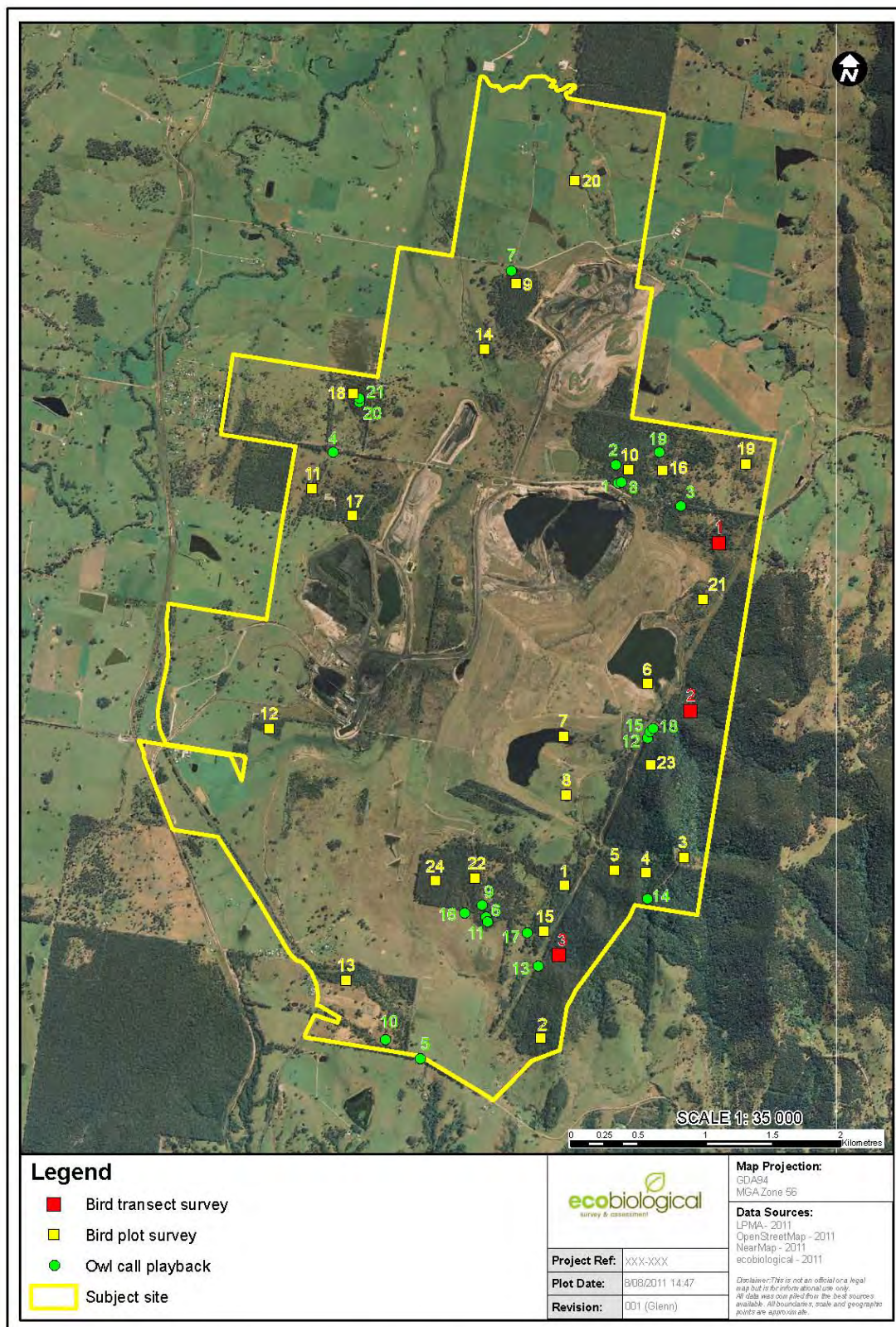


Figure 4: Aerial photograph of the study area showing the location of bird surveys

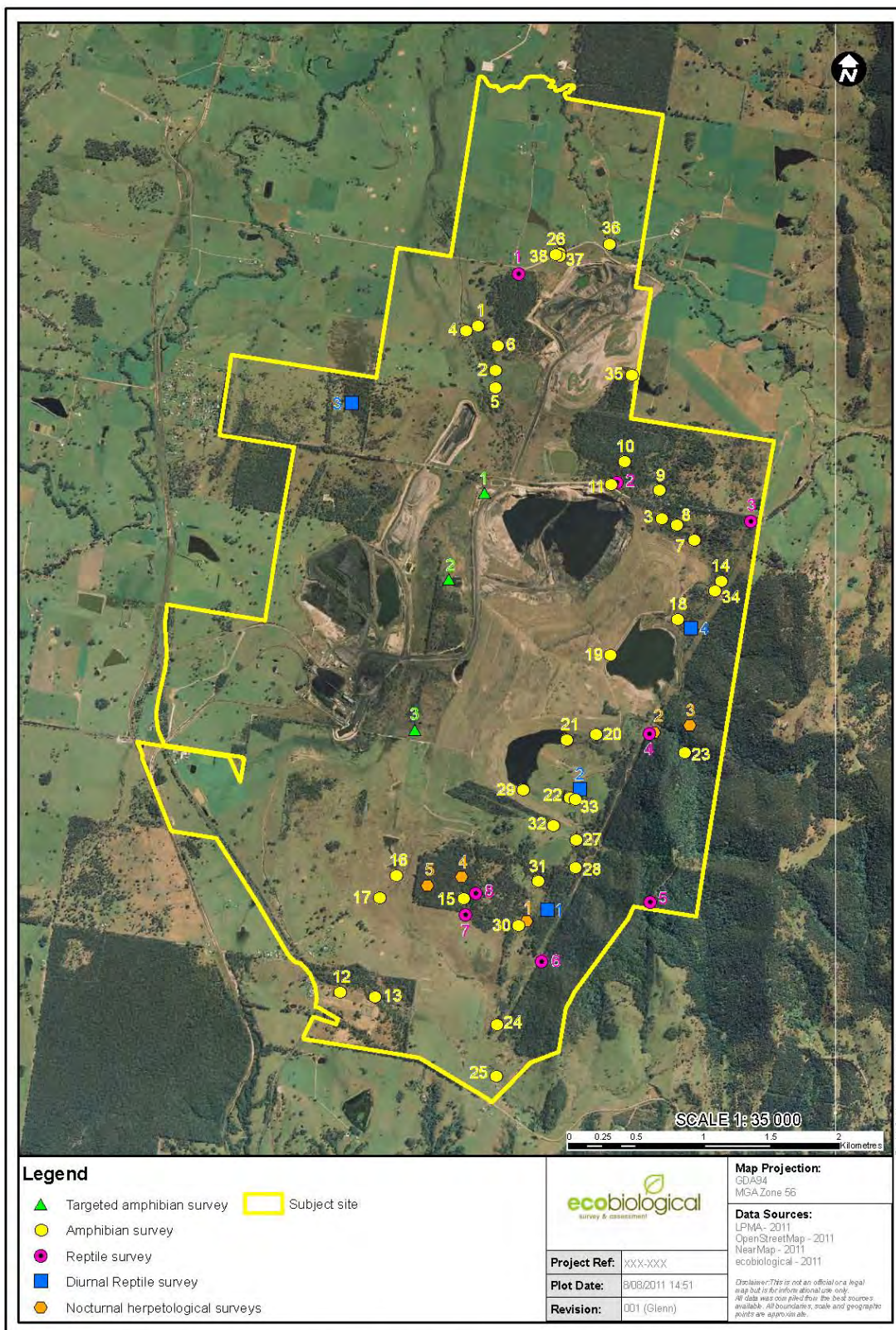


Figure 5: Aerial photograph of the study area showing the location of amphibian and reptile surveys



Cave Habitat Survey

Caves are important roosting sites for a number of cave-dependent bat species that are known in the region of the Gloucester Valley. They also provide shelter sites for a range of other native fauna, such as Rock-wallabies, echidnas and antechinus and a variety of reptiles.

A cave survey was undertaken along the range on the eastern side of the study area. This involved long traverses by two people below the crest of the range. Any caves identified had their location recorded and a cave habitat assessment was conducted.

2.2.3. Koala Habitat Assessment

2.2.3.1. SEPP 44 Koala Habitat Protection

A step-wise process was undertaken in order to determine the value of the study area to the Koala as determined by the SEPP 44:

- (i) *Identification of Potential Koala habitat.* Potential Koala Habitat is defined as 'areas of native vegetation where the trees listed in Schedule 2 of SEPP 44 (Table 3) constitute at least 15% of the total number of trees in the upper and lower strata of the tree component'. Should Potential Koala Habitat be found, further investigation for the existence of core Koala habitat should be undertaken.

Table 3: List of SEPP 44 – Schedule 2 preferred Koala Feed Trees

Preferred Koala Feed Trees	
Scientific Name	Common Name
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Eucalyptus microcorys</i>	Tallow wood
<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

- (ii) *Identification of Core Koala Habitat.* Core Koala Habitat is defined as 'an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population'.



2.2.3.2. Spot Assessment Technique (SAT) Assessment

Surveys using the Spot Assessment Technique (SAT) were undertaken in January 2009 to determine the presence of Koalas through activity in areas determined to represent Potential Koala Habitat. A site inspection, checking of trees for claw marks and the Spot Assessment Technique (SAT tests) was utilised to identify Koala activity.

2.2.3.3. Recovery Plan for the Koala

The recovery plan for the koala (DECC 2008) lists the following additional tree species as primary food trees for the Koala on the North Coast:

- *Eucalyptus parramattensis* (Parramatta Red Gum)
- *Eucalyptus bancroftii* (Orange Gum)
- *Eucalyptus amplifolia* (Cabbage Gum)

The presence of these tree species was also considered when undertaking the Koala habitat assessment.

2.2.4. Fauna Survey Methods and Effort

An assessment of the vertebrate fauna was undertaken across the study area using survey techniques in accordance with:

- DEC Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, Working Draft November 2004;
- DECC Field Survey Methods – Introduction (DECC 2009a);
- DECC Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (DECC 2009b);
- *Survey Guideline for Australia's Threatened Bats* (DEWHA 2010b);
- *Survey Guideline for Australia's Threatened Birds* (DEWHA 2010c); and
- *Survey Guideline for Australia's Threatened Frogs* (DEWHA 2010d).

The Lower Hunter Central Coast Regional Environmental Management Strategy: Flora and Fauna Guidelines (Murray *et al.* 2002a, 2002b) were also considered. It is noted that federal survey guidelines for threatened mammals and reptiles have also been released by SEWPaC (2011b, c); however, this was after the completion of fauna surveys undertaken as part of this study.



The locations and dates of all fauna survey points and transects is given in Appendix 1. The location of mammal and bat surveys is shown in Figure 3, bird surveys in Figure 4 and amphibian and reptile surveys in Figure 5.

Arboreal Mammals

To survey arboreal mammals, Elliott B traps and hair tubes were placed in trees at heights of 3 m or above and at intervals of approximately 20 m. Traps were placed in trees using platforms suspended on tree pegs and hair tubes were nailed to the tree trunks. A handful of nesting material was also placed in each trap to enable a trapped animal to maintain an appropriate body temperature. The total survey effort for non-flying mammals in the study area is shown in Table 4.

Traps and hair tubes were baited with a mixture of rolled oats, honey, peanut butter and treacle. The trunks of trees with the traps and hair tubes (Faunatech – standard size) were sprayed with a honey and water mixture forming a scent line from the upper trunk to a particular trap or hair tube. These traps were checked daily for arboreal species and wafers from the hair tubes were collected after a four-night period.

Table 4: Total effort for mammals

Method		Dry Sclerophyll Forests	Grassy woodlands	Wetland/creek	Comments
Area (ha)		400.82	121.88	26.04	
Elliott A (trap nights)	DEC	500	200	NA	
	ecobiological	720	400		
Elliott B ground (trap nights)	DEC	500	200	NA	
	ecobiological	160	72		No medium-sized threatened terrestrial mammals were likely to occur, therefore trapping effort was reduced.
Cage (trap nights)	DEC	120	48	NA	
	ecobiological	152	64		
Arboreal Elliott (trap nights)	DEC	120	48	NA	
	ecobiological	248	112		
Hairtube ground (trap nights)	DEC	400	160	NA	
	ecobiological	400	160		
Hairtube tree (trap nights)	DEC	120	60	NA	
	ecobiological	276	144		
Nocturnal spotlight	DEC	5 hours	2 hours	NA	
	ecobiological	7 hours	4 hours		

DEC = DEC 2004 survey effort requirements / ecobiological = survey effort by ecobiological



Hair identification methods followed those of Brunner *et al.* (2002). If any hair sample was suspected to be from a vulnerable or endangered species, the sample was sent to Barbara Triggs, an expert in the field of hair identification, for verification.

Spotlighting was undertaken for a one hour period on foot from dusk at each site surveyed. Trees were inspected (during daylight hours) for the presence of habitat hollows and if present then a subset of hollows were watched at dusk to see if any nocturnal birds or mammals emerged.

Two hours of call playback was also undertaken at four locations on or after dusk for threatened arboreal mammals (Koala, Squirrel Glider and Yellow-bellied Glider) by broadcasting calls over a megaphone in an attempt to encourage a response (for call playback dates see Table 1). All call playback sites were located within the study area or within 1 km of the study area. This process involved playing a pre-recorded call for a period of a few minutes, followed by listening and watching for a response from fauna for a few minutes, and repeating.

Terrestrial Mammals

In order to identify any small terrestrial mammals, Elliott A, ground hair-tubes and cage traps were placed along each trapping transect. Ground Elliott Bs were used on a limited level, though as this method does not target any threatened species.

Transects were approximately 400 m in length and traps were placed out at approximately 20 m intervals. A handful of nesting material was also placed in each trap to enable a trapped animal to maintain an appropriate body temperature.

Elliott A and hair tubes were baited with a mix of rolled oats, honey, peanut butter and treacle. Cage traps were baited with raw chicken to target Spotted-tailed Quolls. The traps were set in position for four consecutive nights and checked each morning and placed at least 40 m apart along the trapping transects.

As previously stated, spotlighting was also undertaken on foot for a one-hour period at each site to identify the presence of any large terrestrial mammals. Opportunistic daytime searches were also conducted for the presence of fauna activity such as diggings, droppings or scratch marks, and, where possible, identification was made.



Bats

Anabat II bat-call recorders (Titley Electronics, Ballina) were used to record the calls of any Microchiropteran bats feeding in the area. Each unit was set up at dusk and recording occurred throughout the night until collected the next morning. The recording locations are shown in Figure 5 and the effort undertaken per stratification unit for both Anabat survey is shown in Table 5. Call recordings were analysed by **ecobiological**.

Table 5: Total survey effort for bats

Method		Wet Sclerophyll Forests	Dry Sclerophyll Forests	Grassy woodlands	Wetland/creek
Area (ha)		28.24	400.82	121.88	26.04
Harp trap (trap nights)	DEC		16 nights	8 nights	NA
	ecobiological	Not sampled*	32 nights	16 nights	
Anabat	DEC		64 hrs	32 hrs	NA
	ecobiological	Not sampled*	10 nights / 120 hrs	10 nights / 60 hrs	

DEC = DEC 2004 survey effort requirements

ecobiological = survey effort by ecobiological

* Wet Sclerophyll Forest areas were not sampled due to the high level of disturbance; *Lantana camara* dominated these areas creating low quality habitat and difficult access

Also, near each trapping transect and at the time of the mammal transect surveys, one harp trap was positioned in a bat 'flyway' and set in position for two consecutive nights and then moved to a position adjacent to the trapping transect for a two further nights. These were checked each morning for captured bats which were identified and placed in a "bat box" to allow passive release. Harp traps are useful for capture of slower flying bat species that commonly fly below the canopy. Some of these species have weak echolocation calls or have calls which are readily confused with other bat species, limiting the accuracy of echolocation call analysis.

Spotlighting searches combined with listening for audible calls and movements in trees were undertaken for Megachiropteran bat species. These focussed on flowering trees and any known roost sites.

Birds

The method employed to survey diurnal birds were area searches and transects within the various stratification units in the study area. Plot-based surveys and transects were undertaken for between 20 – 30 minutes. Each plot-based survey site was surveyed between one and four occasions over a four year period.

Transects were sampled on only one occasion.



Birds were identified either visually, with the aid of binoculars, or by call interpretation. Surveys were conducted in the morning or late afternoon, when bird activity is maximised (Bibby *et al.* 2000). Total survey effort for diurnal birds is shown in Table 6.

Table 6: Total survey effort for diurnal birds

Method		Wet Sclerophyll Forests	Dry Sclerophyll Forests	Grassy woodlands	Wetland/creek
Area (ha)		28.24	400.82	121.88	26.04
Diurnal Bird surveys (Includes replication)	DEC	There is no minimum recommended survey effort per stratification unit. A suggested commonly used method is 20 minutes per ha. ecobiological conducted 20 - 30 min surveys for the same area.			
	ecobiological	2 surveys	25 surveys	14 surveys	7 surveys

DEC = DEC 2004 survey effort requirements

ecobiological = survey effort by ecobiological

Opportunistic surveys were also conducted while driving throughout the mine site, when working near the mine dams and farmland water bodies and during other fauna survey activities.

Targeted nocturnal bird surveys were conducted over multiple nights and years at locations throughout the study area. After dark, the calls of threatened nocturnal bird species (Bush Stone-curlew, Powerful Owl, Barking Owl, Masked Owl, Sooty Owl and Grass Owl) were broadcast over a megaphone in an attempt to encourage a response. The study area was also searched to locate any regurgitated owl pellets.

If any pellets were found, their size, shape and content would be used in an attempt to determine the species of owl from which the pellet originated as well as the prey species the owl had been feeding on. Analysis methods followed those of Brunner *et al.* (2002) and Triggs (1996).

The following call playback surveys for owls were undertaken (Table 7). Only two sites* were found to be potentially suitable for the Sooty Owl were it to occur in the area. These were in wet gullies along the eastern ridge line.



Table 7: Owl Call Play-back effort for Stratford

Owl call playbacks	DEC (2004) Survey Requirement	ecobiological Effort
Powerful Owl	5 visits per site on different nights	6 sites 5 visits
Barking Owl	5 visits per site on different nights	6 sites 5 visits
Grass Owl	5 visits per site on different nights	6 sites 5 visits
Sooty Owl	6 visits per site on different nights	2 sites 6 visits*
Masked Owl	8 visits per site on different nights	5 sites 8 visits, 1 site 2 visits

Amphibians

Targeted survey techniques for amphibian species (DECC 2009b) were employed for threatened frog species thought to occur in the study area due to suitability of habitat. This was assessed during preliminary habitat assessments to all water bodies in the study area and opinions of previous work undertaken (MKES 2001). As a result, four species, the Green and Golden Bell Frog *Litoria aurea*, the Booroolong Frog *Litoria booroolongensis*, the Stuttering Frog *Mixophyes balbus* and Davies' Tree Frog *Litoria daviesae* were targeted during amphibian surveys (Table 8).

Table 8: Threatened frog survey effort

Species	Habitat	Timing	ecobiological Effort
<i>Mixophyes balbus</i> (three suitable streams, one accessible)	Mountain streams	September-April	One 200 metre nocturnal transect on two occasions, tadpole survey, call playback
<i>Mixophyes iteratus</i> (Suitable habitat not present for this species at Stratford)	Large streams near forest	September-March	Not required
<i>Litoria aurea</i> (large areas of marginal habitat)	Wetlands, dams	August-February	Three four hourly searches at large water bodies, one hour on three separate occasions at small water bodies, call playbacks, tadpole surveys
<i>Litoria booroolongensis</i> (three suitable streams, one accessible)	Mountain streams	December-February	One 200 metre nocturnal transect on two occasions, tadpole survey, call playback
<i>Litoria daviesae</i> (three suitable streams, one accessible)	Mountain streams	September-March	One 200 metre nocturnal transect on two occasions, tadpole survey, call playback

Though the endangered Giant Barred Frog *Mixophyes iteratus* was identified during a 20 km area search from the centre of the study area and has been recorded near Duralie Mine, its favoured habitat, wide, lowland rivers with rocky substrates, is not present in the study area and this species was not specifically targeted.



For the Booroolong Frog *Litoria booroolongensis*, the Stuttering Frog *Mixophyes balbus* and Davies' Tree Frog *Litoria daviesae* suitable habitat was targeted during 200 m long transect tadpole, nocturnal spotlight surveys and call playback surveys. For the Green and Golden Bell Frog *Litoria aurea* surveys consisted of diurnal searches, tadpole searches, nocturnal spotlight surveys and call playback surveys. Three four hourly searches were conducted at large water bodies, one hour surveys were conducted on three separate occasions at small water bodies.

For tadpole surveys, dip-netting was carried out to locate any tadpoles present in any water bodies. Nocturnal surveys lasted at least 30 minutes by walking lengths of suitable habitat and using head torches to search for frogs by eye shine or by physical sightings. Adult frogs encountered were identified by visual confirmation or by their distinct advertisement calls.

Substantial rainfall was experienced prior to all frog survey events in 2007, 2009 and 2010 providing suitable survey conditions for frogs (DEWHA 2010d).

Reptiles

Several methods were undertaken to detect reptiles in the study area. Table 9 shows the effort undertaken to survey for reptiles.

- (a) Type IV funnel traps (similar to a fish or lobster trap) were paired along two 26 m runs of drift fence. This was left in place for four consecutive days and nights and traps were checked daily.
- (b) Diurnal habitat surveys undertaken at targeted points and at the four trapping stations in 2010. For these surveys, a range of microhabitats were inspected to detect the presence of any reptile species by way of occupancy, scats or other detectable traces. Suitable habitat in the study area included roadsides, coarse woody debris, and crevices, fallen hollow logs and limbs.
- (c) Targeted herpetological surveys were undertaken at night at locations characterised as being linear features in the landscape, particularly along a gully in wet sclerophyll forest/rainforest, along roads and ridgelines to target threatened reptile species (Stephen's Banded Snake *Hoplocephalus stephensii* and Broad-headed Snake *Hoplocephalus bungaroides*).

Pitfall traps were not used due to the difficulty of the terrain, i.e. rocky, so were determined to not be an efficient way of trapping. Funnel traps were used instead and provided a good return for reptile captures.



Table 9: Reptile survey effort

Method		Wet Sclerophyll Forests	Dry Sclerophyll Forests	Grassy woodlands	Wetland/ creek
Area (ha)		28.24	400.82	121.88	26.04
Reptile Run (trap nights)	DEC		120	48	NA
	ecobiological		180	48	
Diurnal Reptile survey (30 min surveys on separate days)	DEC	1 hour	4 hours	2 hours	NA
	ecobiological	1 hour	7 hours	3 hours	
Nocturnal reptile survey 30 min surveys on separate days)	DEC	1 hour	4 hours	2 hours	NA
	ecobiological	1 hour	4 hours	4 hours	

DEC = DEC 2004 survey effort requirements / ecobiological = survey effort by ecobiological

Relative Abundance

Each fauna species detected in the study area was assigned a broad abundance class based upon the frequency in which it was observed. One of four abundance classes were assigned, either one sighting only, uncommon (more than one sighting but encountered only infrequently), common (encountered frequently but not in high numbers relative to other species abundance), or abundant (encountered frequently and in large numbers relative to other species abundance).

Targeted Surveys for Threatened Fauna Species

Threatened fauna species listed in Table 10 were targeted during all fauna surveys. These species were derived from the database and literature searches as detailed in section 2.3.

The survey timing prescribed in the DECC Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (DECC 2009b), *Survey Guideline for Australia's Threatened Frogs* (DEWHA 2010d), *Survey Guideline for Australia's Threatened Birds* (DEWHA 2010c) and *Survey Guideline for Australia's Threatened Bats* (DEWHA 2010b) was considered for each species (Table 10). It is noted that federal survey guidelines for threatened mammals and reptiles have also been released by SEWPaC (2011b, c); however, this was after the completion of fauna surveys undertaken as part of this study.

Table 10: Targeted Threatened Fauna Species Survey Methodology

Scientific Name	Common Name	Conservation Status		Survey Method ecobiological	Comparison of ecobiological methods to Federal survey methods (DEWHA, 2010b, 2010c & 2010d DSEWPaC, 2011b & 2011c)
		TSC Act ¹	EPBC Act ²		
Amphibians					
MYOBATRACHIDAE					
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	One 200 metre nocturnal transect on two occasions from September to April. Tadpole surveys and call playback were conducted.	The timing and type of surveying conducted meets the guidelines. The amount of effort recommended was not met (short by two occasions), however, it was determined that there is no suitable habitat in the study area for this species.
HYLIDAE					
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	Surveys conducted from August to February, three four hourly searches at large water bodies, and one hour on three separate occasions at small water bodies. Call playbacks and tadpole surveys were conducted.	The timing, type of survey methods and effort required set out in the guidelines were met. Season: Sept - Mar Weather conditions: within one week of heavy rainfall Methods: combination of call detection, call playback and spotlight surveys. Habitat assessment and dip netting or trapping can be used to collect larvae Effort: min of four nights under ideal conditions Area: wetland areas.
<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	One 200 metre nocturnal transect on two occasions from December to February. Tadpole surveys and call playback was conducted.	The timing and type of surveys conducted by ecobiological meets the guidelines. The amount of effort recommended was not met (short by two occasions), however, access restrictions reduced the amount of potential habitat able to be searched.
<i>Litoria daviesae</i>	Davies' Tree Frog	V	-	Tadpole surveys, call playback, and nocturnal searches.	
Reptiles					
ELAPIDAE					
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Habitat search and spotlighting.	The methods carried out meet the guidelines as they suggest conducting a habitat search during the day and then subsequent spotlighting. No specific effort is recommended.
<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V	-	Habitat search and spotlighting.	

Table 10 cont: Targeted Threatened Fauna Species Survey Methodology

Scientific Name	Common Name	Conservation Status		Survey Method ecobiological	Survey method for EPBC listed species; DEWHA (2010b, 2010c & 2010d) / DSEWPaC (2011b & 2011c)
		TSC Act ¹	EPBC Act ²		
Birds					
CICONIIDAE					
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	Avifauna census near water bodies.	
ACCIPITRIDAE					
<i>Circus assimilis</i>	Spotted Harrier	V	-	Avifauna census.	
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Avifauna census and spotlighting.	
BURHINIDAE					
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	Avifauna census and call playback.	
ROSTRATULIDAE					
<i>Rostratula australis</i>	Australian Painted Snipe	E	V	Avifauna census near water bodies.	The guidelines recommend searches or transects through wetlands or targeted stationary observations at dawn, dusk and shortly after dusk. Potential habitat for this species was searched during diurnal bird surveys (transects around the edge of potentially suitable wetlands). Detection by flushing was also possible due to the large number of nocturnal amphibian searches undertaken around the edges of waterbodies.
COLUMBIDAE					
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V	-	Avifauna census.	
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V	-	Avifauna census.	
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V	-	Avifauna census.	
PSITTACIDAE					
<i>Calyptrorhynchus lathamii</i>	Glossy Black-Cockatoo	V	-	Avifauna census, habitat search.	
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V		Avifauna census.	
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	-	Avifauna census.	
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Avifauna census.	
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	Avifauna census.	

Table 10 cont: Targeted Threatened Fauna Species Survey Methodology

Scientific Name	Common Name	Conservation Status		Survey Method ecobiological	Survey method for EPBC listed species; DEWHA (2010b, 2010c & 2010d) / DSEWPaC (2011b & 2011c)
		TSC Act ¹	EPBC Act ²		
Birds cont.					
PSITTACIDAE					
<i>Lathamus discolor</i>	Swift Parrot	E	E	Avifauna census.	Area searches in suitable habitat during the morning or late afternoon were conducted across the study area (targeting any areas containing heavily flowering Eucalypts). The effort employed by ecobiological exceeds the recommended 20 hrs / 8 days.
TYTONIDAE					
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	Avifauna census, call playback and spotlighting.	
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Avifauna census, call playback and spotlighting.	
STRIGIDAE					
<i>Ninox strenua</i>	Powerful Owl	V	-	Avifauna census, call playback and spotlighting.	
<i>Ninox connivens</i>	Barking Owl	V	-	Avifauna census, call playback and spotlighting.	
ATRICHORNITHIDAE					
<i>Atrichornis rufescens</i>	Rufous Scrub-bird	V	-	Avifauna census.	
CLIMACTERIDAE					
<i>Climacteris picumnus</i>	Brown Treecreeper	V	-	Avifauna census.	
ACANTHIZIDAE					
<i>Pyrrholaemus saggitatus</i>	Speckled Warbler	V	-	Avifauna census.	
MELIPHAGIDAE					
<i>Anthochaera phrygia</i>	Regent Honeyeater	E	E	Avifauna census.	Area searches in suitable habitat during the morning or late afternoon were conducted across the study area (targeting any areas containing heavily flowering Eucalypts). The effort employed by ecobiological exceeds the recommended 20 hrs / 5days.
<i>Epthianura albifrons</i>	White-fronted Chat	V	-	Avifauna census.	

Table 10 cont: Targeted Threatened Fauna Species Survey Methodology

Scientific Name	Common Name	Conservation Status		Survey Method ecobiological	Survey method for EPBC listed species; DEWHA (2010b, 2010c & 2010d) / DSEWPaC (2011b & 2011c)
		TSC Act ¹	EPBC Act ²		
Birds cont.					
PETROICIDAE					
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	Avifauna census.	
PETROICIDAE					
<i>Petroica phoenicea</i>	Flame Robin	V	-	Avifauna census.	
<i>Petroica boodang</i>	Scarlet Robin	V	-	Avifauna census.	
POMATOSTOMIDAE					
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	V	-	Avifauna census.	
NEOSITTIDAE					
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Avifauna census.	
PACHYCEPHALIDE					
<i>Pachycephala olivacea</i>	Olive Whistler	V	-	Avifauna census.	
<i>Stagonopleura guttata</i>	Diamond Firetail	V		Avifauna census.	
Mammals					
DASYURIDAE					
<i>Dasyurus maculatus maculatus</i> (SE mainland population)	Spotted-tailed Quoll	V	E	Cage traps, scats and hair tubes.	The recommend survey methods and sample area set out in the guidelines was met by ecobiological.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	Hair tubes, Elliot traps and scats.	
<i>Planigale maculata</i>	Common Planigale	V	-	Hair tubes, Elliot traps	
PHASCOLARCTIDAE					
<i>Phascolarctos cinereus</i>	Koala	V	-	Call playback, spotlighting, habitat characterisation and secondary evidence.	
BURRAMYIDAE					
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	Hair tubes, Elliot traps and scats.	

Table 10 cont: Targeted Threatened Fauna Species Survey Methodology

Scientific Name	Common Name	Conservation Status		Survey Method ecobiological	Survey method for EPBC listed species; DEWHA (2010b, 2010c & 2010d) / DSEWPaC (2011b & 2011c)
		TSC Act ¹	EPBC Act ²		
Mammals cont.					
PETAURIDAE					
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	Hair tubes, Elliot traps and scats.	
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Hair tubes, call playback, Elliot traps and scats.	
POTOROIDAE					
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V	-	Cage traps, scats and hair tubes.	
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	V	V	Cage traps, scats and hair tubes.	The recommend survey methods and sample area set out in the guidelines was met by ecobiological.
MACROPODIDAE					
<i>Macropus parma</i>	Parma Wallaby	V	-	Hair tubes, scats and opportunistic observations.	
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Hair tubes, scats and opportunistic observations.	The recommend survey methods and sample area set out in the guidelines was met by ecobiological (including habitat assessment and searches of potential basking areas).
<i>Thylogale stigmatica</i>	Red-legged Pademelon	V	-	Hair tubes, scats and opportunistic observations.	
PTEROPODIDAE					
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Identification of roosting habitat and spotlighting.	The recommend survey methods and sample area set out in the guidelines was met by ecobiological.
EMBALLONURIDAE					
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail bat	V	-	Anabat detecting, harp traps and spotlighting.	

Table 10 cont: Targeted Threatened Fauna Species Survey Methodology

Scientific Name	Common Name	Conservation Status		Survey Method ecobiological	Survey method for EPBC listed species; DEWHA (2010b, 2010c & 2010d) / DSEWPaC (2011b & 2011c)
		TSC Act ¹	EPBC Act ²		
Mammals cont.					
MOLOSSIDAE					
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	Anabat detecting and harp traps.	
VESPERTILIONIDAE					
<i>Kerivoula papuensis</i>	Golden-tipped Bat	V	-	Harp traps.	
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-	Anabat detecting and harp traps.	
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-	Identification of roosting habitat and harp traps.	
VESPERTILIONIDAE					
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Identification of roosting habitat, harp traps and Anabat detecting.	The recommend survey methods set out in the guidelines was met by ecobiological including passive acoustic detection, roost searches and trapping with harp traps. With regard to effort, the guidelines recommend a total of 16 nights with a min of 4 detectors employed between Oct – Mar. ecobiological placed 1-5 Anabat detectors out on 10 nights in April, July, August, November, January and March between 2007 – 2010 (min 180 recording hours). The study area contains very few caves and is unlikely to represent optimal habitat for this species, therefore survey effort is considered adequate.
<i>Myotis macropus</i>	Southern Myotis	V	-	Anabat detecting.	
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Anabat detecting.	
MURIDAE					
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	Hair tubes, Elliot traps.	No specific methods specified in survey guidelines however, the methods used by ecobiological are considered appropriate.
<i>Pseudomys oralis</i>	Hastings River Mouse	E	E	Hair tubes, Elliot traps.	A total of 1120 size A Elliot trap nights were employed exceeding the guideline recommendations. Hair tubes were also employed which is another accepted method.

Nomenclature consistent with Clayton, *et al* (2006) *CSIRO List of Australian Vertebrates: A Reference with Conservation Status*.

¹ Threatened species status under the NSW *Threatened Species Conservation Act, 1995* (current as at 16 August 2010).

² Threatened species status under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current as at 16 August 2010)



2.3. Database and Literature Search

2.3.1. Database Search

A list of known threatened, fauna, endangered populations and migratory species was obtained from relevant databases for a 20 km radius of the study area. In addition, a Protected Matters Search of the DEWHA database was conducted for the same area.

A total of 24 threatened fauna species have been previously recorded within a 20-kilometre radius of the study area (Table 11). These include two frog, one reptile, five bird and 16 mammal species.

In addition, an EPBC Act Protected Matters Search indicated that five species, the Booroolong Frog *Litoria booroolongensis*, Australian Painted Snipe *Rostratula australis*, Regent Honeyeater *Anthochaera phrygia*, Swift Parrot *Lathamus discolor*, Hastings River Mouse *Pseudomys oralis* and the Large-eared Pied Bat *Chalinolobus dwyeri* are modelled to occur in the study area. None has been previously recorded within 10 km of the study area.

Table 11: Threatened fauna species recorded within a 20-kilometre radius of the study area.

Scientific Name	Common Name	Conservation Status		EPBC Act Protected Matters Search ³	Species Records			Previous Survey Records ⁷
		TSC Act ¹	EPBC Act ²		DECCW Atlas of NSW Wildlife ⁴	Australian Museum ⁵	Birds Australia ⁶	
Amphibians								
MYOBATRACHIDAE								
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	●	●	-	-	-
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	●	●	-	-	-
HYLIDAE								
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	●	-	-	-	-
<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	●	-	-	-	-
<i>Litoria daviesae</i>	Davies' Tree Frog	V	-	-	●	-	-	-
Reptiles								
ELAPIDAE								
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	●	-	-	-	-
<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V	-	-	●	-	-	-
Birds								
CICONIIDAE								
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	-	●	-	●	-
ACCIPITRIDAE								
<i>Circus assimilis</i>	Spotted Harrier	V	-	-	●	-	-	-
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	-	●	-	-	-
BURHINIDAE								
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	-	-	●	-	-
ROSTRATULIDAE								
<i>Rostratula australis</i>	Australian Painted Snipe	E	V	●	-	-	-	-
COLUMBIDAE								
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V	-	-	●	-	●	-
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V	-	-	●	-	-	-
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V	-	-	●	-	-	-

Table 11 (cont.): Threatened fauna species recorded within a 20-kilometre radius of the study area.

Scientific Name	Common Name	Conservation Status		EPBC Act Protected Matters Search ³	Species Records			Previous Survey Records ⁷
		TSC Act ¹	EPBC Act ²		DECCW Atlas of NSW Wildlife ⁴	Australian Museum ⁵	Birds Australia ⁶	
Birds (Continued)								
PSITTACIDAE								
<i>Calyptrorhynchus lathami</i>	Glossy Black-Cockatoo	V	-	-	●	-	●	C
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	-	●	-	-	-
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	-	-	-	-	●	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	-	●	-	●	C
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	-	●	-	-	-
<i>Lathamus discolor</i>	Swift Parrot	E	E	●	-	-	-	-
TYTONIDAE								
<i>Tyto tenebricosa</i>	Sooty Owl	V	-	-	●	-	●	-
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	-	●	-	-	-
STRIGIDAE								
<i>Ninox strenua</i>	Powerful Owl	V	-	-	●	-	-	-
<i>Ninox connivens</i>	Barking Owl	V	-	-	●	-	●	-
ATRICHORNITHIDAE								
<i>Atrichornis rufescens</i>	Rufous Scrub-bird	V	-	-	-	-	●	-
CLIMACTERIDAE								
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	-	-	-	●	C
ACANTHIZIDAE								
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	V	-	-	●	-	-	C
MELIPHAGIDAE								
<i>Anthochaera phrygia</i>	Regent Honeyeater	E	E	●	-	-	-	-
<i>Epthianura albifrons</i>	White-fronted Chat	V	-	-	-	-	●	-
PETROICIDAE								
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	-	-	-	●	C
<i>Petroica phoenicea</i>	Flame Robin	V	-	-	●	-	●	-
<i>Petroica boodang</i>	Scarlet Robin	V	-	-	●	-	-	-

Table 11 (cont.): Threatened fauna species recorded within a 20-kilometre radius of the study area.

Scientific Name	Common Name	Conservation Status		EPBC Act Protected Matters Search ³	Species Records			Previous Survey Records ⁷
		TSC Act ¹	EPBC Act ²		DECCW Atlas of NSW Wildlife ⁴	Australian Museum ⁵	Birds Australia ⁶	
Birds (Continued)								
POMATOSTOMIDAE								
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subsp)	V	-	-	●	-	●	C
NEOSITTIDAE								
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	-	●	-	●	C
PACHYCEPHALIDE								
<i>Pachycephala olivacea</i>	Olive Whistler	V	-	-	●	-	●	-
ESTRILIDIDAE								
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	-	-	-	●	C
Mammals								
DASYURIDAE								
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll (SE mainland pop.)	V	E	●	●	-	-	-
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	-	●	●	-	-
<i>Planigale maculata</i>	Common Planigale	V	-	-	●	-	-	-
PHASCOLARCTIDAE								
<i>Phascolarctos cinereus</i>	Koala	V	-	-	●	-	-	-
BURRAMYIDAE								
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	-	●	-	-	-
PETAURIDAE								
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	-	●	-	-	-
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	-	●	-	-	B
POTOROIDAE								
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V	-	-	●	-	-	-
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	V	V	●	●	-	-	-
MACROPODIDAE								
<i>Macropus parma</i>	Parma Wallaby	V	-	-	●	-	-	-
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	●	●	-	-	-
<i>Thylogale stigmatica</i>	Red-legged Pademelon	V	-	-	●	-	-	-
PTEROPODIDAE								
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	●	●	-	-	-

Table 11 (cont.): Threatened fauna species recorded within a 20-kilometre radius of the study area.

Scientific Name	Common Name	Conservation Status		EPBC Act Protected Matters Search ³	Species Records			Previous Survey Records ⁷
		TSC Act ¹	EPBC Act ²		DECCW Atlas of NSW Wildlife ⁴	Australian Museum ⁵	Birds Australia ⁶	
Mammals (Continued)								
EMBALLONURIDAE								
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	-	-	-	-	A
MOLOSSIDAE								
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	-	●	-	-	-
VESPERTILIONIDAE								
<i>Kerivoula papuensis</i>	Golden-tipped Bat	V	-	-	●	-	-	-
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-	-	●	-	-	-
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-	-	●	-	-	B
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	●	●	-	-	-
<i>Myotis macropus</i>	Southern Myotis	V	-	-	●	-	-	-
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	-	●	-	-	-
MURIDAE								
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	●	-	-	-	-
<i>Pseudomys oralis</i>	Hastings River Mouse	E	E	●	-	-	-	-

Nomenclature consistent with Clayton, *et al* (2006) *CSIRO List of Australian Vertebrates A Reference with Conservation Status*.

¹ Threatened species status under the NSW *Threatened Species Conservation Act, 1995* (current as at 16 August 2010).

² Threatened species status under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current as at 16 August 2010).

³ Department of the Environment, Water, Heritage and the Arts (2010) *EPBC Act Protected Matters Search*. Search for co-ordinates: -31.94879, 151.7527; -31.94879, 152.1725; -32.31309, 152.1725; -32.31309, 151.7527.

⁴ DECCW (2010) *Threatened Species - DECCW Atlas Database Records for the Following Search Area: -31.94, 152.17; -31.94, 151.75; -32.31, 152.17; -32.31, 151.75*. Date Received: 24 March 2010.

⁵ Australian Museum (2010) *Database Records within the Following Search Area: -31.94, 152.17; -31.94, 151.75; -32.31, 152.17; -32.31, 151.75*. Date Received: 30 March 2010.

⁶ Birds Australia (2010) *Database Records within the Following Search Area: 382116.8853, 6464557.0731; 422116.8853, 6464557.0731; 422116.8853, 6424557.0731; 382116.8853, 6424557.0731*. Date Received: 29 March 2010.

⁷ Previous survey results have been sourced from the following:

A = Richards, G.C. (2001) *An Assessment of the Bat Fauna at the Proposed Bowens Road North Project, Via Stratford, New South Wales*. Appendix FC of Stratford Coal (2001) *Bowens Road North Project Environmental Impact Statement*.

B = Hoye, G.A. and Finney, D. (1994) *Report on a Survey of the Bat Fauna of an Area Proposed for Open Cut Coal Mining Near Stratford, New South Wales*. Attachment A8.2B of Appendix 8.2 of Stratford Coal (1994) *Stratford Coal Project Environmental Impact Statement*.

C = AGC Woodward-Clyde (1994) *Avifauna*. Attachment A8.3 of Appendix 8.2 of Stratford Coal (1994) *Stratford Coal Project Environmental Impact Statement*.



Based on available published information on their known habitat preferences, all of the species listed in Table 11 and identified in the EPBC Protected Matters Search are thought to have potentially suitable foraging, breeding or roosting habitat resources within the study area. This list also includes the Green and Golden Bell Frog and the Green-thighed Tree Frog based on habitat in the study area having been deemed suitable for these two frogs (MKES 2001; this study).

Twelve EPBC-listed migratory bird species were identified as being modelled to potentially occur within the study area (Table 12). These were comprised of seven terrestrial, four wetland and one marine species. In addition, two others, the Australian Reed-warbler and the Double-banded Plover, listed under the Bonn Convention on the Conservation of Migratory Species of Wild Animals are regarded as likely to occur in the study area.

Table 12: Migratory Species (EPBC Act Protected Matters Search)

Class/Scientific Name	Common Name	Migrant type
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Terrestrial
<i>Hirundapus caudacutus</i>	White-throated Needletail	Terrestrial
<i>Merops ornatus</i>	Rainbow Bee-eater	Terrestrial
<i>Monarcha melanopsis</i>	Black-faced Monarch	Terrestrial
<i>Monarcha trivirgatus</i>	Spectacled Monarch	Terrestrial
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Terrestrial
<i>Anthochaera phrygia</i>	Regent Honeyeater	Terrestrial
<i>Ardea alba</i>	Great Egret	Wetland
<i>Ardea ibis</i>	Cattle Egret	Wetland
<i>Gallinago hardwickii</i>	Latham's Snipe	Wetland
<i>Rostratula benghalensis s. lat. (sic) australis</i>	Australian Painted Snipe	Wetland
<i>Apus pacificus</i>	Fork-tailed Swift	Marine
<i>Acrocephalus australis</i>	Australian Reed-warbler	Bonn
<i>Charadrius bicinctus</i>	Double-banded Plover	Bonn



2.3.2. Literature Search

An initial fauna survey was undertaken for the Stratford Coal Project in 1994 (AGC Woodward-Clyde Pty Ltd 1994). Methods used were Elliott trapping, spotlighting and general observations. Inclement weather prevented other techniques being adopted. A total of 84 bird, 10 mammal (five native), 10 reptile and four frog species were identified. Several threatened bird species, Glossy Black-Cockatoo (*Calyptrorhynchus lathami*), Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*), Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), Speckled Warbler (*Chthonicola sagittata*), Little Lorikeet (*Glossopsitta pusilla*) and Diamond Firetail (*Stagonopleura guttata*) were detected. A supplementary study of frogs (Murray 1994) identified four species in the July of 1994.

A fauna survey (excluding bats) north of Bowens Road was conducted by Mt King Ecological Services (2001). A total of 55 bird (53 native and two introduced), 11 mammal (six native and five introduced), three reptile (all native) and 11 amphibian (all native) species were located within or near the study area.

Previous studies of bats have also been undertaken in the Stratford Mine area (Hoye 1998; Hoye and Finney 1994; Richards 2001). These studies identified the Greater Broad-nosed Bat (*Scoteanax rueppellii*), Southern Myotis (*Myotis macropus*), Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*) and the Eastern Bentwing-bat.



3. Results

3.1. Fauna Habitat Assessment

A qualitative assessment of fauna habitat was made at most of the floristic quadrat sites across the study area. The following stratifications according to structural differences in the vegetation which broadly reflect differing fauna habitats are described below:

- **Derived Grasslands** - open grasslands with over 50% cover of native species.
- **Grassy Woodlands** – Open woodland to open forest 25 - 30 m high. The midstorey, where present, ranged between 5-10 m high with a moderate to dense cover. The shrub stratum was generally sparse, while the ground stratum was moderate to dense.
- **Dry Sclerophyll Forest** (shrub/grass sub-formation) - Woodland to tall open forest to 20-30 m high. In less disturbed or cleared areas the mid stratum was to 5-15 m high with moderate to dense cover. The shrub and ground cover was sparse to moderate.
- **Dry Sclerophyll Forest** (shrubby sub-formation) - Shrubby open forest 15-20 m high.
- **Wet Sclerophyll Forest** (shrubby sub-formation) - Tall to very tall open forest often with a dense understorey of rainforest species. Significant disturbance in some areas due to logging history.
- **Rainforest** – Moist closed forest to 20m high, comprising a dense overstorey, midstorey, shrub and ground stratum.
- **Freshwater Wetlands** - The structure of this community was a low sedgeland/rushland with scattered shrub species.

Generally speaking fauna habitat values were found to be 'moderate' across the study area. The only vegetation found to have low habitat values were nine sites within the Dry Sclerophyll Forest (shrub/grass sub-formation), the freshwater wetland areas and derived grasslands.

The largely grassy dry sclerophyll forests within the Dry Sclerophyll Forest (shrub/grass sub-formation) of a low habitat value were found to largely correspond to the distribution of sites with a low vegetation condition, within the valley and lower slopes of the study area. It can be safely assumed that the same anthropogenic factors that have caused the decline in vegetation condition in these areas have also resulted in a reduced habitat value for fauna. This has led to many of the lowland areas having a reduced habitat complexity and reduced log and hollow availability.



In terms of connectivity of habitat across the landscape, there is an overall lower level of connectivity in the valley floor and lower slopes, while the upslope forested areas have good connectivity with areas of good quality habitat which are external to the study area.

The low habitat value freshwater wetlands and derived grasslands in the study area are in a large part due to anthropogenic changes to the vegetation over time. While many wetland areas have received considerable impact from stock usage in the past, and were observed to have reduced levels of aquatic vegetation and decreased water quality, they still provide important habitat for amphibians.

3.2. Caves

Despite an extensive search of the eastern ridge line and a number of deep gullies, only two locations of caves suitable for bat roost sites were detected. These are listed in Table 13 and depicted in Figure 7.

Table 13: Locations of caves identified on site

Cave	Longitude	Latitude
Cave 1	151.9759	-32.1447
Cave 2	151.9793	-32.1409

Cave 1 was found half way up the eastern side of the study area, below a high point on the ridge line. Cave 1 was a deep cave with a long narrow entrance (Plate 1 and 2). Access into the interior was found to be difficult for the majority of larger terrestrial fauna species as it was perched on a steeply sloping rock face. No signs of animal use were found though this cave would provide suitable habitat for cave-roosting bat species.



Plate 1: Setting for cave 1



Plate 2: Cave 1 exterior

A steep sided gully was also found to have a number of smaller, relatively shallow roosting sites suitable for a range of smaller fauna species such as *Antechinus*, though providing only limited habitat for cave-dwelling bats (Plate 3).



Plate 3: Cave 2 exterior



3.3. Food Plants in Study Area

Table 14 identifies the main plants that have a high value for the local fauna which were encountered within the woodland and forest sections of the study area.

While generally poor in fleshy fruits, habitat in the study area offers considerable nectar, sap and seed resources for a variety of vertebrate fauna including threatened species.

Table 14: Plants found on site which provide particular fauna habitat attributes

Scientific Name	Common Name	Habitat Values	Habitat Where Found
<i>Acacia irrorata</i> subsp. <i>irrorata</i>	Wattle	Glider feed tree	GW
<i>Allocasuarina littoralis</i> , <i>Allocasuarina torulosa</i>	Forest Oak	Glossy Black-Cockatoo feed tree	DSF
<i>Angophora subvelutina</i>	Rough-barked Apple	Glider sap tree	GW / DSF
<i>Callistemon linearis</i> , <i>Callistemon salignus</i>	Bottlebrush	Nectar producing plants	GW
<i>Corymbia maculata</i>	Spotted Gum	Glider sap tree	GW / DSF
<i>Eucalyptus amplifolia</i>	Cabbage Gum	Glider sap tree	GW / DSF
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	Winter-flowering eucalypt	DSF
<i>Eucalyptus globoidea</i>	White Stringybark	Winter-flowering eucalypt	DSF
<i>Eucalyptus microcorys</i>	Tallowwood	Prime Koala food tree (SEPP 44)	WSF / DSF
<i>Eucalyptus moluccana</i>	Grey Box	Glider sap tree	GW
<i>Eucalyptus propinqua</i>	Grey Gum	Glider sap tree; Koala food tree	DSF
<i>Eucalyptus tereticornis</i>	Forest Red Gum	Glider sap tree; Winter-flowering eucalypt; prime Koala food tree (SEPP 44)	GW
<i>Exocarpos cupressiformis</i>	Native Cherry	Fruit bearing plant	DSF
<i>Ficus coronata</i> , <i>Ficus rubiginosa</i>	Figs	Fruit bearing plants	GW
<i>Leptospermum polygalifolium</i>	Tea-tree	Nectar producing plants	DSF
<i>Melaleuca decora</i> , <i>M. linariifolia</i> , <i>M. nodosa</i> , <i>M. sieberi</i> , <i>M. styphelioides</i>	Paperbark	Nectar producing plants	GW / FW / DSF
<i>Persoonia linearis</i>	Geebung	Fruit-bearing plant	DSF
<i>Rubus moluccanus</i> , <i>R. parvifolius</i>		Fruit bearing plant s	GW / DSF
<i>Xanthorrhoea glauca</i>	Grass Tree	Nectar bearing plant	GW / DSF

Key to habitat codes:

DSF: Dry Sclerophyll Forest; WSF: Wet Sclerophyll Forest; GW: Grassy Woodland; FW: Freshwater Wetland



3.4. Habitat Tree Hollow Surveys

Surveys of hollow type and density consisted of; (i) a survey of hollow types in living and standing dead trees in low-lying areas of the study area; and (ii) an assessment of hollow density across the study area using Biometric data obtained during flora quadrats.

Sixty-six (66) hollow-bearing living trees and 36 standing dead trees were detected during hollow type surveys across the study area. Categories of hollow entrance size encountered are depicted in Figure 6. One hundred and thirty-six (136) hollows were detected in total with 86 having small entrances (<8 cm diameter), 32 medium-sized entrances (8-20 cm diameter) and 18 large hollow entrances (>20 cm diameter).

The size of the external opening is not always indicative of the internal size of the hollows (Gibbons and Lindenmayer 2002) with many species of arboreal mammal selecting small hollow entrances to chambers with a large internal diameter.

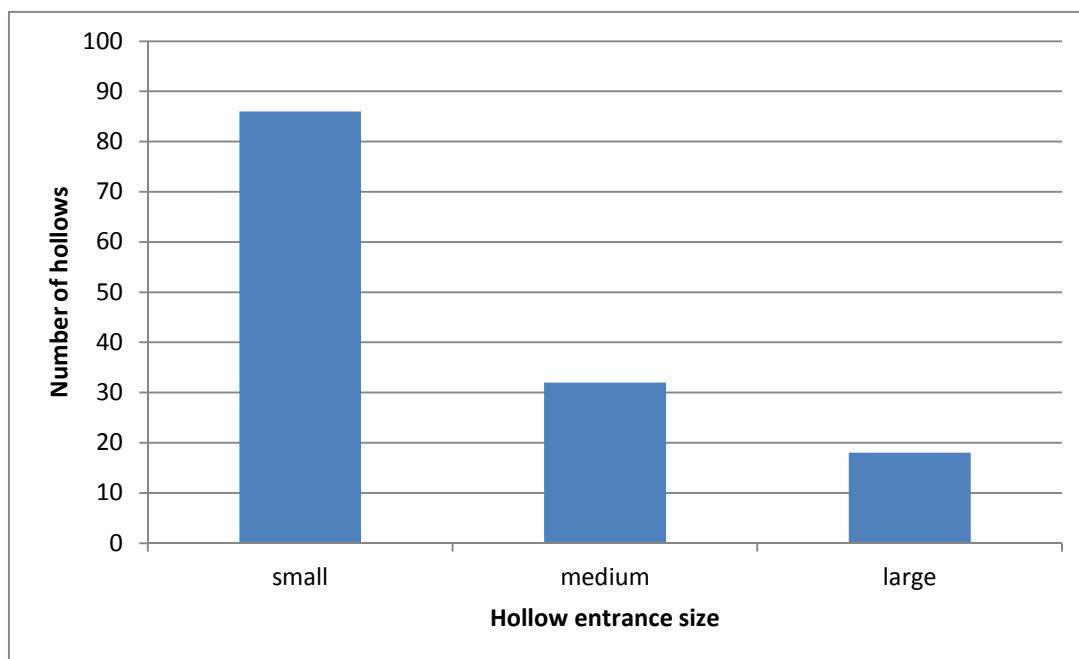
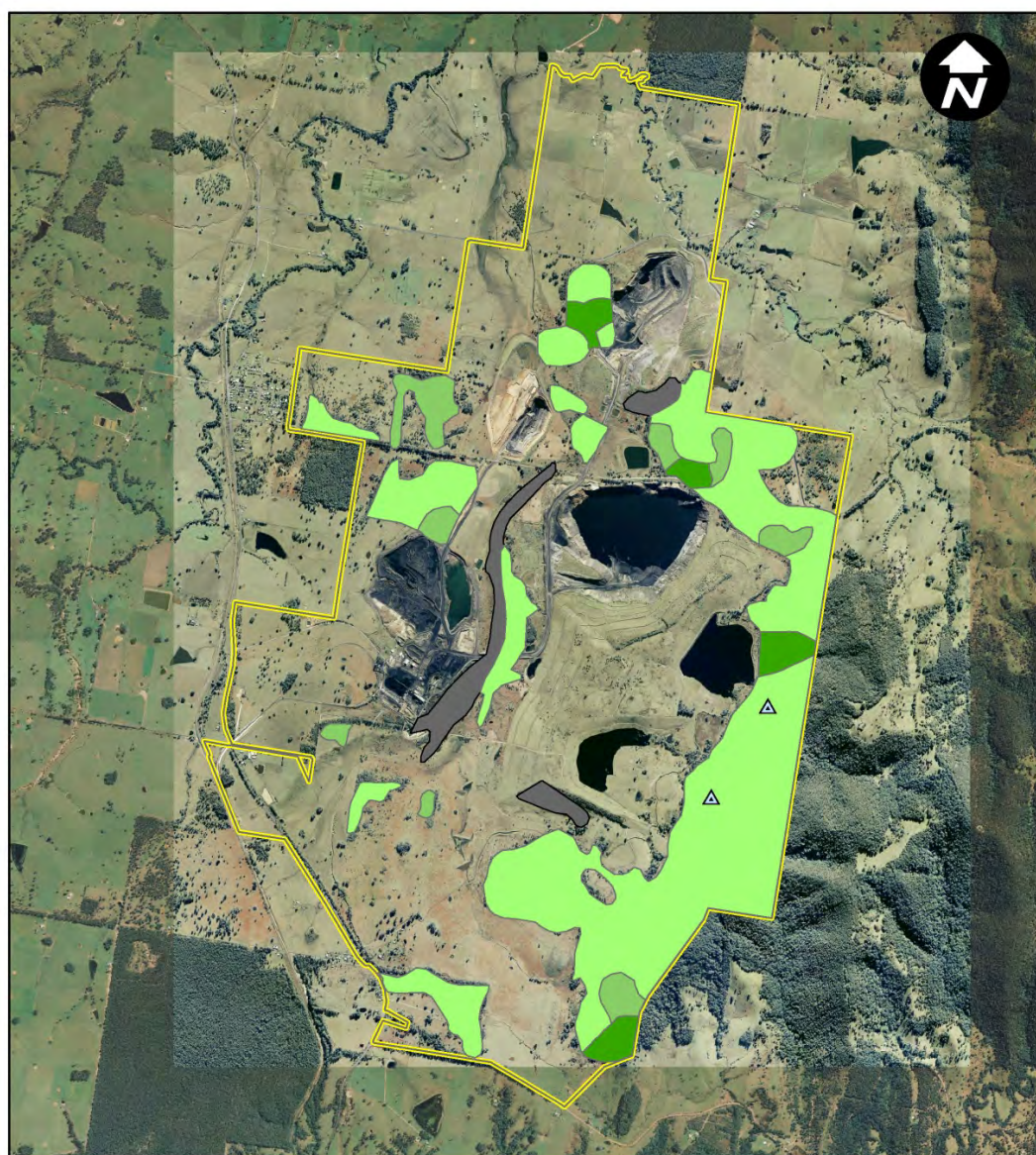


Figure 6: Number of trees within each hollow diameter size class.

Note: Small < 8 cm, medium = 8 – 20 cm and large > 20 cm diameter.

Using the Biometric data collected at the flora quadrats, the average hollow density across the study area was mapped (Figure 7). For the most part, the density of visible hollows was less than 10/ ha across the study area, though areas of above average density (15-30 / ha) do exist along the eastern range and in some lowland woodland patches.



Legend

- △ Cave Location
- Study Area

Hollow density per hectare

- >20 Hollows
- 10-20 Hollows
- <10 Hollows
- 0 Hollows

ecobiological
survey & assessment

Coordinate System: NSW LCC
Ecobiological - 2010

0 0.5 1 2 km

Figure 7: Aerial photograph of the study area showing the location of trees containing habitat hollows.



3.5. Koala Habitat Assessment

3.5.1. SEPP 44 – Koala Habitat

Potential Koala habitat under SEPP 44 is defined as 'areas of native vegetation where the trees listed in Schedule 2 of SEPP 44 (Table 3) constitute at least 15% of the total number of trees in the upper and lower strata of the tree component.

Areas which comply with the definition of 'Potential Koala habitat are restricted to two vegetation types that were identified during flora surveys (ecobiological, 2010). These areas are listed below and mapped in Figure 8:

- Group 6: Redgum - Box Grassy Woodland; and
- Group 7: Spotted Gum - Thick-leaved Mahogany Forest.

These areas are associated with Forest Red Gum *Eucalyptus tereticornis* and Tallowwood *E. microcorys*. No other SEPP 44 listed species constituted greater than 15% of the total number of trees in the upper and lower strata of the tree component.

Areas dominated by *E. tereticornis*, which is all of the extent of the Red Gum/Box Grassy Woodland type within the study area (6.1 ha), is regarded as Potential Koala habitat. This species covers small areas of the valley floor on the alluvial soil landscapes.

The Spotted Gum/Mahogany Forest type, Group 7, has the preferred food tree *E. microcorys* as a co-dominant throughout its distribution at Stratford. However this species only occurs at densities greater than 15% of the canopy cover in patches throughout the extent of this type (DAP pers. obs.). This forest is confined to the upslope areas of the Gloucester Buckett landscape type on the forested eastern side of the study area. Ground-truthing and mapping of patches with greater than 15% occurrence of preferred feed tree species within this forest type have not been undertaken, however, the mapping in Figure 8 shows the extent of this community in the study area.

Given Potential Koala habitat was found, SAT assessment techniques were used as described in section 3.5.2 below to confirm whether or not the area could be Core Koala habitat.

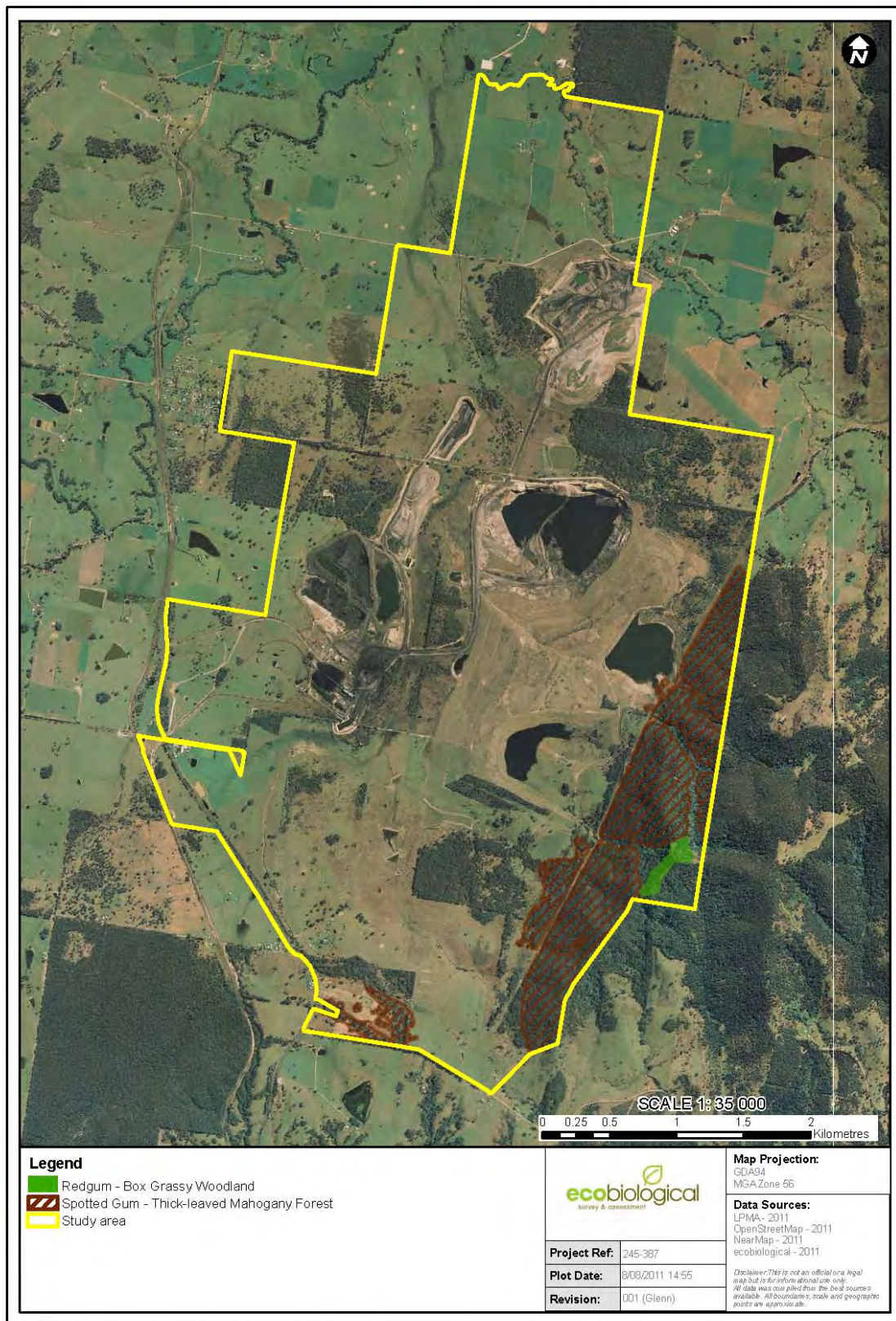


Figure 8: Aerial photograph of the study area showing the locations of potential koala habitat.



3.5.2. Spot Assessment Technique (SAT) Assessment

Given potential koala habitat was identified, SAT assessment techniques were used to confirm whether the area is core koala habitat. No evidence of Koala activity was found during SAT assessments and the Koala was not observed during other survey activities conducted across the study area.

No recent evidence or sightings of Koalas occur within the study area. Five Koala records have occurred within 10 km of the Stratford Mine Area (BioNet 2010; OEH Wildlife Atlas). These were recorded between 1991 and 2002. Two records from 1998 and 1999 were recorded from a patch of lowland woodland on Woods Road, Craven, while the other three were all recorded from The Glen Nature Reserve from 1991, 2001 and 2002.

3.5.3. Recovery Plan for the Koala

In addition to the species listed in SEPP 44, the koala recovery plan (DECC, 2008) lists *Eucalyptus amplifolia* (Cabbage Gum) as a primary food tree species. This species occurs on site within the Cabbage Gum Floodplain Grassy Woodland (ecobiological, 2010). This community may also provide habitat for the koala however, SAT tests and other appropriate survey methods did not detect any Koala activity across the study area.

3.6. Fauna Species Composition

A total of 178 fauna species were recorded within the study area (consisting of 13 amphibian, 13 reptile, 121 bird and 31 mammal species). A list of these species and their relative abundance is shown in Appendices 2 (birds), 3 (non-flying fauna and nocturnal birds) and 4 (bats).

3.6.1. Amphibians

Frog species were detected in high numbers throughout wet areas such as gullies and in the water bodies of the study area (Appendix 3). Though relative abundance varied from year to year, a number of species were found in high numbers, particularly *Limnodynastes peronii*, *Limnodynastes tasmaniensis*, *Litoria fallax*, *Litoria peronii* and *Uperoleia fusca*. One species, *Pseudophryne coriacea*, was detected widely in 2010 in locations away from standing water. Three species, *Crinia signifera*, *Litoria dentata* and *Uperoleia laevigata* were only detected on one occasion.



3.6.2. Reptiles

Reptiles were not a well represented group in the survey results with most species detected only once or on a few occasions (Appendix 3). Three species were found to be relatively common, detected widely in reptile searches, *Ctenotus robustus*, or observed frequently during opportunistic observations *Chelodina longicollis* and *Physignathus lesueurii*.

3.6.3. Birds

Birds were the most diverse vertebrate group in the study area; however the majority of species were only seen on five occasions or less (Appendix 2). Twenty-six (26) species were only detected once, while 10 species were commonly observed during 20 or more surveys. These were the Australian Magpie, Australian Raven, Grey Fantail, Laughing Kookaburra, Noisy Miner, Red-browed Finch, Superb Fairy-wren, Variegated Fairy-wren, White-throated Treecreeper and the Yellow-faced Honeyeater.

3.6.4. Mammals

Native non-flying mammals were found to be a relatively diverse group in the study area, though most were observed and detected infrequently and the species composition varied from year to year, e.g. the Squirrel Glider was only detected in 2007 and not on subsequent trapping efforts (Appendix 3). The more commonly and widely detected species were the Brown Antechinus, the Wallaroo, the Common Brushtail Possum and the Bush Rat.

For bats, the most abundant species was Gould's Wattled Bat, accounting for 55% of all bat passes recorded in 2010 (Appendix 4). Less commonly encountered bat species (< five passes) included the Eastern Horseshoe Bat, the Chocolate Wattled Bat and *Mormopterus sp. 2* which was only recorded once in 2008.

3.6.5. Exotic Fauna

Two birds (Common Starling and the Spotted Dove) and five of the mammal species detected were exotic species (Rabbit, Hare, Cat, Fox and House Mouse). Of these species, all were considered to be uncommon with the exception of the Rabbit which was found to be common in the study area.



3.7. Threatened Fauna Species

Eleven (11) threatened fauna species were recorded during the surveys (Table 15 and Figure 9). The locations of these records are given in Appendix 5. These consist of five bird species, three non-flying mammals and three Microchiropteran bats. The New Holland Mouse (*Pseudomys novaehollandiae*) is listed as Vulnerable under the EPBC Act and not listed under the TSC Act, whereas all other threatened species recorded in the study area are listed only at the state level under the TSC Act as Vulnerable.

Glossy Black-Cockatoo *Calyptorhynchus lathami*

Two Glossy Black-Cockatoos were sighted during a bird survey transect in August 2008 (Figure 9, Appendix 5). The sighting was of one male and one female within a regrowth area of Dry Sclerophyll Forest containing the feed tree *Allocasuarina littoralis*. This species is likely to have a patchy distribution throughout the study area and has probably decreased due to past agricultural practices. Another feed tree species, *A. torulosa*, is common throughout the Spotted Gum/Thick-leaved Mahogany Forest (also a Dry Sclerophyll Forest community).

Masked Owl *Tyto novaehollandiae*

Two Masked Owls were sighted after responding to call playback on 1/2/10 and on 2/2/10 one call response to call playback was recorded at the same location (Transect 11) within Dry Sclerophyll Forest habitat (Figure 9, Appendix 5). It is likely that these animals are a breeding pair and that it was the male of the pair that responded on the subsequent evening. The Masked Owl lives as monogamous, sedentary life-long pairs in large permanent home ranges. Laying is irregular and unpredictable, occurring from late summer to spring but mostly March to July (DEC 2006). At the time of the record, it is possible that the pair was investigating potential nesting locations or may have established a nest site.

Grey-crowned Babbler *Pomatostomus temporalis*

The Grey-crowned Babbler was detected via opportunistic sightings and during a bird survey. On 10/4/07, three birds were observed foraging at one location and another seven birds were observed foraging at a second location. On 17/4/07, four birds were observed during a bird survey at a third location, followed by an opportunistic sighting of two birds at a fourth location. On 16/7/07, six birds were observed foraging at a fifth location. On 27/11/07, five birds were observed foraging together at a sixth location. Five of these locations are in close proximity along Parkers Road and it is possible that individuals sighted on different dates represent members of the same family groups (Figure 9, Appendix 5).



Several old nest sites were observed in the northern and western sections of the study area found among paperbark trees in Grassy Woodland habitat, on the edges of cleared lands and in Dry Sclerophyll grassy forest (Figure 9, Appendix 5).

Varied Sittella *Daphoenositta chrysoptera*

The Varied Sittella was another species encountered only among the lower slopes and valley Grassy Woodland and Dry Sclerophyll Forest. Two individuals were sighted during a bird survey at one location in April 2007. Six individuals were sighted at a second location during bird surveys on 2/2/10 and 19/3/10 and were likely to be the same family group. Three individuals were sighted on 2/2/10 at a third location during a bird survey (Figure 9, Appendix 5).

Magpie Goose *Anseranas semipalmata*

A single Magpie Goose was opportunistically observed flying south from the central wetland within the study area in February 2010 (Figure 9, Appendix 5).

Squirrel Glider *Petaurus norfolcensis*

An individual Squirrel Glider was trapped at Transect 3 in Grassy Woodland habitat on 18/4/07 and 20/4/07. The sex was not noted and it is possible that they were the same animal (Figure 9, Appendix 5).

Brush-tailed Phascogale *Phascogale tapoatafa*

An individual male Brush-tailed Phascogale was trapped at Transect 10 on 21/1/09. An individual (sex not noted) was trapped two days later on 23/1/09 on the same trapping transect within Dry Sclerophyll Forest. It is possible that this was the same animal. In 2010, an individual was trapped on 4/2/10, 5/2/10 and 7/2/10 (the sex was not noted and it is possible that they were the same animal) at Transect 12 located within Grassy Woodland habitat (Figure 9, Appendix 5).

New Holland Mouse *Pseudomys novaehollandiae*

An individual New Holland Mouse was trapped at Transect 14 on 7/2/10 (sex not noted) in lower slope Dry Sclerophyll Forest with a ground cover dominated significantly by Blady Grass *Imperata cylindrica* (Figure 9, Appendix 5). This rodent species is listed as threatened (Vulnerable) under the EPBC Act but is not listed at a NSW state level.



Little Bentwing-bat *Miniopterus australis*

A predominantly cave-dwelling bat, the Little Bentwing-bat was detected at three locations by echolocation detectors in March 2010 (Figure 9, Appendix 5). A total of 11 passes were recorded at the three locations on a single night. This species has never been recorded prior to this survey in the study area. It was detected in lower slope Grassy Woodland and Dry Sclerophyll Forest habitat.

Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*

The Eastern Bentwing-bat was recorded by echolocation detectors from a variety of habitats including Wet Sclerophyll Forest. In August 2008 the species was recorded at five locations over two nights. In March 2010 the Eastern Bentwing-bat was recorded at two locations with a total of eight bat passes, on the one night. It was also recorded by Hoyer (1994) and Hoyer and Finney (1998). Both the Bentwing-bat species may roost in the study area due to the suitability of cave habitat and would both use the forested parts of the study area for foraging purposes.

Eastern Freetail-bat *Mormopterus norfolkensis*

The tree hollow-dwelling Eastern Freetail-bat was recorded by echolocation detectors from a variety of habitats. It was recorded at one location in 2007 and four locations in 2008. In 2010, the species was recorded at three different sites with 15 bat passes counted. It was found in a range of habitat from Grassy Woodland to Dry Sclerophyll Forest with a shrub/grass understorey. This species appears to roost and forage in a variety of habitats across the study area.

An example of call signatures of the threatened bat species detected by **ecobiological** are given in Appendix 6.



Table 15: Threatened fauna species detected in study area

Scientific Name	Common Name	Conservation Status		Detection Method	Habitat	No. of individuals observed (where available)
		TSC Act	EPBC Act			
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V	-	Bird survey	DSF	Two individuals (a male and female) at one location in August 2008; AGC Woodward-Clyde 1994.
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Owl Call playback	DSF	Two individuals (likely to be a breeding pair) were sighted at one location in February 2010.
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	V	-	Opportunistic sightings / bird survey	GW / WSF / DSF	Six records of between 2 – 7 birds in April, July and November 2007 and 12 nest locations.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Bird survey	DSF / GW	Two individuals at one location in April 2007; six individuals at a second location in February and March 2010; three individuals at a third location in February 2010.
<i>Anseranas semipalmata</i>	Magpie Goose	V	-	Opportunistic	FW	One individual observed flying over wetland habitat in February 2010.
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Trapping survey	GW	An individual was trapped on 18/4/07 at Transect 3. An individual was trapped at the same location on 20/4/07.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	Trapping survey	DSF / GW	One capture of a male on 21/1/09 and a capture of an individual (sex not recorded) at the same transect on 23/1/09. An individual (sex not recorded) was captured on 4, 5 & 7 February 2010 at the same transect.
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	Trapping survey	DSF	One individual trapped on 7/2/2010 at Transect 14.
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-	Anabat Recording	GW / DSF	11 passes from three locations in March 2010.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-	Anabat Recording	WSF	Five locations in 2008, two locations in 2010; Hoye (1998); Hoye and Finney (1994).
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	Anabat Recording	GW / DSF	One location in 2007; four locations in 2008 and three locations in 2010.



Table 15 cont: Threatened fauna species detected in study area

Scientific Name	Common Name	Conservation Status		Detection Method	Habitat	No. of individuals observed (where available)
		TSC Act	EPBC Act			
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	Anabat Recording	Not available	Richards (2001).
<i>Myotis macropus</i>	Southern Myotis	V	-	Anabat Recording	Not available	Hoye and Finney (1994)
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Anabat Recording	Not available	Hoye and Finney (1994)
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	Bird survey	Not available	AGC Woodwood-Clyde (1994)
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	Bird survey	Not available	AGC Woodwood-Clyde (1994)
<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	Bird survey	Not available	AGC Woodwood-Clyde (1994)
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Bird survey	Not available	AGC Woodwood-Clyde (1994)
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Bird survey	Not available	AGC Woodwood-Clyde (1994)

Key to habitat codes:

DSF: Dry Sclerophyll Forest; WSF: Wet Sclerophyll Forest; GW: Grassy Woodland;

FW: Freshwater Wetland

An additional eight threatened species (three bat and five bird) are known from previous surveys of the study area (Table 15). These species were targeted during field surveys but were not detected.

The Hooded Robin, Brown Treecreeper, Speckled Warbler, Little Lorikeet and Diamond Firetail are all woodland bird species which have been recorded within the study area previously by AGC Woodwood-Clyde (1994). The Brown Treecreeper and Speckled Warbler were recorded by ecobiological (2009) in proximity of the Duralie mine site to the south.

The Yellow-bellied Sheath-tail-bat is a high flying species not often detected during bat surveys by **ecobiological**, though was detected north of Bowens Road by Richards (2001). Potential roosting and foraging habitat is present within the study area. The Southern Myotis was detected by Hoye and Finney (1994) and is usually associated with water bodies and riparian areas. Potential roosting and foraging habitat is present within the study area. Like the Southern Myotis, the Greater Broad-nosed Bat, detected in 1994 (Hoye and Finney 1994) has not been detected subsequently. This species roosts in tree hollows and potential roosting and foraging habitat is present within the study area.

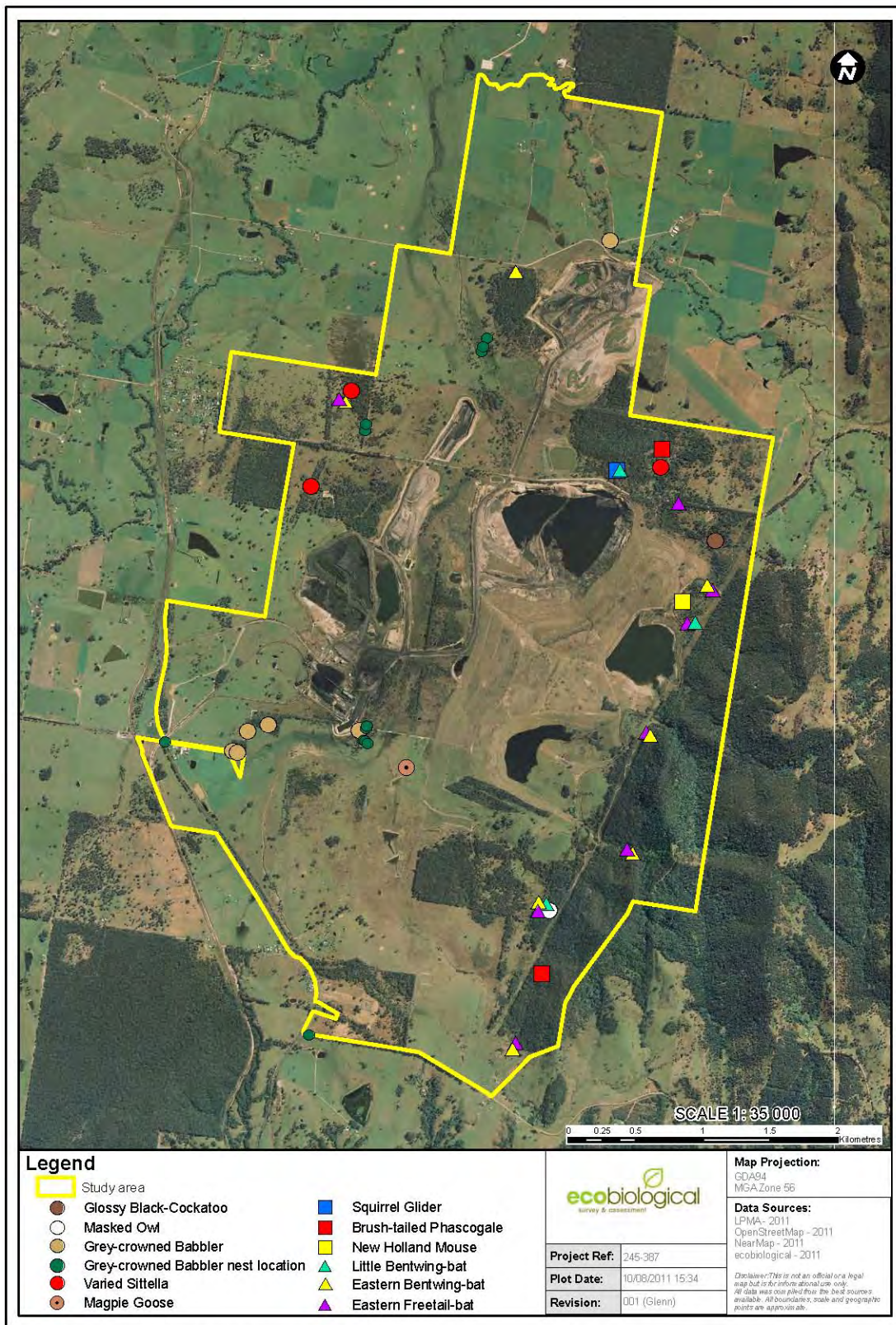


Figure 9: Aerial photograph of the study area showing the locations of threatened fauna detected during field surveys



3.8. Migratory Species

Nine listed migratory species (EPBC listed and listed under international conventions) were detected during surveys in the study area, the Cattle Egret, Australian Reed-warbler, Black-faced Monarch, Double-banded Plover, Latham's Snipe, Fork-tailed Swift, Great Egret, Rainbow Bee-eater and the White-bellied Sea-eagle (Table 16). All were recorded infrequently, with the Black-faced Monarch detected most often in the more densely vegetated upslope Spotted Gum/Broad-leaved Mahogany Forest areas.

Cattle Egret, Australian Reed-warbler, Double-banded Plover, Latham's Snipe and the Great Egret were found in the lower slope habitats associated with wetlands or standing water.

Table 16: Listed migratory fauna species detected during surveys.

Scientific Name	Common Name	Survey Method	No. of individuals observed
<i>Acrocephalus australis</i> ^B	Australian Reed-warbler	Bird survey	Two at two locations in 2008
<i>Monarcha melanopsis</i> ^{B, M}	Black-faced Monarch	Bird survey	Four records at four locations in 2008/09
<i>Ardea ibis</i> ^{C, J, M}	Cattle Egret	Bird survey	One record in 2007
<i>Charadrius bicinctus</i> ^B	Double-banded Plover	Bird survey	One record in 2010
<i>Gallinago hardwickii</i>	Latham's Snipe	Bird survey	One record in 2010
<i>Apus pacificus</i> ^{C, J, M, R}	Fork-tailed Swift	Bird survey	One record in 2010
<i>Ardea alba</i> ^{C, J, M}	Great Egret	Bird survey	One record in 2008
<i>Merops ornatus</i> ^{J, M}	Rainbow Bee-eater	Bird survey	One record in 2010
<i>Haliaeetus leucogaster</i> ^{C, M}	White-bellied Sea-Eagle	Bird survey	Two records one in 2008, one in 2010

Listed Categories: B, C, J, M, R (Bonn Convention/CAMBA/JAMBA/EPBC/RoKAMBA)



4. Conclusions

Field surveys of the study area were conducted between April 2007 and March 2010. The key findings are summarised below.

A total of 178 fauna species were recorded within the study area (consisting of 13 frog, 13 reptile, 121 bird and 31 mammal species). Two birds (Common Starling and Spotted Dove) and five of the mammals detected were exotic species (Rabbit, Hare, Cat, Fox and House Mouse). Eleven (11) threatened fauna species were recorded during the surveys, the Grey-crowned Babbler, Glossy Black-Cockatoo, Varied Sittella, Magpie Goose, Masked Owl, Brush-tailed Phascogale, Squirrel Glider, New Holland Mouse, Little Bentwing-bat, Eastern Bentwing-bat and the Eastern Freetail-bat. An additional three threatened bat species are known from previous surveys of the study area.

Nine listed migratory species (EPBC listed and listed under international conventions) were detected during surveys in the study area; the Cattle Egret, Australian Reed-warbler, Black-faced Monarch, Double-banded Plover, Latham's Snipe, Fork-tailed Swift, Great Egret, Rainbow Bee-eater and the White-bellied Sea-eagle.



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Appendix 1: Fauna survey data

Label number	Type of survey conducted	Date	Latitude	Longitude
Mammal Surveys				
Anabat Locations				
1	Anabat Call Recording	21/8/2008	151.9652516	-32.16138569
2	Anabat Call Recording	21/8/2008	151.974646	-32.14873438
3	Anabat Call Recording	21/8/2008	151.9758144	-32.14065389
4	Anabat Call Recording	20/8/2008	151.9811274	-32.13111377
5	Anabat Call Recording	20/8/2008	151.9659	-32.1096
6	Anabat Call Recording	20/1/2009 & 21/1/2009	151.9543889	-32.14030556
7	Anabat Call Recording	20/1/2009 & 21/1/2009	151.9736944	-32.12358333
8	Anabat Call Recording	20/1/2009 & 21/1/2009	151.9735278	-32.12238889
9	Anabat Call Recording	16/7/2007 & 17/7/2007	151.9785	-32.12525
10	Anabat Call Recording	20/1/2009 & 21/1/2009	151.9511111	-32.12130556
11	Anabat Call Recording	16/7/2007	151.9575556	-32.16208333
12	Anabat Call Recording	20/1/2009 & 21/1/2009	151.9737641	-32.1238634
13	Anabat Call Recording	19/4/2007 & 27/11/2007	151.962457	-32.15190831
14	Anabat Call Recording	19/4/2007 & 16/7/2007	151.9548339	-32.16076363
15	Anabat Call Recording	18/4/2007 & 27/11/2007	151.962863	-32.15299113
16	Anabat Call Recording	18/03/2010	151.9739572	-32.12296564
17	Anabat Call Recording	18/03/2010	151.9523524	-32.1182297
18	Anabat Call Recording	18/03/2010	151.9677707	-32.15203777
19	Anabat Call Recording	18/03/2010	151.9796933	-32.13347781
Harp Trap Locations				
1	Harp Trap	16 - 21/04/2007	151.9655	-32.10933333
2	Harp Trap	16 - 21/04/2007	151.9540874	-32.13978875
3	Harp Trap	16 - 21/04/2007	151.9501889	-32.12425
4	Harp Trap	16 - 21/04/2007	151.9810167	-32.13065126
5	Harp Trap	16 - 21/04/2007	151.9810434	-32.13066987
6	Harp Trap	2 - 23/01/2009	151.9757725	-32.14048583
7	Harp Trap	2 - 23/01/2009	151.9760464	-32.15164675
8	Harp Trap	2 - 23/01/2009	151.967764	-32.15579699
9	Harp Trap	2 - 23/01/2009	151.9737641	-32.1238634
10	Harp Trap	2 - 23/01/2009	151.962457	-32.15190831
11	Harp Trap	2 - 6/02/2010	151.9548339	-32.16076363
12	Harp Trap	2 - 6/02/2010	151.9772448	-32.12161432
13	Harp Trap	2 - 6/02/2010	151.9800024	-32.13247842
14	Harp Trap	2 - 6/02/2010	151.9537064	-32.11777277
Trapping Transect Locations				
1	Elliott As, Bs, hair tubes, cages	16 - 21/04/2007	151.9654	-32.11
2	Elliott As, Bs, hair tubes, cages	16 - 21/04/2007	151.9533	-32.1253
3	Elliott As, Bs, hair tubes, cages	16 - 21/04/2007	151.9736	-32.123



Label number	Type of survey conducted	Date	Latitude	Longitude
Mammal Surveys cont.				
Trapping Transect Locations cont.				
4	Elliott As, Bs, hair tubes, cages	16 - 21/04/2007	151.9537	-32.1405
5	Elliott As, Bs, hair tubes, cages	16 - 21/04/2007	151.9537	-32.1405
6	Elliott As, Bs, hair tubes, cages	2 - 23/01/2009	151.9538	-32.1608
7	Elliott As, Bs, hair tubes, cages	2 - 23/01/2009	151.9759	-32.1414
8	Elliott As, Bs, hair tubes, cages	2 - 23/01/2009	151.9765	-32.1509
9	Elliott As, Bs, hair tubes, cages	2 - 23/01/2009	151.9654	-32.11
10	Elliott As, Bs, hair tubes, cages	2 - 23/01/2009	151.9674	-32.1568
11	Elliott As, Bs, hair tubes, cages	2 - 6/02/2010	151.9679929	-32.15250607
12	Elliott As, Bs, hair tubes, cages	2 - 6/02/2010	151.9772448	-32.12161432
13	Elliott As, Bs, hair tubes, cages	2 - 6/02/2010	151.9800024	-32.13247842
14	Elliott As, Bs, hair tubes, cages	2 - 6/02/2010	151.9537064	-32.11777277
Hairrope Transect				
1	Hair Tubes only	28/09 - 1/10/2010	151.9701	-32.1513
Bird Surveys				
Owl Call Playback Locations				
1	Owl Call Playback	15/03/2007 & 26/04/2007	151.9736944	-32.12358333
2	Owl Call Playback	15/03/2007 & 26/04/2007	151.9735278	-32.12238889
3	Owl Call Playback	15/03/2007 & 26/04/2007	151.9785	-32.12525
4	Owl Call Playback	15/03/2007 & 26/04/2007	151.9511111	-32.12130556
5	Owl Call Playback	15/03/2007 & 26/04/2007	151.9575556	-32.16208333
6	Owl Call Playback	22/08/2008	151.9628381	-32.15243055
7	Owl Call Playback	22/08/2008	151.9656667	-32.10927778
8	Owl Call Playback	22/08/2008	151.9737641	-32.1238634
9	Owl Call Playback	22/08/2008	151.962457	-32.15190831
10	Owl Call Playback	22/08/2008	151.9548339	-32.16076363
11	Owl Call Playback	22/08/2008	151.962863	-32.15299113
12	Owl Call Playback	22/01/2009	151.9757296	-32.14059077
13	Owl Call Playback	22/01/2009	151.9670905	-32.15588129
14	Owl Call Playback	22/01/2009	151.975617	-32.15150185
15	Owl Call Playback	22/01/2009	151.9757752	-32.14061533
16	Owl Call Playback	22/01/2009	151.9612601	-32.15228076
17	Owl Call Playback	4 - 7/02/210 & 28 - 30/03/2010	151.9661288	-32.15369147
18	Owl Call Playback	4 - 7/02/210 & 28 - 30/03/2010	151.9760138	-32.14006671
19	Owl Call Playback	4 - 7/02/210 & 28 - 30/03/2010	151.9797946	-32.12160297
20	Owl Call Playback	4 - 7/02/210 & 28 - 30/03/2010	151.9531757	-32.11796117



Label number	Type of survey conducted	Date	Latitude	Longitude
Bird Plot Survey Locations				
1	Bird Plot Survey	13/08/2009 & 20/01/2009	151.9691	-32.1506
2	Bird Plot Survey	13/08/2009 & 20/01/2009	151.9671	-32.1608
3	Bird Plot Survey	12/08/2009 & 21/01/2009	151.9785	-32.1488
4	Bird Plot Survey	12/08/2009 & 21/01/2009	151.9755	-32.1498
5	Bird Plot Survey	12/08/2009 & 21/01/2009	151.973	-32.1496
6	Bird Plot Survey	11/08/2008, 20/01/2009 & 22/01/2009	151.9758	-32.1372
7	Bird Plot Survey	11/08/2008, 20/01/2009, 3/02/2010 & 18/03/2010	151.9692	-32.1406
8	Bird Plot Survey	12/08/2008	151.9693	-32.1446
9	Bird Plot Survey	17/04/2007 & 16/07/2007	151.9657	-32.1103
10	Bird Plot Survey	17/04/2007	151.9744	-32.1228
11	Bird Plot Survey	17/04/2007	151.9495	-32.1239
12	Bird Plot Survey	17/04/2007 & 27/11/2007	151.946	-32.1399
13	Bird Plot Survey	16/07/2007	151.9518	-32.1568
14	Bird Plot Survey	17/07/2007 & 28/11/2007	151.9632	-32.1147
15	Bird Plot Survey	2 - 3/02/2010 & 18/03/2010	151.9674	-32.1536
16	Bird Plot Survey	2/02/2010 & 19/03/2010	151.9771	-32.1228
17	Bird Plot Survey	2/02/2010 & 19/03/2010	151.9527	-32.1257
18	Bird Plot Survey	2/02/2010 & 19/03/2010	151.9528	-32.1175
19	Bird Plot Survey	3/02/2010 & 19/03/2010	151.9837	-32.1225
20	Bird Plot Survey	2/02/2010 & 3/02/2010	151.9704	-32.1034
21	Bird Plot Survey	11/08/2008 & 2/02/2010	151.9802	-32.1315
22	Bird Plot Survey	13/08/2008 & 20/01/2009	151.9621	-32.1501
23	Bird Plot Survey	11/08/2008 & 22/01/2009	151.976	-32.1426
24	Bird Plot Survey	13/08/2008 & 21/01/2009	151.959	-32.1502
Bird Transect Survey Locations				
1	Bird Transect Survey	11/08/2008	151.9814	-32.1278
2	Bird Transect Survey	12/08/2008	151.9687	-32.1553
3	Bird Transect Survey	13/08/2008	151.9794	-32.1387
Amphibian and Reptile Surveys				
Amphibian Survey Locations				
1	Amphibian Survey	27 - 28/11/2007	151.9627778	-32.11302778
2	Amphibian Survey	27 - 28/11/2007	151.9643889	-32.11594445
3	Amphibian Survey	27 - 28/11/2007	151.9771944	-32.12602778
4	Amphibian Survey	27 - 28/11/2007	151.9618611	-32.11336111



Label number	Type of survey conducted	Date	Latitude	Longitude
Amphibian and Reptile Surveys cont.				
Amphibian Survey Locations cont.				
5	Amphibian Survey	27 - 28/11/2007	151.9641944	-32.11725
6	Amphibian Survey	27 - 28/11/2007	151.9643056	-32.11427778
7	Amphibian Survey	27 - 28/11/2007	151.9796667	-32.12741667
8	Amphibian Survey	27 - 28/11/2007	151.9783333	-32.1265
9	Amphibian Survey	27 - 28/11/2007	151.9770278	-32.12422222
10	Amphibian Survey	27 - 28/11/2007	151.9743056	-32.12219445
11	Amphibian Survey	27 - 28/11/2007	151.9731944	-32.12369445
12	Amphibian Survey	27 - 28/11/2007	151.9514444	-32.15752778
13	Amphibian Survey	27 - 28/11/2007	151.9542222	-32.15783333
14	Amphibian Survey	20/01/2009	151.9817369	-32.13028807
15	Amphibian Survey	21/01/2009	151.9612287	-32.15136403
16	Amphibian Survey	21/01/2009	151.9559207	-32.14993198
17	Amphibian Survey	21/01/2009	151.9544966	-32.15110201
18	Amphibian Survey	20/01/2009	151.9781382	-32.13278697
19	Amphibian Survey	20/01/2009	151.9730416	-32.13521269
20	Amphibian Survey	20/01/2009	151.9718238	-32.14046379
21	Amphibian Survey	20/01/2009	151.9695479	-32.14069655
22	Amphibian Survey	20/01/2009	151.969718	-32.14464703
23	Amphibian Survey	21/01/2009	151.9787442	-32.14175879
24	Amphibian Survey	21/01/2009	151.9637428	-32.15984752
25	Amphibian Survey	21/01/2009	151.9636331	-32.1633551
26	Amphibian Survey	2/02/2010	151.969345	-32.108241
27	Amphibian Survey	2/02/2010	151.97034	-32.147477
28	Amphibian Survey	2/02/2010	151.970073	-32.149341
29	Amphibian Survey	2/02/2010	151.965968	-32.14408
30	Amphibian Survey	2/02/2010	151.965536	-32.153236
31	Amphibian Survey	2/02/2010	151.967186	-32.150207
32	Amphibian Survey	2/02/2010	151.968412	-32.146511
33	Amphibian Survey	2/02/2010	151.970185	-32.144833
34	Amphibian Survey	2/02/2010	151.981268	-32.130926
35	Amphibian Survey	3/02/2010	151.974958	-32.116493
36	Amphibian Survey	3/02/2010	151.973246	-32.10767
37	Amphibian Survey	3/02/2010	151.969345	-32.108241



Label number	Type of survey conducted	Date	Latitude	Longitude
Amphibian and Reptile Surveys cont.				
Targeted Amphibian Survey Locations				
1	Targeted Amphibian Survey	28/09/2010	151.9632	-32.1242
2	Targeted Amphibian Survey	29/09/2010	151.9604	-32.1301
3	Targeted Amphibian Survey	30/09/2010	151.9575	-32.1401
Reptile Survey Locations				
1	Reptile Run	16/04/2007	151.9660556	-32.10941667
2	Reptile Run	16/04/2007	151.9736111	-32.12352778
3	Reptile Run	21/01/2009	151.9840111	-32.12630172
4	Reptile Run	20/01/2009	151.9758133	-32.14046253
5	Reptile Run	20/01/2009	151.9758787	-32.15162764
6	Reptile Run	21/01/2009	151.9672382	-32.15566169
7	Reptile Run	21/01/2009	151.9613342	-32.1522992
8	Reptile Run	1 - 5/11/2010	151.9623	-32.1509
Diurnal Reptile Survey Locations				
1	Diurnal Reptile survey	2/02/2010	151.967807	-32.152
2	Diurnal Reptile survey	2/02/2010	151.97029	-32.144
3	Diurnal Reptile survey	2/02/2010	151.952771	-32.1181
4	Diurnal Reptile survey	2/02/2010	151.979458	-32.1333
Nocturnal Herpetological Survey Locations				
1	Nocturnal Herp survey	2/02/2010	151.966248	-32.153
2	Nocturnal Herp survey	3/02/2010	151.976233	-32.1403
3	Nocturnal Herp survey	3/02/2010	151.979235	-32.14
4	Nocturnal Herp survey	28/11/2010	151.9611	-32.1497
5	Nocturnal Herp survey	28/11/2010	151.9584	-32.1504

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Appendix 2: Birds recorded in study area

(a) 2007

Scientific Name	Common Name	Conservation Status	9	10	11	12	13	14	RA
<i>Gymnorhina tibicen</i>	Australian Magpie		+	+	+	+	+	+	A
<i>Corvus coronoides</i>	Australian Raven		+	+	+	+	+	+	A
<i>Chenonetta jubata</i>	Australian Wood Duck		+	+		+			C
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				+				O
<i>Acanthiza pusilla</i>	Brown Thornbill		+	+	+				C
<i>Ardea ibis</i>	Cattle Egret	Migratory sp. (EPBC Act)	+						O
<i>Coracina tenuirostris</i>	Cicadabird							+	O
<i>Ocyphaps lophotes</i>	Crested Pigeon		+			+	+	+	C
<i>Platycercus elegans</i>	Crimson Rosella		+	+	+				C
<i>Taeniopygia bichenovii</i>	Double-barred Finch				+				O
<i>Platycercus eximius</i>	Eastern Rosella		+	+	+	+	+		C
<i>Eopsaltria australis</i>	Eastern Yellow Robin			+			+		U
<i>Cacatua roseicapilla</i>	Galah		+						O
<i>Pachycephala pectoralis</i>	Golden Whistler				+				O
<i>Cracticus torquatus</i>	Grey Butcherbird					+			O
<i>Rhipidura fuliginosa</i>	Grey Fantail		+	+	+		+	+	C
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		+	+	+		+		C
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	Vulnerable (TSC Act)				+			U
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		+		+		+	+	C
<i>Meliphaga lewinii</i>	Lewin's Honeyeater							+	O
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant			+					O
<i>Grallina cyanoleuca</i>	Magpie-lark		+		+	+	+		C
<i>Vanellus miles</i>	Masked Lapwing		+			+		+	C
<i>Philemon corniculatus</i>	Noisy Friarbird				+				O
<i>Manorina melanocephala</i>	Noisy Miner		+	+	+	+	+	+	A
<i>Oriolus sagittatus</i>	Olive-backed Oriole							+	O
<i>Aviceda subcristata</i>	Pacific Baza						+		O
<i>Anas superciliosa</i>	Pacific Black Duck					+			O
<i>Centropus phasianinus</i>	Pheasant Coucal					+		+	U
<i>Cracticus nigrogularis</i>	Pied Butcherbird		+	+	+				C
<i>Strepera graculina</i>	Pied Currawong							+	O
<i>Anthochaera carnunculata</i>	Red Wattlebird						+		O

2007 cont.

Scientific Name	Common Name	Conservation Status	9	10	11	12	13	14	RA
<i>Neochmia temporalis</i>	Red-browed Finch		+		+				U
<i>Pachycephala rufiventris</i>	Rufous Whistler		+	+	+			+	C
<i>Pardalotus punctatus</i>	Spotted Pardalote			+			+	+	C
<i>Threskiornis spinicollis</i>	Straw-necked Ibis		+						O
<i>Pardalotus striatus</i>	Striated Pardalote				+		+	+	C
<i>Acanthiza lineata</i>	Striated Thornbill		+				+		U
<i>Malurus cyaneus</i>	Superb Fairy-wren			+	+				U
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Vulnerable (TSC Act)			+				O
<i>Malurus lamberti</i>	Variegated Fairy-wren		+	+	+				C
<i>Hirundo neoxena</i>	Welcome Swallow			+					O
<i>Egretta novaehollandiae</i>	White-faced Heron					+			O
<i>Ardea pacifica</i>	White-necked Heron					+			O
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater				+				O
<i>Gerygone olivacea</i>	White-throated Gerygone				+			+	U
<i>Cormobates leucophaeus</i>	White-throated Treecreeper		+	+	+		+	+	C
<i>Corcorax melanorhamphos</i>	White-winged Chough				+				O
<i>Rhipidura leucophrys</i>	Willie Wagtail		+						O
<i>Leucosarcia melanoleuca</i>	Wonga Pigeon						+		O
<i>Acanthiza nana</i>	Yellow Thornbill		+	+	+		+	+	C
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater		+	+	+		+	+	C
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				+				O
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo		+				+		U
Total species at each site			26	20	28	14	20	19	

Relative abundance (RA): O = one sighting only; U = uncommon; C = common; A = abundant.

For survey number locations see Figure 4.

(b) 2008/2009

Scientific Name	Common Name	Conservation Status	1	3	4	5	6	7	8	16	21	22	23	24	T 1	T 2	T 3	RA
<i>Anhinga novaehollandiae</i>	Australasian Darter							+										O
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe						+	+										U
<i>Anas rhynchotis</i>	Australasian Shoveler														+			O
<i>Alisterus scapularis</i>	Australian King-Parrot				+									+	+			U
<i>Gymnorhina tibicen</i>	Australian Magpie		+	+	+		+	+	+	+	+	+	+	+	+			A
<i>Corvus coronoides</i>	Australian Raven		+	+	+		+			+	+	+	+	+		+		C
<i>Acrocephalus australis</i>	Australian Reed-warbler	Migratory sp. (EPBC Act)						+					+					U
<i>Chenonetta jubata</i>	Australian Wood Duck							+				+	+					U
<i>Geopelia humeralis</i>	Bar-shouldered Dove		+				+											U
<i>Manorina melanophrys</i>	Bell Miner		+	+	+	+					+							U
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike			+	+	+	+			+								U
<i>Monarcha melanopsis</i>	Black-faced Monarch	Migratory sp. (EPBC Act)	+	+		+		+										U
<i>Gerygone mouki</i>	Brown Gerygone		+	+									+					U
<i>Acanthiza pusilla</i>	Brown Thornbill		+	+	+	+	+			+			+		+	+		C
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater														+			O
<i>Phaps elegans</i>	Brush Bronzewing						+											O
<i>Acanthiza reguloides</i>	Buff-rumped Thornbill			+	+					+	+			+				U
<i>Coracina tenuirostris</i>	Cicadabird			+		+												U
<i>Sturnus vulgaris</i> (Introduced sp.)	Common Starling		+															O
<i>Platycercus elegans</i>	Crimson Rosella		+		+	+						+						U
<i>Eurystomus orientalis</i>	Dollarbird									+								O
<i>Taeniopygia bichenovii</i>	Double-barred Finch						+											O
<i>Gallinula tenebrosa</i>	Dusky Moorhen							+	+				+					U
<i>Platycercus eximius</i>	Eastern Rosella		+					+	+			+	+					U
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill		+	+	+		+			+			+		+	+		C
<i>Psophodes olivaceus</i>	Eastern Whipbird		+	+	+	+												U
<i>Eopsaltria australis</i>	Eastern Yellow Robin			+	+	+	+			+			+		+	+	+	C
<i>Fulica atra</i>	Eurasian Coot							+										O
<i>Petrochelidon ariel</i>	Fairy Martin							+										O
<i>Lichenostomus fuscus</i>	Fuscous Honeyeater													+				O
<i>Cacatua roseicapilla</i>	Galah										+							O

2008/2009 cont.

Scientific Name	Common Name	Conservation Status	1	3	4	5	6	7	8	16	21	22	23	24	T 1	T 2	T 3	RA
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	Vulnerable (TSC Act)													+			O
<i>Pachycephala pectoralis</i>	Golden Whistler		+	+	+	+	+						+			+		C
<i>Cisticola exilis</i>	Golden-headed Cisticola							+		+			+					U
<i>Phalacrocorax carbo</i>	Great Cormorant							+										O
<i>Ardea alba</i>	Great Egret	Migratory sp. (EPBC Act)						+										O
<i>Cracticus torquatus</i>	Grey Butcherbird				+		+			+	+	+	+					U
<i>Rhipidura fuliginosa</i>	Grey Fantail		+	+	+	+	+	+		+	+	+	+		+	+	+	C
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		+				+						+					U
<i>Aythya australis</i>	Hardhead							+										O
<i>Dacelo novaeguineae</i>	Laughing Kookaburra			+	+		+	+	+	+		+	+					C
<i>Myiagra rubecula</i>	Leaden Flycatcher			+		+				+			+					U
<i>Meliphaga lewinii</i>	Lewin's Honeyeater		+	+	+	+		+			+				+	+	+	C
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant						+											O
<i>Megalurus gramineus</i>	Little Grassbird												+					O
<i>Grallina cyanoleuca</i>	Magpie-lark							+	+						+			U
<i>Vanellus miles</i>	Masked Lapwing						+	+	+				+					U
<i>Falco cenchroides</i>	Nankeen Kestrel							+										O
<i>Philemon corniculatus</i>	Noisy Friarbird			+	+	+					+		+					U
<i>Manorina melanocephala</i>	Noisy Miner							+	+	+	+	+	+	+				C
<i>Anas superciliosa</i>	Pacific Black Duck						+	+	+									U
<i>Centropus phasianinus</i>	Pheasant Coucal			+														O
<i>Cracticus nigrogularis</i>	Pied Butcherbird			+	+					+	+	+	+					U
<i>Phalacrocorax varius</i>	Pied Cormorant							+	+									U
<i>Strepera graculina</i>	Pied Currawong		+	+	+	+	+	+		+	+		+			+		C
<i>Porphyrio porphyrio</i>	Purple Swampphen								+				+					U
<i>Anthochaera carnunculata</i>	Red Wattlebird		+		+	+				+		+	+					U
<i>Malurus melanocephalus</i>	Red-backed Fairy-wren							+										O
<i>Neochmia temporalis</i>	Red-browed Finch		+	+	+	+	+	+		+	+		+	+	+			C
<i>Pachycephala rufiventris</i>	Rufous Whistler						+			+			+					U
<i>Zosterops lateralis</i>	Silvereye		+	+	+	+	+	+			+				+	+		C
<i>Stipiturus malachurus</i>	Southern Emu-wren										+				+			U

2008/2009 cont.

Scientific Name	Common Name	Conservation Status	1	3	4	5	6	7	8	16	21	22	23	24	T 1	T 2	T 3	RA
<i>Pardalotus punctatus</i>	Spotted Pardalote			+	+	+	+			+	+	+	+	+	+	+	+	C
<i>Pardalotus striatus</i>	Striated Pardalote			+						+		+	+					U
<i>Acanthiza lineata</i>	Striated Thornbill		+	+	+	+				+	+	+					+	C
<i>Malurus cyaneus</i>	Superb Fairy-wren		+	+	+	+	+	+		+	+		+	+	+	+		C
<i>Hirundo nigricans</i>	Tree Martin							+										O
<i>Malurus lamberti</i>	Variegated Fairy-wren		+	+	+	+	+				+		+		+	+	+	C
<i>Aquila audax</i>	Wedge-tailed Eagle									+			+					U
<i>Hirundo neoxena</i>	Welcome Swallow							+										O
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Migratory sp. (EPBC Act)						+										O
<i>Sericornis frontalis</i>	White-browed Scrubwren		+	+	+	+				+	+		+		+			C
<i>Egretta novaehollandiae</i>	White-faced Heron						+	+	+									U
<i>Columba leucomela</i>	White-headed Pigeon					+												O
<i>Melithreptus lunatus</i>	White-naped Honeyeater			+	+	+											+	U
<i>Gerygone olivacea</i>	White-throated Gerygone			+	+			+		+			+					U
<i>Cormobates leucophaeus</i>	White-throated Treecreeper		+	+	+	+	+			+	+			+	+	+	+	C
<i>Corcorax melanorhamphos</i>	White-winged Chough				+					+								U
<i>Rhipidura leucophrys</i>	Willie Wagtail							+					+	+				U
<i>Acanthiza nana</i>	Yellow Thornbill			+	+		+			+								U
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater		+	+	+	+				+	+	+	+	+	+	+	+	C
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill																	U
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo					+												O
Total species at each site			26	34	33	27	28	34	11	30	22	15	36	12	20	14	9	

Relative abundance (RA): O = one sighting only; U = uncommon; C = common; A = abundant.

For survey number locations see Figure 4.

(c) 2010

Scientific Name	Common Name	Conservation Status	2	7	15	16	17	18	19	20	OPP	RA
<i>Anhinga novaehollandiae</i>	Australasian Darter			+								O
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe			+								O
<i>Alisterus scapularis</i>	Australian King-Parrot		+		+	+		+		+		C
<i>Gymnorhina tibicen</i>	Australian Magpie		+	+	+	+	+	+	+	+		
<i>Corvus coronoides</i>	Australian Raven		+	+	+	+		+	+	+		C
<i>Chenonetta jubata</i>	Australian Wood Duck			+								O
<i>Geopelia humeralis</i>	Bar-shouldered Dove				+	+		+	+	+		C
<i>Manorina melanophrys</i>	Bell Miner				+							O
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		+		+	+	+			+		C
<i>Elsemyornis melanops</i>	Black-fronted Dotterel			+								O
<i>Elanus axillaris</i>	Black-shouldered Kite						+					O
<i>Himantopus himantopus</i>	Black-winged Stilt			+								O
<i>Acanthiza pusilla</i>	Brown Thornbill		+		+	+	+	+				C
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater					+	+	+				U
<i>Acanthiza reguloides</i>	Buff-rumped Thornbill		+		+	+	+	+		+		C
<i>Anas castanea</i>	Chestnut Teal			+								O
<i>Sturnus vulgaris</i> (Introduced sp.)	Common Starling								+			O
<i>Ocyphaps lophotes</i>	Crested Pigeon			+					+			U
<i>Platycercus elegans</i>	Crimson Rosella		+									O
<i>Eurystomus orientalis</i>	Dollarbird					+						O
<i>Charadrius bicinctus</i>	Double-banded Plover	Migratory sp. (EPBC Act)		+								O
<i>Taeniopygia bichenovii</i>	Double-barred Finch					+	+	+				U
<i>Platycercus eximius</i>	Eastern Rosella		+	+		+		+	+			C
<i>Psophodes olivaceus</i>	Eastern Whipbird				+			+				U
<i>Eopsaltria australis</i>	Eastern Yellow Robin		+		+	+	+	+		+		C
<i>Fulica atra</i>	Eurasian Coot			+								O
<i>Petrochelidon ariel</i>	Fairy Martin			+								O
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo		+					+				U
<i>Apus pacificus</i>	Fork-tailed Swift	Migratory sp. (EPBC Act)	+									O
<i>Lichenostomus fuscus</i>	Fuscous Honeyeater					+						O
<i>Pachycephala pectoralis</i>	Golden Whistler		+		+	+		+		+		C

2010 cont.

Scientific Name	Common Name	Conservation Status	2	7	15	16	17	18	19	20	OPP	RA
<i>Cisticola exilis</i>	Golden-headed Cisticola			+				+	+	+		U
<i>Phalacrocorax carbo</i>	Great Cormorant			+								O
<i>Podiceps cristatus</i>	Great Crested Grebe			+								O
<i>Cracticus torquatus</i>	Grey Butcherbird		+	+	+	+		+				C
<i>Rhipidura fuliginosa</i>	Grey Fantail		+		+	+	+	+		+		C
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		+									O
<i>Anas gracilis</i>	Grey Teal			+								O
<i>Aythya australis</i>	Hardhead			+								O
<i>Microeca fascians</i>	Jacky Winter									+		O
<i>Gallinago hardwickii</i>	Latham's Snipe	Migratory sp. (EPBC Act)		+								O
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		+		+	+		+	+			C
<i>Myiagra rubecula</i>	Leaden Flycatcher		+		+							U
<i>Meliphaga lewinii</i>	Lewin's Honeyeater		+									O
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant			+								O
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant			+					+			U
<i>Anseranas semipalmata</i>	Magpie Goose	Vulnerable (TSC Act)									+	O
<i>Grallina cyanoleuca</i>	Magpie-lark		+	+		+	+		+			C
<i>Vanellus miles</i>	Masked Lapwing			+					+			U
<i>Biziura lobata</i>	Musk Duck			+								O
<i>Philemon corniculatus</i>	Noisy Friarbird					+						O
<i>Manorina melanocephala</i>	Noisy Miner		+	+		+	+	+				C
<i>Psophodes olivaceus</i>	Eastern Whipbird				+			+				U
<i>Anas superciliosa</i>	Pacific Black Duck			+					+			U
<i>Centropus phasianinus</i>	Pheasant Coucal			+			+	+				U
<i>Cracticus nigrogularis</i>	Pied Butcherbird		+	+		+	+	+	+	+		C
<i>Strepera graculina</i>	Pied Currawong		+	+	+		+	+	+			C
<i>Porphyrio porphyrio</i>	Purple Swampphen								+			O
<i>Merops ornatus</i>	Rainbow Bee-eater	Migratory sp. (EPBC Act)							+			O
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet					+						O
<i>Anthochaera carnunculata</i>	Red Wattlebird		+	+								U
<i>Neochmia temporalis</i>	Red-browed Finch		+		+	+	+	+				C
<i>Pachycephala rufiventris</i>	Rufous Whistler				+	+	+	+	+	+		C
<i>Todiramphus sanctus</i>	Sacred Kingfisher				+				+			U
<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet		+									O

2010 cont.

Scientific Name	Common Name	Conservation Status	2	7	15	16	17	18	19	20	OPP	RA
<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater				+	+						U
<i>Zosterops lateralis</i>	Silvereye		+		+		+	+				U
<i>Stipiturus malachurus</i>	Southern Emu-wren		+									O
<i>Streptopelia chinensis</i> (Introduced sp.)	Spotted Dove							+				O
<i>Pardalotus punctatus</i>	Spotted Pardalote		+	+								U
<i>Pardalotus striatus</i>	Striated Pardalote		+					+				U
<i>Acanthiza lineata</i>	Striated Thornbill		+		+	+	+			+		C
<i>Malurus cyaneus</i>	Superb Fairy-wren		+		+	+	+	+	+	+		C
<i>Hirundo nigricans</i>	Tree Martin			+	+							U
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Vulnerable (TSC Act)				+		+				U
<i>Malurus lamberti</i>	Variegated Fairy-wren		+		+	+	+	+				C
<i>Aquila audax</i>	Wedge-tailed Eagle					+						O
<i>Hirundo neoxena</i>	Welcome Swallow			+					+			U
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Migratory sp. (EPBC Act)		+								O
<i>Sericornis frontalis</i>	White-browed Scrubwren		+		+			+				U
<i>Egretta novaehollandiae</i>	White-faced Heron			+								O
<i>Melithreptus lunatus</i>	White-naped Honeyeater							+				O
<i>Gerygone olivacea</i>	White-throated Gerygone		+			+	+	+				U
<i>Cormobates leucophaeus</i>	White-throated Treecreeper		+		+	+	+	+		+		C
<i>Corcorax melanorhamphos</i>	White-winged Chough		+									O
<i>Rhipidura leucophrys</i>	Willie Wagtail		+	+			+	+				U
<i>Acanthiza nana</i>	Yellow Thornbill		+		+	+	+	+				C
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater		+		+	+	+	+		+		C
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill								+			O
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo		+				+					U
Total species at each site			41	37	30	34	26	37	21	17	2	

OPP = Opportunistic; Relative abundance (RA): O = one sighting only; U = uncommon; C = common; A = abundant.

For survey number locations see Figure 4.

Appendix 3: Non-flying fauna and nocturnal birds recorded within the study area

Scientific Name	Common Name	Conservation Status	2007								2009							
			Water body	1	2	3	4	5	OP P	RA	Water body	6	7	8	9	10	OP P	R A
Reptilia																		
<i>Ctenotus robustus</i>	Robust Ctenotus												x	x		x		C
<i>Lampropholis delicata</i>	Garden Sun-skink														x			U
<i>Physignathus lesueurii lesueurii</i>	Eastern Water Dragon											x					x	U
<i>Varanus varius</i>	Lace Monitor														x	x		U
Amphibia																		
<i>Crinia signifera</i>	Common Eastern Froglet		x						x	U						x		U
<i>Limnodynastes peronii</i>	Striped Marsh Frog		x							C	x	x	x		x	x		A
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog		x						x	C	x	x						U
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		x							C	x				x	x		C
<i>Litoria latopalmata</i>	Broad-palmed Frog		x							C	x			x	x	x		C
<i>Litoria peronii</i>	Peron's Tree Frog		x							C	x			x	x			C
<i>Litoria tyleri</i>	Tyler's Tree Frog		x							U	x				x			U
<i>Litoria wilcoxi</i>	Rocky River Frog		x							U	x							U
<i>Mixophyes fasciolatus</i>	Great Barred Frog		x							U								
<i>Uperoleia fusca</i>	Dusky Toadlet		x							C								
<i>Uperoleia laevigata</i>	Eastern Toadlet										x							O
Mammalia																		
<i>Antechinus stuartii</i>	Brown Antechinus				x					U			x	x	x	x		C
<i>Isodon macrourus</i>	Northern Brown Bandicoot											x						O
<i>Perameles nasuta</i>	Long-nosed Bandicoot																	
<i>Macropus giganteus</i>	Eastern Grey Kangaroo																x	U
<i>Macropus rufogriseus</i>	Red-necked Wallaby		x							U							x	U
<i>Petaurus norfolcensis</i>	Squirrel Glider	Vulnerable (TSC Act)			x					U								
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Vulnerable (TSC Act)														x		O
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum								x	O								
<i>Rattus fuscipes</i>	Bush Rat											x		x	x			C
<i>Tachyglossus aculeatus</i>	Echidna												x					U
<i>Trichosurus vulpecula</i>	Common Brushtail Possum									U				x				U

Scientific Name	Common Name	Conservation Status	2007							2009									
			Water body		1	2	3	4	5	OP P	RA	Water body	6	7	8	9	10	OP P	R A
Mammalia cont.																			
<i>Mus domesticus</i> (Introduced sp.)	House Mouse													x				O	
<i>Vulpes vulpes</i> (Introduced sp.)	Red Fox			x						U									
<i>Felis catus</i> (Introduced sp.)	House Cat								x	U									
<i>Oryctolagus cuniculus</i> (Introduced sp.)	European Rabbit			x					x	C							x	C	
<i>Lepus capensis</i> (Introduced sp.)	Brown Hare			x					x	U									
Nocturnal birds																			
<i>Aegotheles cristatus</i>	Australian Owlet-Nightjar				x					U									
<i>Eurostopodus mystacalis</i>	White-throated Nightjar															x		U	
<i>Ninox novaeseelandiae</i>	Southern Boobook					x				U									
<i>Podargus strigoides</i>	Tawny Frogmouth					x				U					x			U	
<i>Tyto alba</i>	Barn Owl																		
Total species at each site			10		1	3	3	2	0			9	5	4	8	10	7		

Relative abundance (RA): O = one sighting only; U = uncommon; C = common; A = abundant.

1 - 10: refers to trapping transect numbering (Figure 3); OPP = opportunistic record.

Scientific Name	Common Name	Conservation Status	2010						
			Water body searches	11	12	13	14	OPP	RA
Reptilia									
<i>Chelodina longicollis</i>	Snake-necked Tortoise		x					x	C
<i>Cryptoblepharus virgatus</i>	Wall Lizard				x				U
<i>Ctenotus robustus</i>	Robust Ctenotus			x					C
<i>Eulamprus heatwolei</i>	Heatwole's Water Skink				x	x			U
<i>Lampropholis caligula</i>	Barrington Sun-skink			x					U
<i>Lampropholis guichenoti</i>	Grass Sun-skink				x		x		U
<i>Lampropholis delicata</i>	Garden Sun-skink								U
<i>Physignathus lesueurii lesueurii</i>	Eastern Water Dragon		x					x	C
<i>Pogona barbata</i>	Eastern Bearded Dragon							x	U
<i>Pseudechis porphyriacus</i>	Red-belly Black Snake			x					O
<i>Rhinoplocephalus nigrescens</i>	Small-eyed Snake							x	U
<i>Tiliqua scincoides</i>	Blue-tongued Lizard								R
<i>Varanus varius</i>	Lace Monitor			x					U
Amphibia									
<i>Crinia signifera</i>	Common Eastern Froglet		x						U
<i>Limnodynastes peronii</i>	Striped Marsh Frog		x	x	x		x		C
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog		x		x				A
<i>Litoria dentata</i>	Bleating Tree Frog					x			U
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		x			x	x		C
<i>Litoria latopalmata</i>	Broad-palmed Frog		x	x	x			x	A
<i>Litoria peronii</i>	Peron's Tree Frog		x			x			C
<i>Litoria tyleri</i>	Tyler's Tree Frog		x	x	x		x		U
<i>Litoria wilcoxi</i>	Rocky River Frog		x						O
<i>Mixophyes fasciolatus</i>	Great Barred Frog							x	U
<i>Pseudophryne coriacea</i>	Red-backed Toadlet		x	x	x	x			C
<i>Uperoleia fusca</i>	Dusky Toadlet		x						A
Mammalia									
<i>Antechinus stuartii</i>	Brown Antechinus			x	x	x	x		C

Scientific Name	Common Name	Conservation Status	2010						
			Water body searches	11	12	13	14	OPP	RA
Mammalia cont.									
<i>Perameles nasuta</i>	Long-nosed Bandicoot			x					U
<i>Macropus giganteus</i>	Eastern Grey Kangaroo							x	U
<i>Macropus robustus</i>	Wallaroo			x	x	x	x	x	C
<i>Macropus rufogriseus</i>	Red-necked Wallaby			x				x	U
<i>Petaurus breviceps</i>	Sugar Glider			x			x		U
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Vulnerable (TSC Act)			x				O
<i>Trichosurus vulpecula</i>	Common Brushtail Possum			x	x	x	x		C
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	Vulnerable (EPBC Act)					x		O
<i>Rattus fuscipes</i>	Bush Rat			x		x	x		C
<i>Oryctolagus cuniculus</i> (Introduced sp.)	European Rabbit				x			x	C
Nocturnal Birds									
<i>Ninox novaeseelandiae</i>	Southern Boobook				x				U
<i>Podargus strigoides</i>	Tawny Frogmouth				x				U
<i>Tyto novaehollandiae</i>	Masked Owl	Vulnerable (TSC Act)		x					U
Total species at each site			12	16	15	9	10		

Relative abundance (RA): O = one sighting only; U = uncommon; C = common; A = abundant.

11 - 14: refers to trapping transect numbering (Figure 3); OPP = opportunistic record.

Appendix 4: Bats recorded in study area.

Species	Common name	Conservation Status	2007					2008					2009					2010			
Transect/Anabat location			13	11	9	14	15	5	2	4	1	3	8	6	10	12	7	16	17	18	19
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat				x				x										28	78	15
<i>Chalinolobus morio</i>	Chocolate Wattled Bat							x										4			
<i>Miniopterus australis</i>	Little Bentwing-bat	Vulnerable (TSC Act)																4		2	5
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	Vulnerable (TSC Act)						x	x	x	x	x							3	5	
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	Vulnerable (TSC Act)			x				x	x	x	x							9	4	2
<i>Mormopterus sp. 2</i>									x												
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat		X										x								
<i>Nyctophilus sp.</i>																		1	11	2	5
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat		X					x			x							2			
<i>Tadarida australis</i>	White Striped Freetail-bat						x											2	3	2	10
<i>Vespadelus pumilus</i>	Eastern Forest Bat				x			x	x	x								4		7	8
<i>Vespadelus vulturnus</i>	Little Forest Bat				x		x	x	x	x	x	x	x		x	x			1	1	1
Relative Abundance (passes)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	55	101	46
Species Diversity			2	0	4	0	2	5	6	4	4	3	2	0	1	1	0	6	6	8	7

X: indicates presence, in 2010, numbers indicate number of passes

For survey number locations see Figure 3.

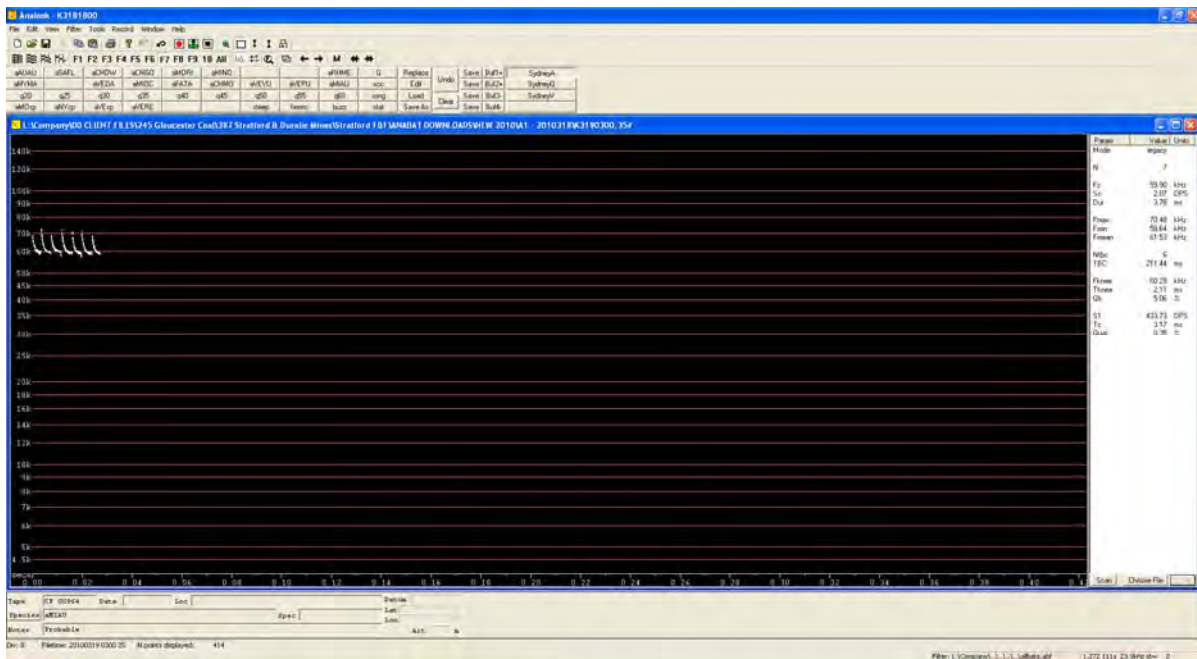


Appendix 5: Threatened species data

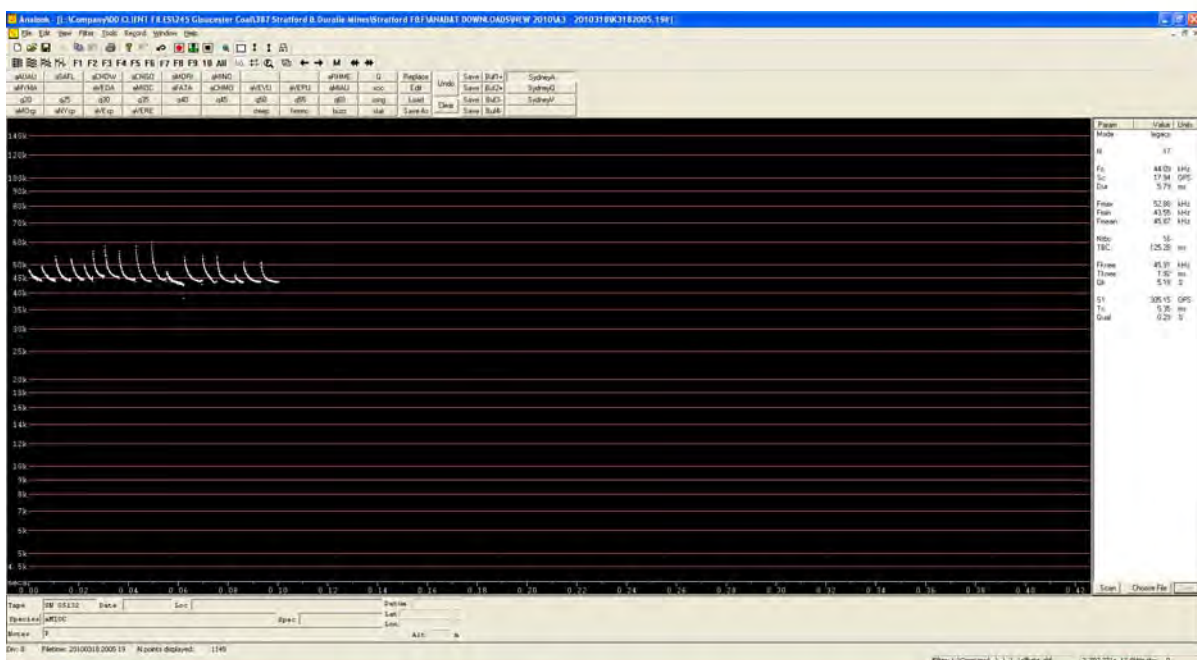
Scientific Name	Common Name	Longitude	Latitude
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	151.9674	-32.1568
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	151.9772	-32.1216
<i>Miniopterus s. oceanensis</i>	Eastern Bentwing-bat	151.9524	-32.1182
<i>Miniopterus s. oceanensis</i>	Eastern Bentwing-bat	151.9659	-32.1096
<i>Miniopterus s. oceanensis</i>	Eastern Bentwing-bat	151.9653	-32.1614
<i>Miniopterus s. oceanensis</i>	Eastern Bentwing-bat	151.9758	-32.1407
<i>Miniopterus s. oceanensis</i>	Eastern Bentwing-bat	151.9811	-32.1311
<i>Miniopterus s. oceanensis</i>	Eastern Bentwing-bat	151.9746	-32.1487
<i>Miniopterus s. oceanensis</i>	Eastern Bentwing-bat	151.9678	-32.152
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	151.9518	-32.118
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	151.9653	-32.1614
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	151.9672	-32.1526
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	151.9742	-32.1484
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	151.9758	-32.1407
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	151.9785	-32.1253
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	151.9791	-32.1333
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	151.9811	-32.1311
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	151.9814	-32.1278
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	151.9431	-32.1416
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	151.946	-32.1399
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	151.9733	-32.1076
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	151.9444	-32.1403
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	151.9436	-32.1417
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	151.9531	-32.1403
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9537	-32.1402
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9537	-32.1402
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9378	-32.1409
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9631	-32.1149
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9636	-32.1141
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9539	-32.1202
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9539	-32.1198
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9632	-32.1147
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9535	-32.141
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9536	-32.141
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9538	-32.1412
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler nest location	151.9489	-32.1607
<i>Miniopterus australis</i>	Little Bentwing-bat	151.974	-32.123
<i>Miniopterus australis</i>	Little Bentwing-bat	151.9797	-32.1335
<i>Miniopterus australis</i>	Little Bentwing-bat	151.9678	-32.152
<i>Anseranas semipalmata</i>	Magpie Goose	151.9566	-32.1429
<i>Tyto novaehollandiae</i>	Masked Owl	151.968	-32.1525
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	151.9800	-32.1324
<i>Petaurus norfolcensis</i>	Squirrel Glider	151.9736	-32.123
<i>Daphoenositta chrysoptera</i>	Varied Sittella	151.9495	-32.1239
<i>Daphoenositta chrysoptera</i>	Varied Sittella	151.9771	-32.1228
<i>Daphoenositta chrysoptera</i>	Varied Sittella	151.9528	-32.1175



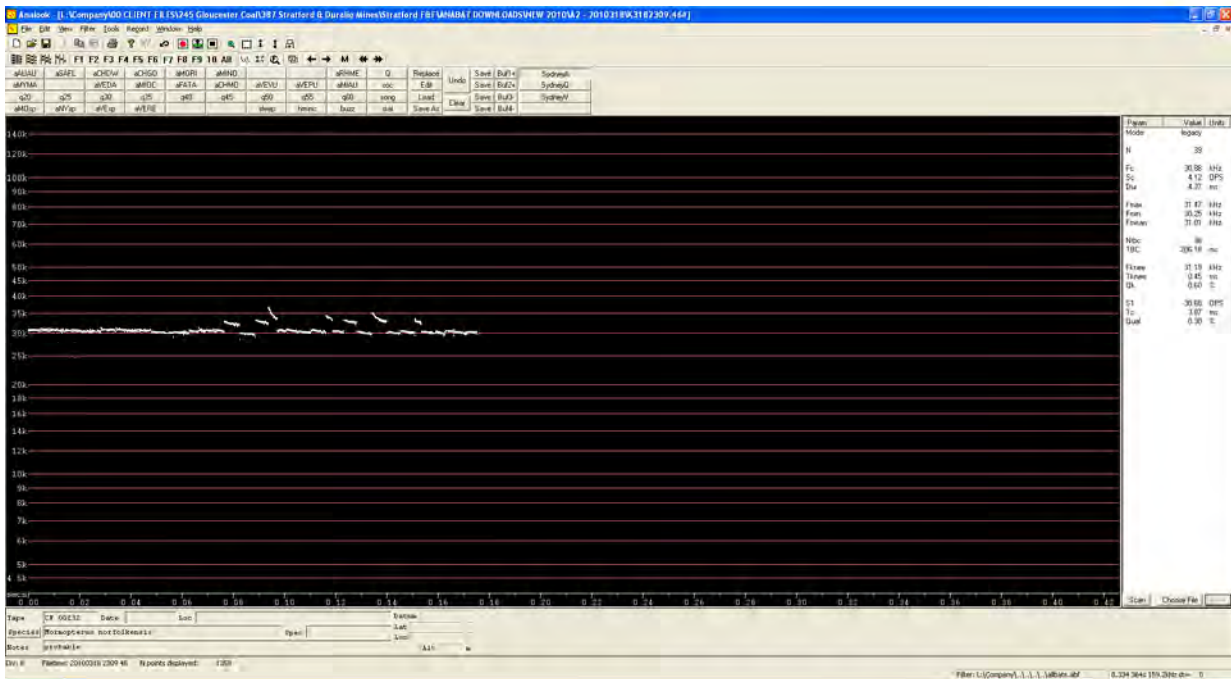
Appendix 6: An example of bat call signatures of detected threatened microbats



Miniopterus australis



Miniopterus schreibersii oceanensis



Mormopterus norfolkensis

ecobiological
survey & measurement



Appendix 7: Contributions and qualifications of ecobiological staff

Name	Qualification	Title/Experience	Contribution
David Paull	M.Res. Sc.	Senior Ecologist 20 years' experience in field ecology and assessment.	Data analysis, Report writing, 2010 fauna surveys.
Simon Clulow	B. Sc./B. Teach	Ecologist (Herpetologist) 6 years - Research in evolutionary biology, ecology, reproductive physiology and conservation biology (with a focus in the field of herpetology).	Amphibian and reptile surveys, trapping design, mammal and reptile trap checking, owl call playback spotlighting.
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Adam Blundell	B. Env Sc. (Hons)	Senior Environmental Scientist 10 years – Research on large forest owls, trained by Barbara Triggs in hair and scat analysis.	Trapping design, hair sample analysis, spotlighting, owl call playback.
Ryan Parsons	B. Env.Sc.	Botanist	Habitat hollow survey.
Dianna Brettschneider	B. App. Sc (Env)	GIS Manager 3 years - georeferencing, processing, analysis and display of spatial data in GIS.	Preparation of map layouts for report.

Appendix G: Fauna survey report, AMBS (2011)

Stratford Surrounds Baseline Fauna Surveys



Prepared by Australian Museum Business Services
for Gloucester Coal Limited

March 2012

AMBS Reference: 110396

Document Information 110396

Citation:	AMBS 2011. Stratford Surrounds Baseline Fauna Surveys. Report prepared for Gloucester Coal Limited by Australian Museum Business Services.
Versions:	Version 1: Draft Report issued 24/11/2011 Version 2: Draft Report v2 issued 17/01/2012 Version 3: Draft Report v3 issued 3/03/2012
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Executive Summary

Australian Museum Business Services were commissioned by Gloucester Coal Limited to undertake a study of terrestrial fauna in and around the Stratford Mining Complex, which is located within the Gloucester Valley in mid-northern New South Wales (NSW). The study included a desktop review, targeted fauna surveys and assessments of fauna habitats. Field surveys were performed between June and October 2011. The study was focussed on terrestrial vertebrate fauna and any terrestrial invertebrate fauna listed as threatened species on the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The desktop review found that 57 threatened animal species that have been previously recorded or were predicted as having the potential to occur within a 20 km radius of the study area are listed under the TSC Act and/or the EPBC Act. These records include 23 species of mammals, 27 species of birds, one species of reptile, and six species of frogs. Forty of these species were considered to have potential to occur within the study area, although for some species their likelihood of occurring was considered to be very low.

A total of 214 vertebrate fauna species were recorded during the targeted fauna surveys. Species recorded included 48 mammals, 131 birds, 19 reptiles, and 16 frogs. Five of the mammal species were non-positive identifications made from ultrasonic recordings. Seven introduced mammal species were also recorded during the surveys.

Twenty-five species that were recorded during the targeted surveys are listed as threatened under the TSC Act and/or the EPBC Act. Threatened species that were positively recorded included 10 birds (Comb-crested Jacana, Glossy Black-cockatoo, Little Lorikeet, Sooty Owl, Masked Owl, Speckled Warbler, Flame Robin, Scarlet Robin, Grey-crowned Babbler (eastern subspecies), and Varied Sittella) and 11 mammals (Brush-tailed Phascogale, Koala, Yellow-bellied Glider, Squirrel Glider, Long-nosed Potoroo, New Holland Mouse, Grey-headed Flying-fox, Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail-bat and Southern Myotis). Four threatened bat species, the Large-eared Pied Bat, the Eastern False Pipistrelle, the Greater Broad-nosed Bat and the Eastern Cave Bat were “possible” identifications made from ultrasonic recordings.

The habitat assessments indicate that habitat for threatened fauna occurs throughout most of the study area. In some parts of the study area, habitat features are extensive, while in others they are patchy and of limited quality. Seven main habitat types were described; rainforest, dry sclerophyll forest, wet sclerophyll forest, grassy woodlands, aquatic habitat, disturbed habitat and cleared land.

A number of threatened species that were recorded in the study area rely on the presence of hollow-bearing trees for parts of their life cycle. Included among these species are the Squirrel Glider, Glossy Black-cockatoo, Masked Owl and Sooty Owl. While hollow-bearing trees were present across the study area, they were limited in number and unevenly distributed. Such trees were thus considered uncommon, with most locations throughout the study area containing less than 10 hollows per 0.5 hectare. Other habitat features such as fallen timber and old logs were present in varying densities throughout the study area. Some of the lowland woodland areas were abundant with fallen timber, providing excellent habitat for species such as the Brush-tailed Phascogale.

1 Introduction

1.1 Background

Australian Museum Business Services (AMBS) was commissioned by Gloucester Coal Limited to undertake terrestrial fauna surveys in and around the Stratford Mining Complex. The surveys were required to gather information regarding threatened fauna in the area. The specific objectives of the surveys were to:

- undertake baseline fauna surveys in the study area;
- undertake habitat assessments within the study area;
- record opportunistic vertebrate fauna sightings; and
- undertake targeted surveys for the Swift Parrot and Regent Honeyeater within the current Stratford mining lease.

1.2 Study Area

The study area is located within the Gloucester Valley in mid-northern New South Wales (NSW) (Figure 1). The study area is shown on Figure 2. The locality is defined as an area encompassing a 20 km radius of the study area.

The study area consists of undulating agricultural land and moderate to steeply sloping terrain between 60 and 300 metres (m) above sea level. The area forms the watershed between the Wards and Mammy Johnsons Rivers, which form part of the Karuah River catchment between Berrico Nature Reserve and the Glen Nature Reserve.

1.3 Authorship and Acknowledgements

Fauna survey work was undertaken by Mark Semeniuk, George Madani, Narawan Williams, Tom O'Sullivan, Adam Smith, Dejan Stojanovic, Lisa McCaffrey, Terry O'Dwyer, Graham Pyke and Fiona Powell. Identification of ultrasonic microbat calls was undertaken by Narawan Williams and Greg Ford. Identification of scats, hair funnel and hair tube samples was undertaken by Barbara Triggs (Dead Finish Pty Ltd). Senior Project Manager Glenn Muir provided technical advice and direction for the study.

This report was prepared by AMBS Ecologist Mark Semeniuk and reviewed by Terry O'Dwyer.

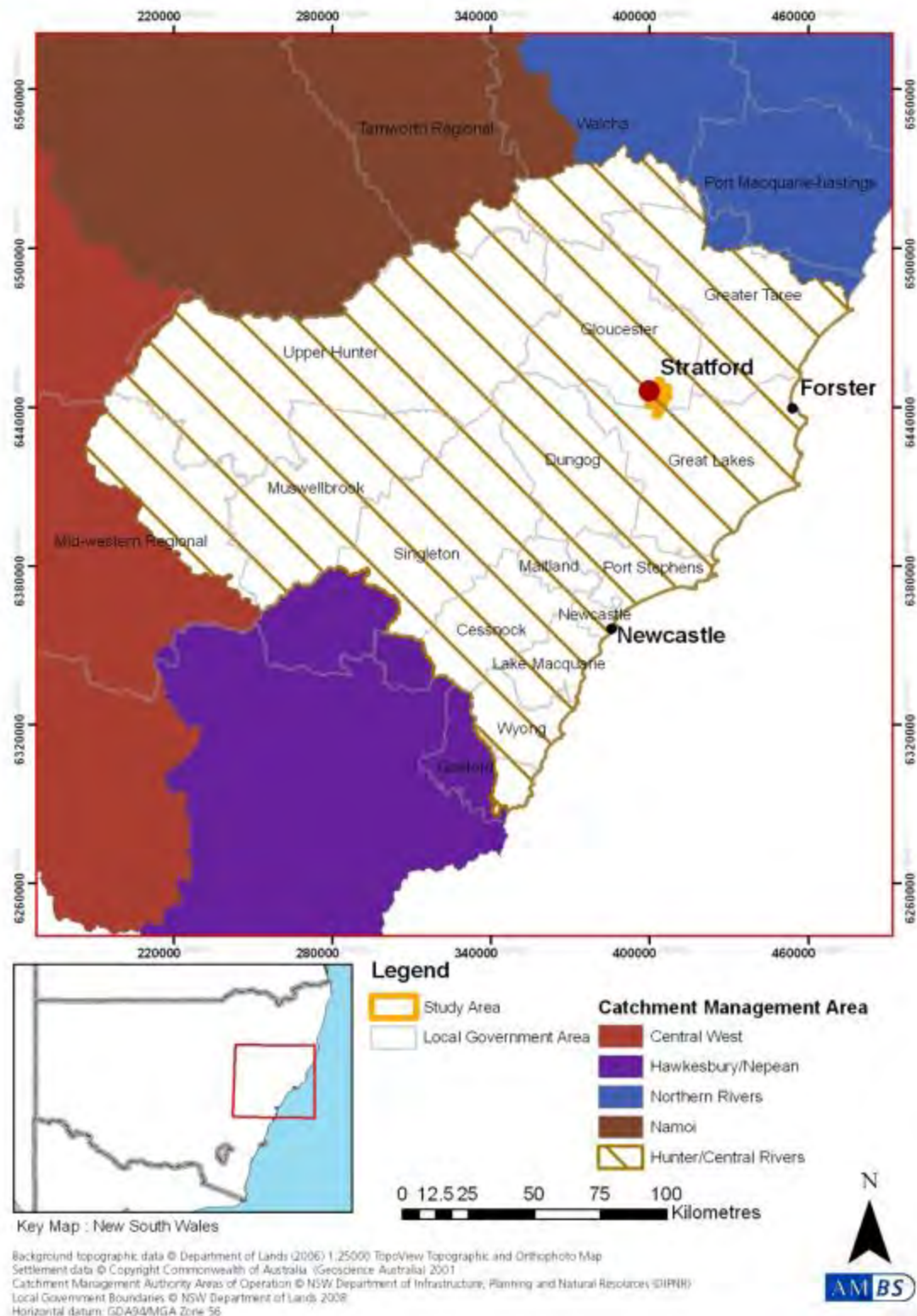


Figure 1: Regional context of the study area.



Figure 2: Study area location.

2 Methods

The current surveys included a desktop review (Section 2.1), targeted surveys conducted during winter (Section 2.2) and spring (Section 2.3) of 2011 and habitat assessments (Section 2.4). Methods for these are described in the following sections.

2.1 Desktop Review

A desktop review of existing information regarding fauna within the study area and locality was undertaken. Information sources included:

- a search of the NSW Office of Environment and Heritage (OEH) *Atlas of NSW Wildlife* database for records of threatened fauna species listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act);
- a search of the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Protected Matters database for matters of national environmental significance listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- a search of the Australian Museum and Birds Australia databases;
- topographic and aerial photographs of the locality; and
- reports of previous flora and fauna survey reports undertaken in the study area (AMBS 2011a; Biosphere Environmental Consultants 2011; Ecobiological 2010a, 2010b; Ecobiological 2011; Kerle 2011).

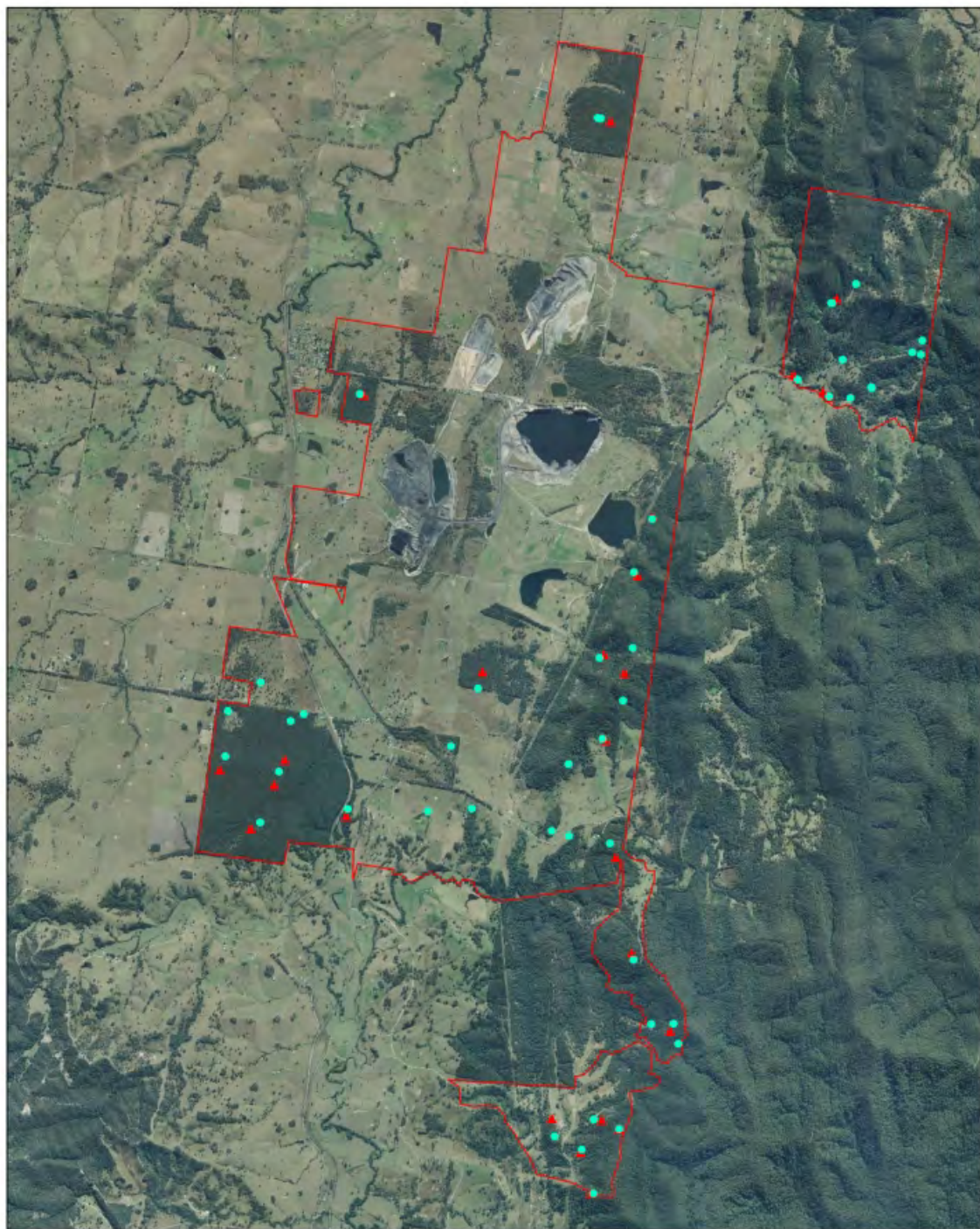
2.2 Winter Surveys

Fauna surveys undertaken during winter consisted of targeted threatened bird surveys, hair sampling and camera monitoring. Methodology employed during the winter survey for these are summarised in Table 1. Survey locations are shown on Figures 3 to 9.

Table 1: Winter fauna survey techniques and effort.

Technique	Sites	No. deployed per site	Survey effort / Description
Diurnal Bird Census	23	n/a	Survey dates: 28/06/2011 – 2/07/2011; 19–26/07/2011. 20 minute standard search within 3 hours of dawn, each site surveyed four times. All birds observed or heard were recorded. Surveys targeted flowering trees where possible.
Hair Funnels (on ground)	10	20	Left <i>in-situ</i> for a minimum of 14 days at each site between 28/06/2011 – 12/08/2011. All hair funnels were baited with chicken necks targeting the Spotted-tailed Quoll (<i>Dasyurus maculatus</i>). Spacing between funnels at each site was 100 m.
Hair Tubes (on trees)	10	30	Left <i>in-situ</i> for a minimum of 14 days at each site between 28/06/2011 – 12/08/2011. Each tube contained universal bait or universal bait with sardines, targeting the Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>). Tubes were placed between 0.5–2 m above the ground and spacing was approximately 20 m.
Remote Cameras	12	1	Each camera left <i>in-situ</i> for a minimum of 14 days between 28/06/2011 – 12/08/2011. Each camera was attached to a tree approximately 0.5 m above the ground. A bait chamber with chicken necks was positioned between 1–3 m from the camera, targeting the Spotted-tailed Quoll (<i>Dasyurus maculatus</i>).

The threatened bird surveys were originally proposed to be undertaken over eight survey days. The bird surveys planned to target the Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*). However, due to a lack of winter flowering trees observed during July, only four survey days were undertaken. An additional eight survey days were also undertaken, but the surveys were no longer specifically targeting the Swift Parrot or the Regent Honeyeater.



Legend

— Study Area

● Anabats

▲ Harp traps

0 0.5 1 2 3 4 Kilometres



Figure 3: Harp trap and Anabat locations.

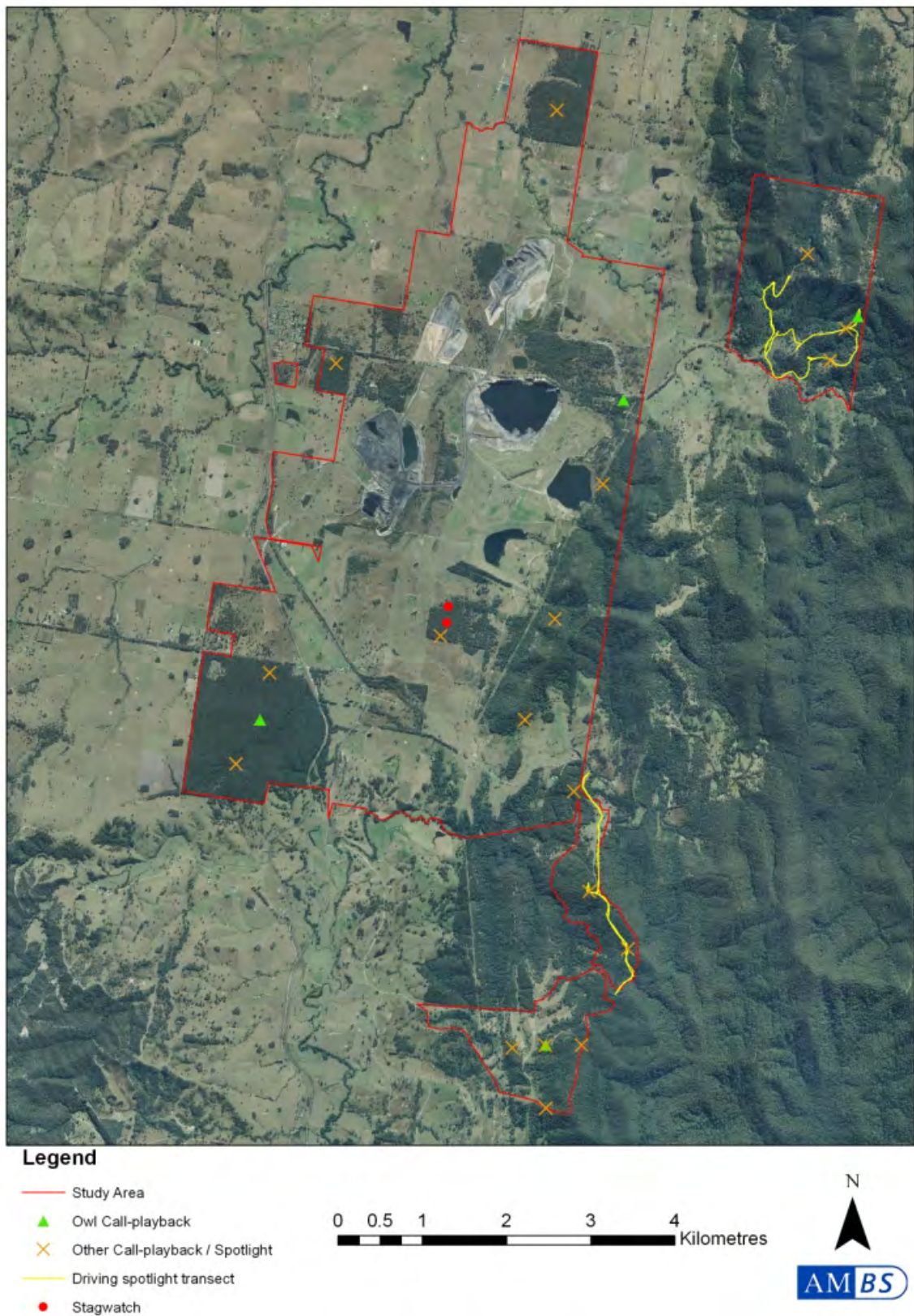


Figure 4: Call-playback and spotlighting locations.

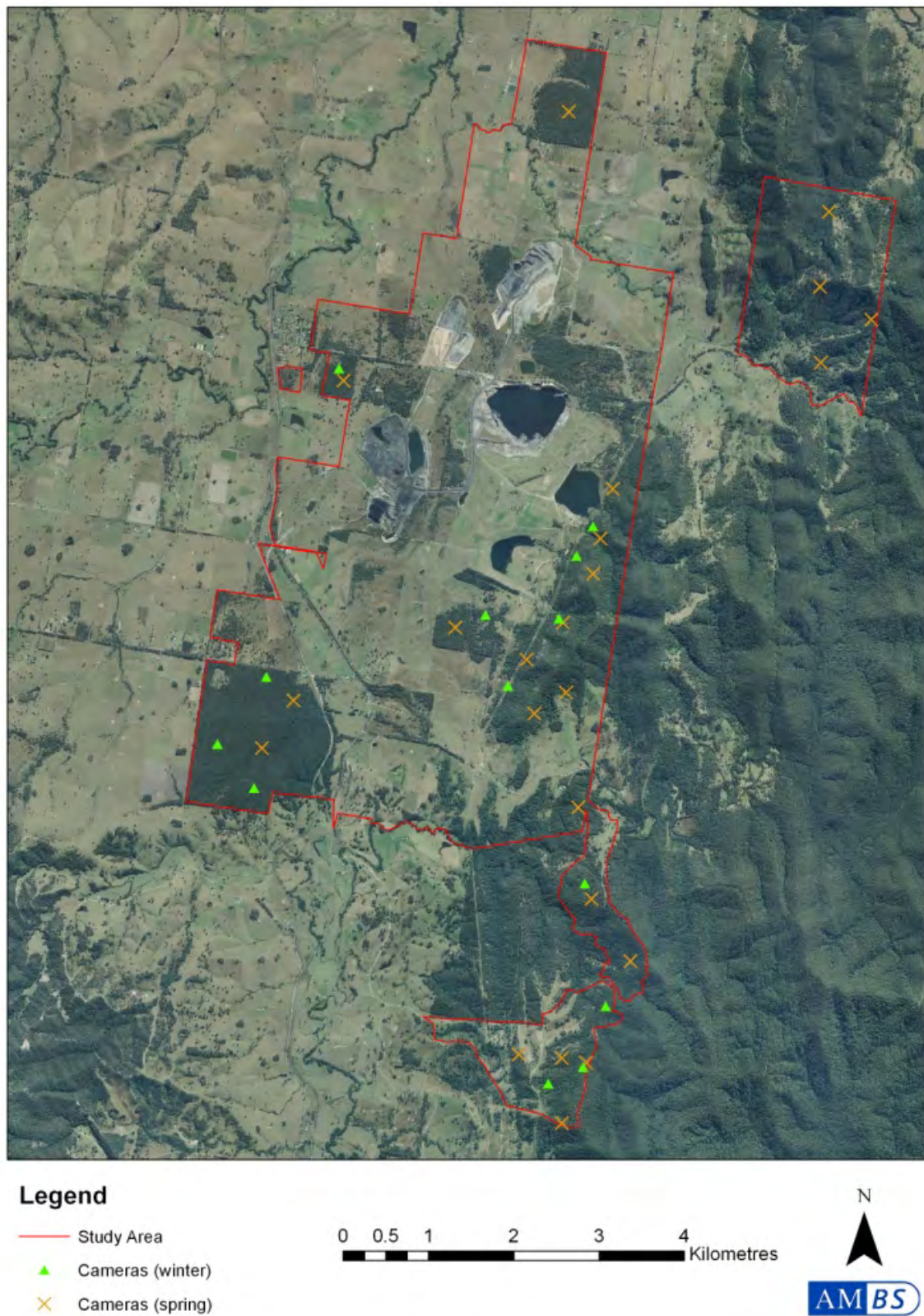


Figure 5: Remote camera locations.

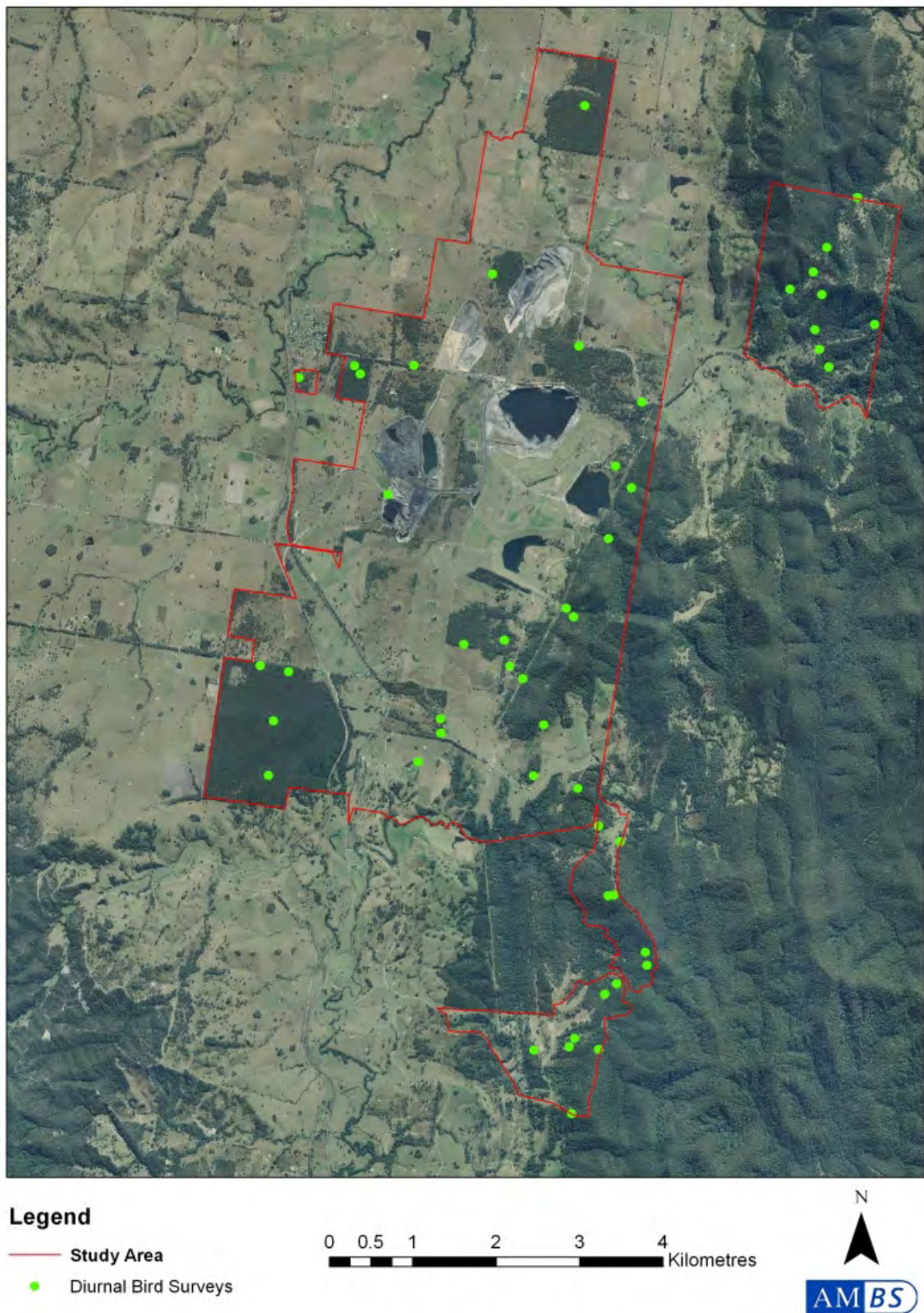
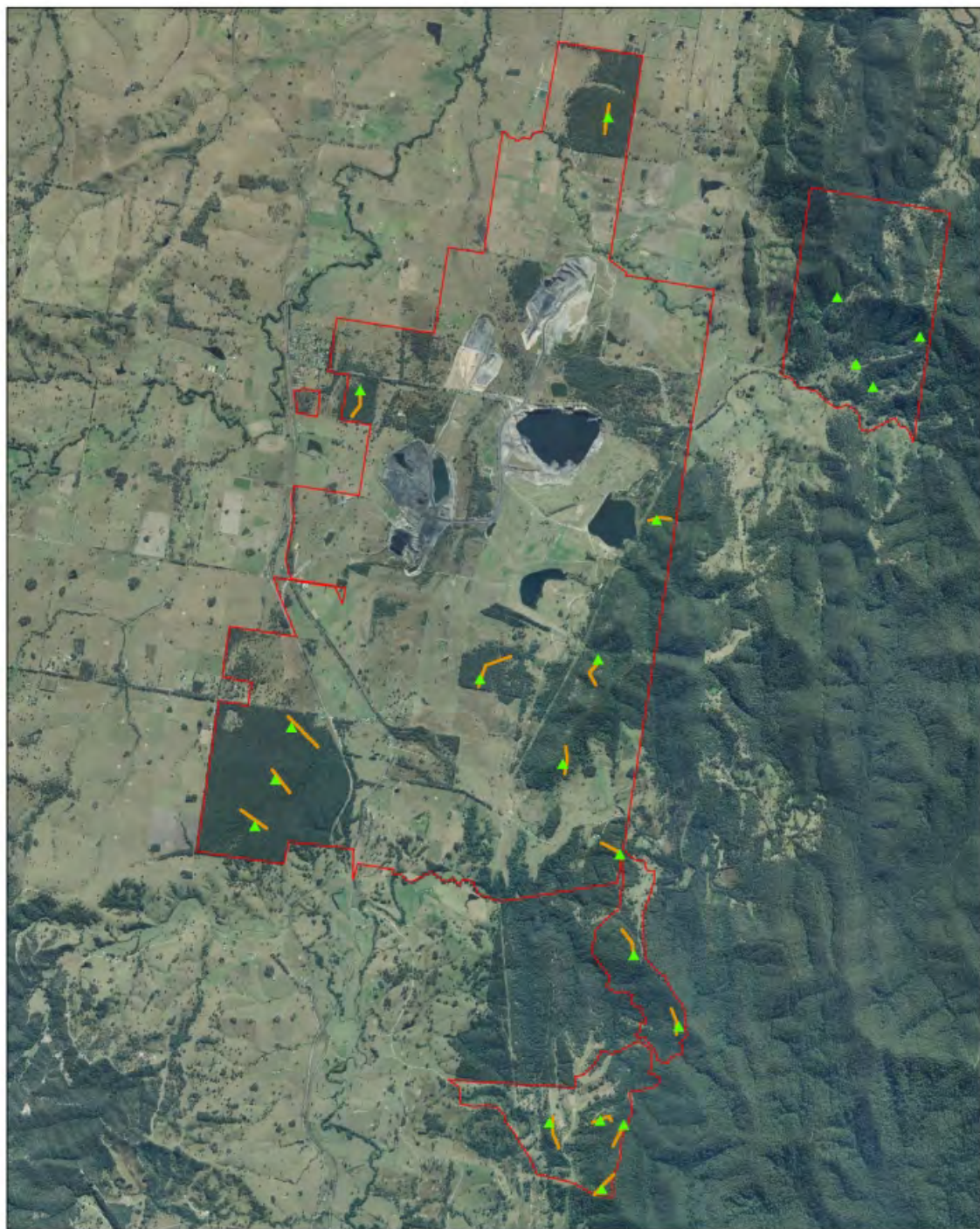


Figure 6: Diurnal bird survey locations.

**Legend**

- Study Area
 - ▲ Funnel traps
 - Elliott/Cage trap transects
- 0 0.5 1 2 3 4 Kilometres



Figure 7: Elliott, cage and funnel trapping locations.

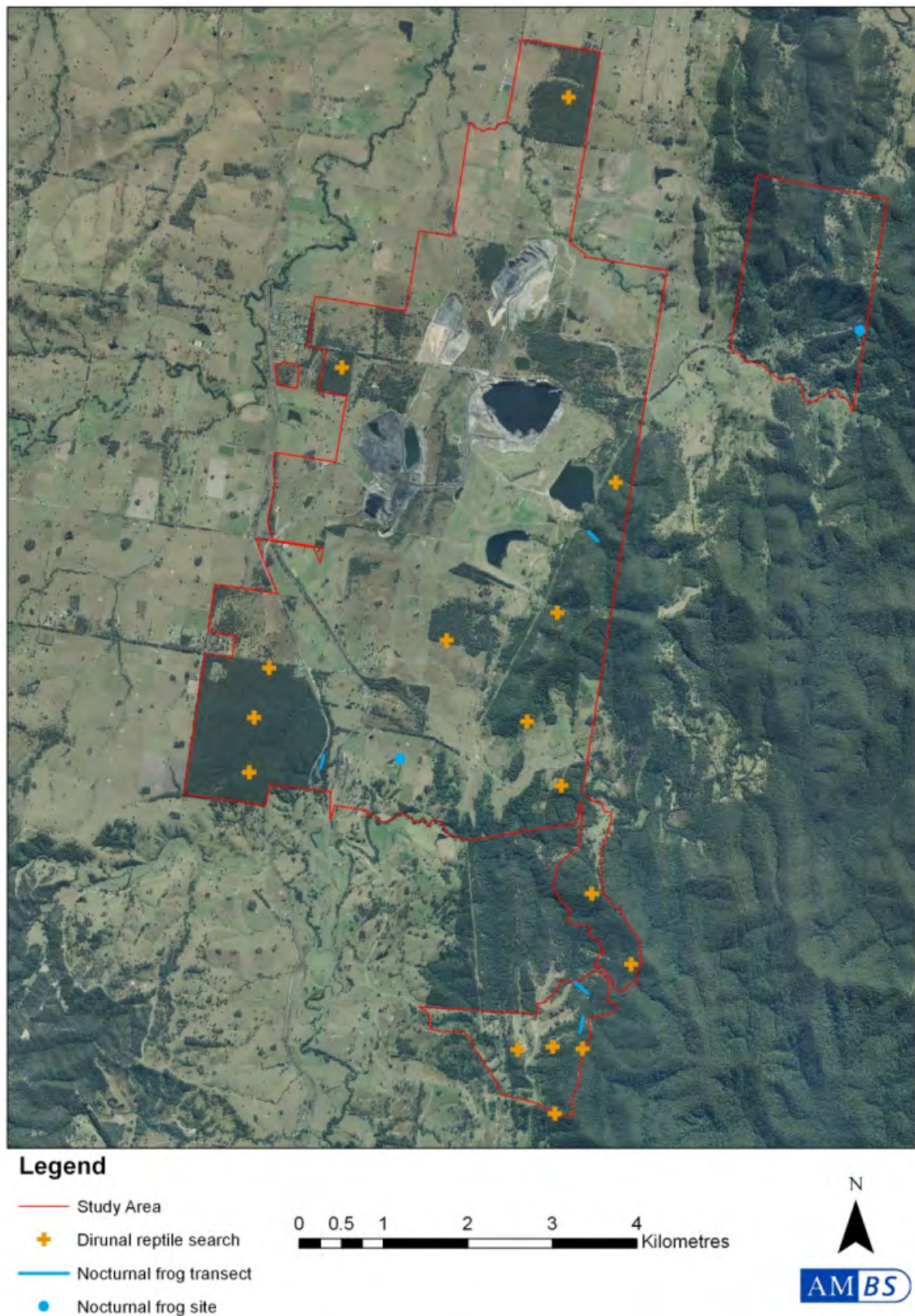


Figure 8: Frog and reptile survey locations.

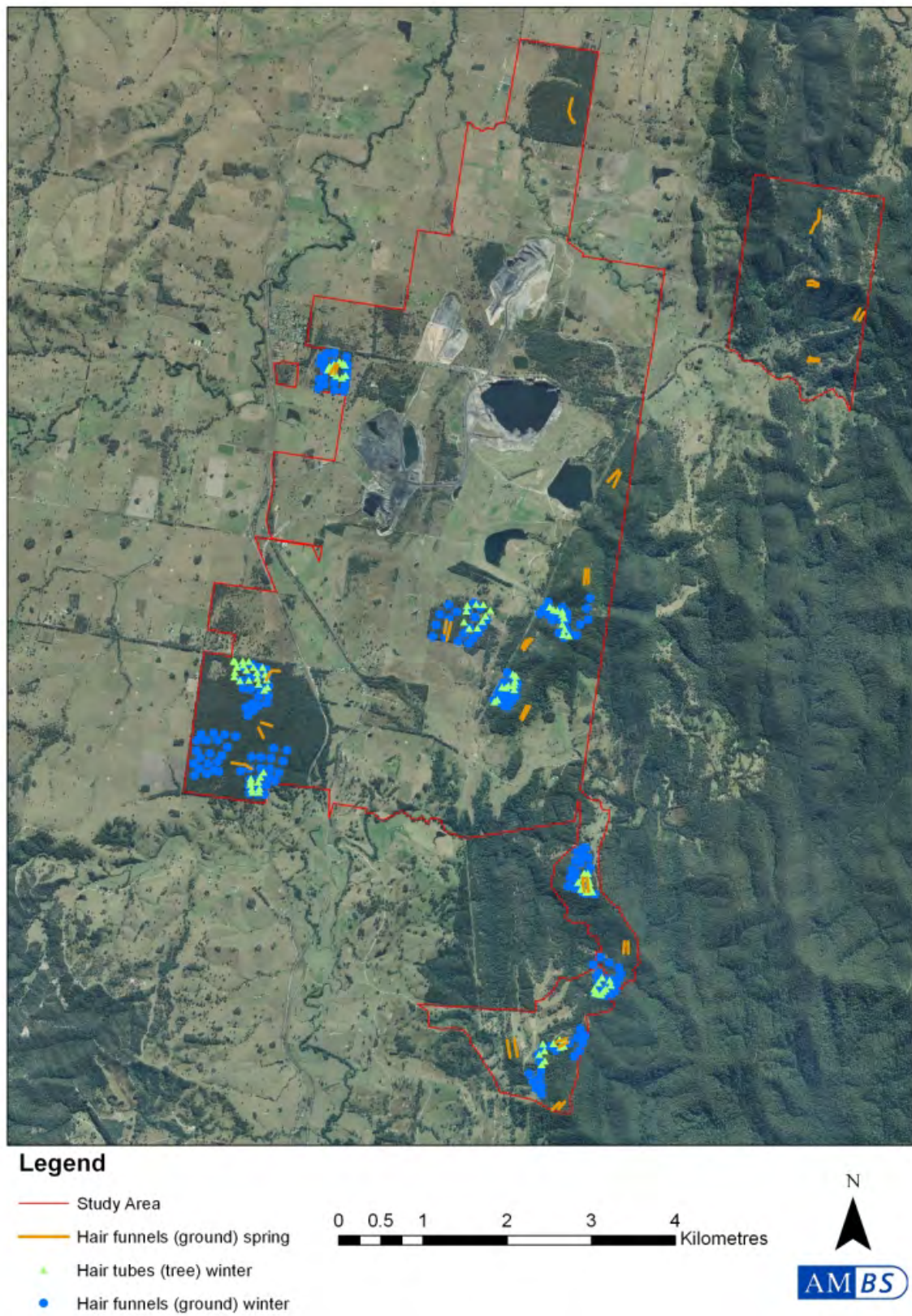


Figure 9: Hair funnel and hair tube locations.

Weather conditions during the survey period are summarised in Table 2. Weather conditions throughout the survey period were cool and mostly dry. Minimum temperatures ranged from 2.3 to 11.7 degrees Celsius (°C), while maximum temperatures were between 11.6 to 24.5°C (Table 2). There was heavy rainfall between 20 to 23 July (Table 2).

Table 2: Climate data for the winter survey period.

Date	Temp min (°C)*	Temp max (°C)*	Rainfall (mm)**	Moon phase
28/06/2011	5.4	17.7	0	Last quarter
29/06/2011	10.4	18	4.2	Last quarter
30/06/2011	7.6	17	0.8	Last quarter
1/07/2011	8.2	15.6	1.2	New moon
2/07/2011	6	–	1.6	New moon
3/07/2011	–	–	0.4	New moon
4/07/2011	–	22.1	0	New moon
5/07/2011	11.1	16.5	0.2	New moon
6/07/2011	11.4	16.8	0	New moon
7/07/2011	11.6	17.5	0	New moon
8/07/2011	3.9	16.3	0	First quarter
9/07/2011	6.9	14.8	0.2	First quarter
10/07/2011	8.7	14.8	0	First quarter
11/07/2011	10.8	17.2	0	First quarter
12/07/2011	6.7	18	0	First quarter
13/07/2011	10.9	15.3	0	First quarter
14/07/2011	7.6	15.4	0	First quarter
15/07/2011	4.5	11.6	0.2	Full moon
16/07/2011	–	–	0	Full moon
17/07/2011	–	–	0.6	Full moon
18/07/2011	–	19	1	Full moon
19/07/2011	4.2	14.6	0.2	Full moon
20/07/2011	8.6	16.1	12	Full moon
21/07/2011	11.7	14.4	30.8	Full moon
22/07/2011	10.9	14.6	36.2	Full moon
23/07/2011	8.8	15.1	12.4	Last quarter
24/07/2011	7.6	17.1	0.6	Last quarter
25/07/2011	4.3	19.2	0.2	Last quarter
26/07/2011	7.3	17.9	0	Last quarter
27/07/2011	4.7	16.9	0	Last quarter
28/07/2011	3.5	19.1	0.2	Last quarter
29/07/2011	2.3	20	0.2	Last quarter
30/07/2011	2.3	19.9	0.2	New moon
31/07/2011	4.3	21.1	0	New moon
1/08/2011	4.7	22.3	0	New moon
2/08/2011	6.1	24	0	New moon
3/08/2011	5.1	21	0	New moon
4/08/2011	5.5	24.5	0	New moon
5/08/2011	5.1	23.2	0	New moon
6/08/2011	5.7	23.6	0	First quarter
7/08/2011	9.4	17.6	0.2	First quarter
8/08/2011	6.9	17.5	0.6	First quarter
9/08/2011	5.5	16.3	4	First quarter
10/08/2011	8.2	17	0.2	First quarter
11/08/2011	2.4	18.2	0	First quarter
12/08/2011	6.6	18.1	0.4	First quarter

Source: Bureau of Meteorology (2011)

* data from the Paterson weather station (approximately 60 km from study area).

** data from the Craven weather station (within study area).

mm = millimetres

2.3 Spring Surveys

Spring fauna surveys throughout the survey area were performed during 12 September 2011 to 15 October 2011. Four survey sessions occurred during this period (Table 3) using a range of survey techniques, including Elliott traps (ground and tree), cage traps, funnel traps, harp traps, hair funnels, camera monitoring, diurnal bird surveys, reptile searches, frog searches, call-playback, nocturnal spotlighting and the use of Anabat detectors (Table 3). Survey locations are shown in Figures 3 to 9.

Table 3: Survey period and fauna survey techniques undertaken during the spring survey.

Technique	Survey Period			
	12–17/09/2011	19–23/09/2011	3–7/10/2011	10–15/10/2011
Elliott A Traps (on ground)	✓	✓		✓
Cage Traps	✓	✓		✓
Elliott B Traps (on tree platforms)	✓	✓		✓
Funnel Traps	✓	✓	✓	✓
Hair Funnels (on ground)*		✓	✓	✓
Diurnal Bird Census	✓	✓	✓	✓
Diurnal Reptile Search	✓	✓		✓
Nocturnal Call playback (forest owls)	✓	✓	✓	✓
Nocturnal Call playback (other)	✓	✓	✓	✓
Nocturnal Spotlighting	✓	✓	✓	✓
Nocturnal Frog Search			✓	✓
Harp Trapping	✓	✓	✓	✓
Anabat	✓	✓	✓	✓
Opportunistic Records	✓	✓	✓	✓
Remote Cameras*		✓	✓	✓

*note: hair funnels and remote cameras were also being used during 24 September 2011 to 2 October 2011 and 8 to 9 October 2011.

Methods and survey effort are summarised in Table 4.

Table 4: Spring fauna survey techniques and effort.

Technique	Sites	No. deployed per site	Survey effort / Description
Elliott A Traps (on ground)	16	25	Traps were checked every morning for 4 days (100 trap nights at each site). Each trap contained universal bait, cotton wool or leaf litter, and was placed in a plastic bag. Spacing between traps was 10 m.
Cage Traps	16	6	Traps were checked every morning for 4 days (24 trap nights at each site). Each trap contained universal bait with truffle oil targeting the Long-nosed Potoroo. Spacing between traps was about 50 m.
Elliott B Traps (on tree platforms)	16	6	Traps were checked every morning for 3–4 days (24 trap nights at each site). Elliott B traps were placed on tree mounts approximately 3–5 m above the ground. Each trap contained universal bait, cotton wool or leaf litter, and was placed in a plastic bag. A honey-water solution was sprayed up and down the tree trunk as an additional attractant. Spacing between traps was at least 20 m.

Technique	Sites	No. deployed per site	Survey effort / Description
Funnel Traps	20	4	Two funnel traps were paired at 1 m in from each end of a 10 m polyethylene drift fence. Traps were checked every morning for 4 days (16 trap nights at each site).
Hair Funnels (on ground)	19	20	Hair funnels at most sites were left <i>in-situ</i> for a minimum of 14 days between 19/09/2011 –15/10/2011. Four sites in the north-east were left <i>in-situ</i> for only 7 days due to timing of approval of site access. Hair funnels were baited alternating with universal bait or universal bait with truffle oil. Spacing between funnels was 20m.
Diurnal Bird Census	28	n/a	20 minute standard search within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal Reptile Search	16	n/a	Active search of potential reptile habitats performed for 60 person minutes at each site.
Nocturnal Call playback (targeting forest owls)	4	n/a	Each session included an initial listening period (10 minutes) followed by call broadcast of Bush Stone-curlew (5 nights per site), Powerful Owl (5 nights per site), Masked Owl (8 nights per site), Barking Owl (5 nights per site) and Sooty Owl (5 nights per site). Each broadcast was for 5 minutes followed by 5 minutes of listening. A 10 minute spotlighting session was conducted following the final listening period. All species observed or heard were recorded.
Nocturnal Call playback (other)	18	n/a	Call-playback was undertaken for the Yellow-bellied Glider (11 sites), Squirrel Glider (10 sites) and Koala (10 sites) on one occasion at each site. Each session included an initial listening period (10 minutes) followed by call broadcast (5 minutes each species). Each broadcast was followed by 5 minutes of listening. Spotlighting followed each call playback session (see below). Call-playback was also undertaken opportunistically for the Masked Owl (1 site) and Sooty Owl (2 sites) at locations where potential habitat was considered to occur.
Nocturnal Spotlighting	12	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed for 60 person minutes at each site. All species observed or heard were identified. Spotlighting from a vehicle also occurred at two sites, on two occasions at each site.
Nocturnal Frog Search	6	n/a	Searches were performed for 30–60 person minutes at each site and all species observed or heard were identified. Each site was surveyed on 2 separate nights.
Harp Trapping	25	1	Harp traps were checked each morning for 2 days (2 trap nights at each site).
Anabat	44	1	Anabats were left overnight for 2 nights at each site and retrieved each morning.
Opportunistic Records	n/a	n/a	Opportunistic observations of fauna were recorded throughout the study area.
Remote Cameras	22	1	All cameras left <i>in-situ</i> for a minimum of 14 days between 19/09/2011 – 15/10/2011. Four sites were left <i>in-situ</i> for only 7 days due to timing of approval to access sites.

Weather conditions during the survey period are summarised in Table 5. Weather conditions throughout the survey period were warm and mostly dry. Minimum temperatures ranged from 3.9 to 15.8 °C, while maximum temperatures were between 16.6 to 32.3°C (Table 5). There was heavy rainfall during 26 September 2011, and 2 to 3 October 2011.

Table 5: Climate data for the spring survey period.

Date	Temp min (°C)*	Temp max (°C)*	Rainfall (mm)**	Moon phase
12/09/2011	10.1	18.2	0.6	Full moon
13/09/2011	3.9	22	0.2	Full moon
14/09/2011	12.2	24.8	0	Full moon
15/09/2011	9.4	24.6	0	Full moon
16/09/2011	6.4	28.1	0	Full moon
17/09/2011	10.1	30.5	0	Full moon
18/09/2011	9.5	32.3	0	Full moon
19/09/2011	12.6	27.2	0	Full moon
20/09/2011	13.6	29.7	0.2	Last quarter
21/09/2011	8.3	22.9	0	Last quarter
22/09/2011	7.6	25.7	0	Last quarter
23/09/2011	8.6	30	0	Last quarter
24/09/2011	15.3	22.4	0	Last quarter
25/09/2011	13.5	17.2	3	Last quarter
26/09/2011	12.1	19.2	22	Last quarter
27/09/2011	6.2	21.4	0	New moon
28/09/2011	7.7	19.4	0.2	New moon
29/09/2011	14.6	21.6	5.8	New moon
30/09/2011	11	20.7	0	New moon
1/10/2011	6.3	18.1	0	New moon
2/10/2011	-	-	9.4	New moon
3/10/2011	10	18.4	36.6	New moon
4/10/2011	9.6	18.2	2.6	First quarter
5/10/2011	6.5	19.5	0	First quarter
6/10/2011	11.3	16.6	0.2	First quarter
7/10/2011	12.3	23.5	1.8	First quarter
8/10/2011	14.3	22.3	0	First quarter
9/10/2011	12.3	24.3	1.2	First quarter
10/10/2011	8.6	23.1	0	First quarter
11/10/2011	10.6	22.7	0	First quarter
12/10/2011	7.8	21.8	0	Full moon
13/10/2011	10.1	19.4	0	Full moon
14/10/2011	11.7	22.7	0	Full moon
15/10/2011	15.8	24.6	0	Full moon

Source: Bureau of Meteorology (2011)

* data from the Paterson weather station (approximately 60 km from study area).

** data from the Craven weather station (within study area).

2.4 Habitat Assessments

Standard habitat assessments were conducted at a range of sites (n=57) throughout the study area. Previous vegetation mapping of the study area (Figure 10) was used as a guide for stratification, and sites for standardised habitat assessments were distributed accordingly within each vegetation type. At each standard site, the following features were recorded within an area of 50 x 100 m:

- broad habitat type;
- age structure;
- predominant topography;
- altitude;
- disturbance history (e.g. fire, grazing);
- dominant shrub growth;
- dominant ground layer;
- litter / humus depth;
- abundance of key plant species (e.g. *Acacia* spp., *Allocasuarina* spp. etc.);
- abundance of weeds;
- ground layer features (percent cover vegetation, rock, soil, litter, logs);
- number of large dead trees;
- number of trees with hollows;
- number of hollows (small <10 centimetres (cm), medium 10-30 cm, large >30 cm, or basal hollows);
- abundance of decorticating bark;
- number of logged stumps, fallen branches and rock crevices;
- length of large (>30 cm) logs; and
- stream or water body characteristics.

At locations throughout the study area where standard habitat assessments were not undertaken, brief habitat descriptions and photographs were recorded. It was also noted whether the habitat was similar to an area in which a standard habitat assessment was undertaken.

The data obtained from the habitat assessments was used to determine the likelihood of threatened fauna occurring in locations throughout the study area.

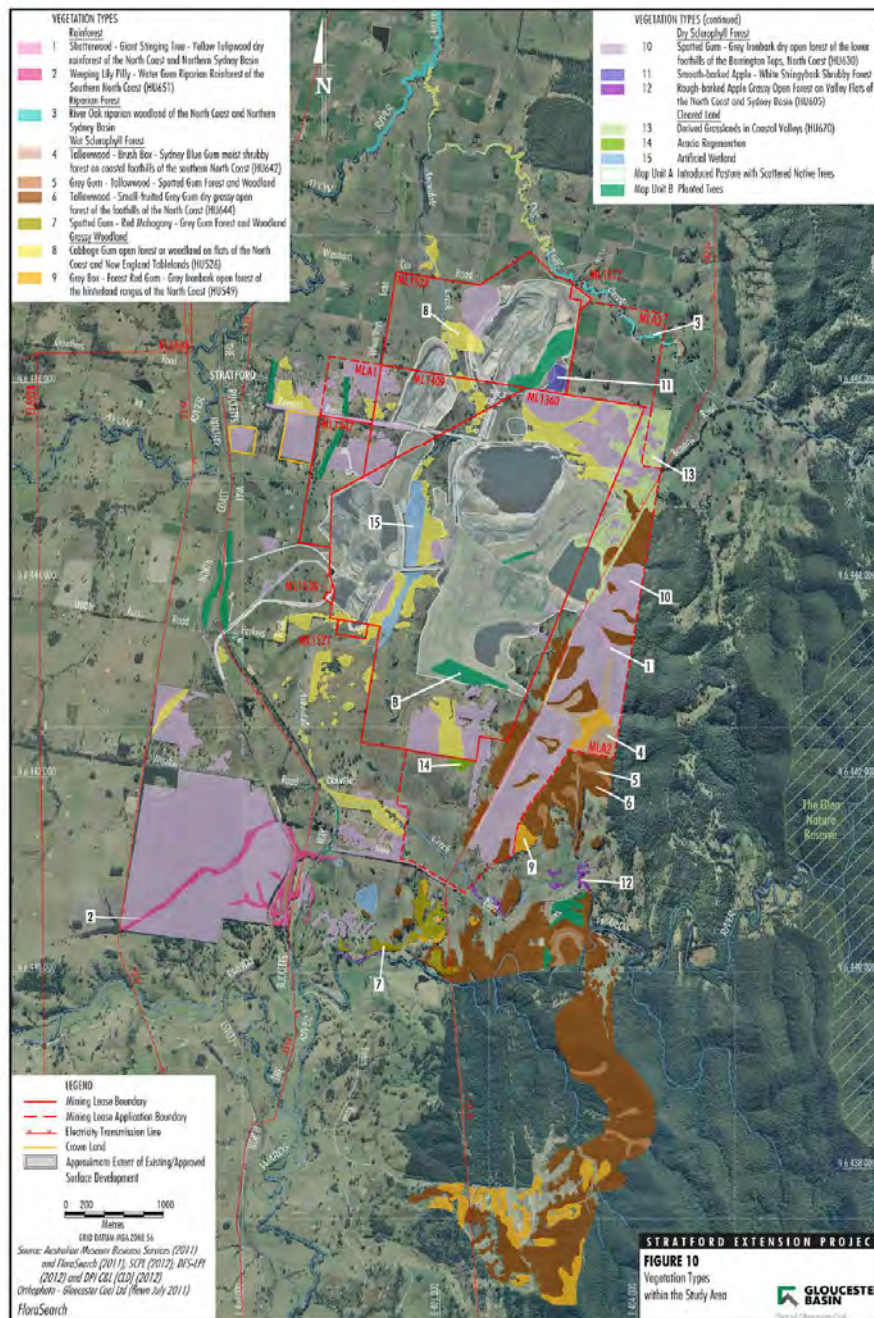


Figure 10: Vegetation Types within the Study Area.

3 Results

The following sections display the results from the desktop review (Section 3.1), targeted fauna surveys (Section 3.2), habitat assessments (Section 3.3) and threatened species habitat (Section 3.4).

3.1 Desktop Review

A total of 57 threatened fauna species listed under the TSC Act or EPBC Act have been previously recorded or predicted as having the potential to occur within a 20 km radius of the study area (Table 6). This includes 24 mammals, 28 birds, one reptile and six frogs (Table 6).

3.2 Fauna Surveys

A total of 214 vertebrate fauna species were recorded during the surveys comprising 16 frogs, 19 reptiles, 131 birds and 48 mammals (Appendix A). Five of these mammal species were non-positive identifications from Anabat recordings, and seven were introduced species. Each species was assigned an abundance category based on the frequency and numbers in which they were observed. Each species was classed as either one sighting only, uncommon (more than one sighting but encountered only infrequently), common (encountered frequently but not in high numbers relative to other species abundance), or abundant (encountered frequently and in large numbers relative to other species abundance). Microbats identified only from Anabat units were not assigned an abundance category. Twenty-five species recorded during the surveys are listed as threatened under the TSC Act and/or EPBC Act (Table 7) and the locations of where they were recorded are shown in Figures 12 to 26. Details of the threatened species that were recorded are presented in the following sections of this report. Seven introduced species were recorded during the surveys. All introduced species were mammals and all were infrequently encountered except the European Hare, which was classed as being commonly occurring (Appendix A).

Some information relating to the ecology of the threatened species discussed below has been obtained from the OEH Threatened Species Profile database (OEH 2011).

Comb-crested Jacana *Irediparra gallinacea*

The Comb-crested Jacana was recorded within an artificial wetland on 11 October 2011 during a standard diurnal bird survey (Figure 11). Two individuals were present. They were sighted again opportunistically the next day. This species utilises permanent freshwater wetlands with abundant floating vegetation, especially water-lilies, or fringing and aquatic vegetation. Potential habitat for this species is not likely to be extensive throughout the study area.

Glossy Black-cockatoo *Calyptorhynchus lathami*

The Glossy Black-cockatoo was recorded several times throughout the study area (Figure 12). Individuals were observed on seven occasions, while foraging signs (chewed *Allocasuarina* sp. cones) were recorded in 16 locations, which were clustered in three main locations; in the north, central east and far south of the study area (Figure 12).

Little Lorikeet *Glossopsitta pusilla*

The Little Lorikeet was recorded on 29 June 2011 during a standard diurnal bird survey (Figure 11). Two individuals were recorded foraging in Dry Sclerophyll Forest in the study area. This species feeds primarily on nectar and pollen, particularly on profusely-flowering eucalypts. It is likely that the species moves through the study area in response to the availability of food resources.

Table 6: Threatened species previously recorded or predicted to have potential to occur within 20 km of the study area.

Common Name	Scientific Name	Conservation Status ¹		Data Record Source				
		TSC Act	EPBC Act	OEH Atlas ²	EPBC Report ³	Australian Museum ⁴	Birds Australia ⁵	Previous Reports ⁶
Frogs								
Green and Golden Bell Frog	<i>Litoria aurea</i>	E	V	✓	✓			
Booroolong Frog	<i>Litoria booroolongensis</i>	E	E	✓	✓			
Green-thighed Frog	<i>Litoria brevipalmata</i>	V		✓				
Davies' Tree Frog	<i>Litoria daviesae</i>	V		✓				
Giant Barred Frog	<i>Mixophyes iteratus</i>	E	E	✓	✓			✓
Stuttering Frog	<i>Mixophyes balbus</i>	E	V	✓	✓			
Reptiles								
Stephens' Banded Snake	<i>Hoplocephalus stephensii</i>	V		✓				
Birds								
Magpie Goose	<i>Anseranas semipalmata</i>	V						✓
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	E		✓			✓	
Bush Stone-curlew	<i>Burhinus grallarius</i>	E				✓		
Australian Painted Snipe	<i>Rostratula australis</i>	E	V		✓			
White-fronted chat	<i>Epthianura albifrons</i>	V					✓	
Comb-crested Jacana	<i>Irediparra gallinacea</i>	V						✓
Little Eagle	<i>Hieraaetus morphnoides</i>	V		✓				
Spotted Harrier	<i>Circus assimilis</i>	V		✓				
Rose-crowned Fruit-Dove	<i>Ptilinopus regina</i>	V		✓				✓
Superb Fruit-Dove	<i>Ptilinopus superbus</i>	V		✓				
Wompoo Fruit-Dove	<i>Ptilinopus magnificus</i>	V		✓		✓	✓	
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V		✓			✓	✓
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V		✓				✓
Swift Parrot	<i>Lathamus discolor</i>	E	E	✓	✓			✓
Little Lorikeet	<i>Glossopsitta pusilla</i>	V		✓			✓	✓
Turquoise Parrot	<i>Neophema pulchella</i>	V		✓				
Powerful Owl	<i>Ninox strenua</i>	V		✓			✓	✓
Barking Owl	<i>Ninox connivens</i>	V		✓			✓	
Sooty Owl	<i>Tyto tenebricosa</i>	V		✓			✓	✓

Common Name	Scientific Name	Conservation Status ¹		Data Record Source				
		TSC Act	EPBC Act	OEI Atlas ²	EPBC Report ³	Australian Museum ⁴	Birds Australia ⁵	Previous Reports ⁶
Masked Owl	<i>Tyto novaehollandiae</i>	V		✓				✓
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V		✓			✓	✓
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	E		✓			
Flame Robin	<i>Petroica phoenicea</i>	V		✓			✓	
Scarlet Robin	<i>Petroica boodang</i>	V					✓	✓
Speckled Warbler	<i>Pyrrholaemus saggitatus</i>	V		✓			✓	✓
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V		✓			✓	✓
Olive Whistler	<i>Pachycephala olivacea</i>	V		✓		✓	✓	
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V		✓		✓	✓	✓
Mammals								
Koala	<i>Phascolarctos cinereus</i>	V		✓				✓
Common Planigale	<i>Planigale maculata</i>	V		✓				
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	V		✓		✓		✓
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	E	✓	✓			
Squirrel Glider	<i>Petaurus norfolcensis</i>	V		✓				✓
Yellow-bellied Glider	<i>Petaurus australis</i>	V		✓				✓
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	V		✓				
Hastings River Mouse	<i>Pseudomys oralis</i>	E	E		✓			
New Holland Mouse	<i>Pseudomys novaehollandiae</i>	–	V	✓	✓			✓
Long-nosed Potoroo	<i>Potorous tridactylus</i>	V	V	✓	✓	✓		
Rufous Bettong	<i>Aepyprymnus rufescens</i>	V		✓		✓		
Red-legged Pademelon	<i>Thylogale stigmatica</i>	V		✓				
Parma Wallaby	<i>Macropus parma</i>	V		✓				
Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	E	V	✓	✓			
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	✓	✓			✓#
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V		✓				✓#
Little Bentwing-bat	<i>Miniopterus australis</i>	V		✓				✓
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V		✓				✓
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V		✓				✓
Southern Myotis	<i>Myotis macropus</i>	V		✓				✓

Common Name	Scientific Name	Conservation Status ¹		Data Record Source				
		TSC Act	EPBC Act	OEI Atlas ²	EPBC Report ³	Australian Museum ⁴	Birds Australia ⁵	Previous Reports ⁶
Golden-tipped Bat	<i>Kerivoula papuensis</i>	V		✓				
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V		✓				
Eastern Cave Bat	<i>Vespadelus troughtoni</i>	V						✓ #
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	✓	✓			

¹ Threatened fauna species status listed under the TSC Act and/or EPBC Act (current as of 29 November 2011).

² OEI Atlas of NSW Wildlife (2011). Database Search Area Between -31.94, 151.75; -31.94, 152.17; -32.31, 152.17; -32.31, 151.75. Data received 19 May 2011

³ SEWPaC Protect Matters (2011). Report received 29 April 2011. Coordinates used: 151.9596 -32.1501.

⁴ Australian Museum (2011). Database Search Area Between -31.94, 151.75; -31.94, 152.17; -32.31, 152.17; -32.31, 151.75. Data received 1 June 2011.

⁵ Birds Australia (2011). Database Search Area Between -31.94, 151.75; -31.94, 152.17; -32.31, 152.17; -32.31, 151.75. Data received 20 May 2011.

⁶ Previous Reports include: AMBS 2011a; Biosphere Environmental Consultants 2011; Ecobiological 2010a, 2010b; Ecobiological 2011; Kerle 2011.

possible identification from Anabat.

Table 7: Threatened fauna species recorded in the study area.

Common name	Scientific name	Conservation Status ¹	
		TSC Act	EPBC Act
Birds			
Comb-crested Jacana	<i>Irediparra gallinacea</i>	V	–
Glossy Black-cockatoo	<i>Calyptorhynchus lathami</i>	V	–
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	–
Sooty Owl	<i>Tyto tenebricosa</i>	V	–
Masked Owl	<i>Tyto novaehollandiae</i>	V	–
Speckled Warbler	<i>Pyrrholaemus sagittatus</i>	V	–
Flame Robin	<i>Petroica phoenicea</i>	V	–
Scarlet Robin	<i>Petroica boodang</i>	V	–
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	–
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	–
Mammals			
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	V	–
Koala	<i>Phascolarctos cinereus</i>	V	–
Yellow-bellied Glider	<i>Petaurus australis</i>	V	–
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	–
Long-nosed Potoroo	<i>Potorous tridactylus</i>	V	V
New Holland Mouse	<i>Pseudomys novaehollandiae</i>	–	V
Grey-headed Flying-fox	<i>Pteropus poliocephalis</i>	V	V
Large-eared Pied Bat*	<i>Chalinolobus dwyeri</i>	V	V
Eastern False Pipistrelle*	<i>Falsistrellus tasmaniensis</i>	V	–
Little Bentwing-bat	<i>Miniopterus australis</i>	V	–
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	–
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V	–
Southern Myotis	<i>Myotis macropus</i>	V	–
Greater Broad-nosed Bat*	<i>Scoteanax rueppellii</i>	V	V
Eastern Cave Bat*	<i>Vespadelus troughtoni</i>	V	–

¹ – Threatened fauna species status listed under the TSC Act and/or EPBC Act (current as of 29 November 2011).

Key: * indicates species was not positively recorded; V = vulnerable

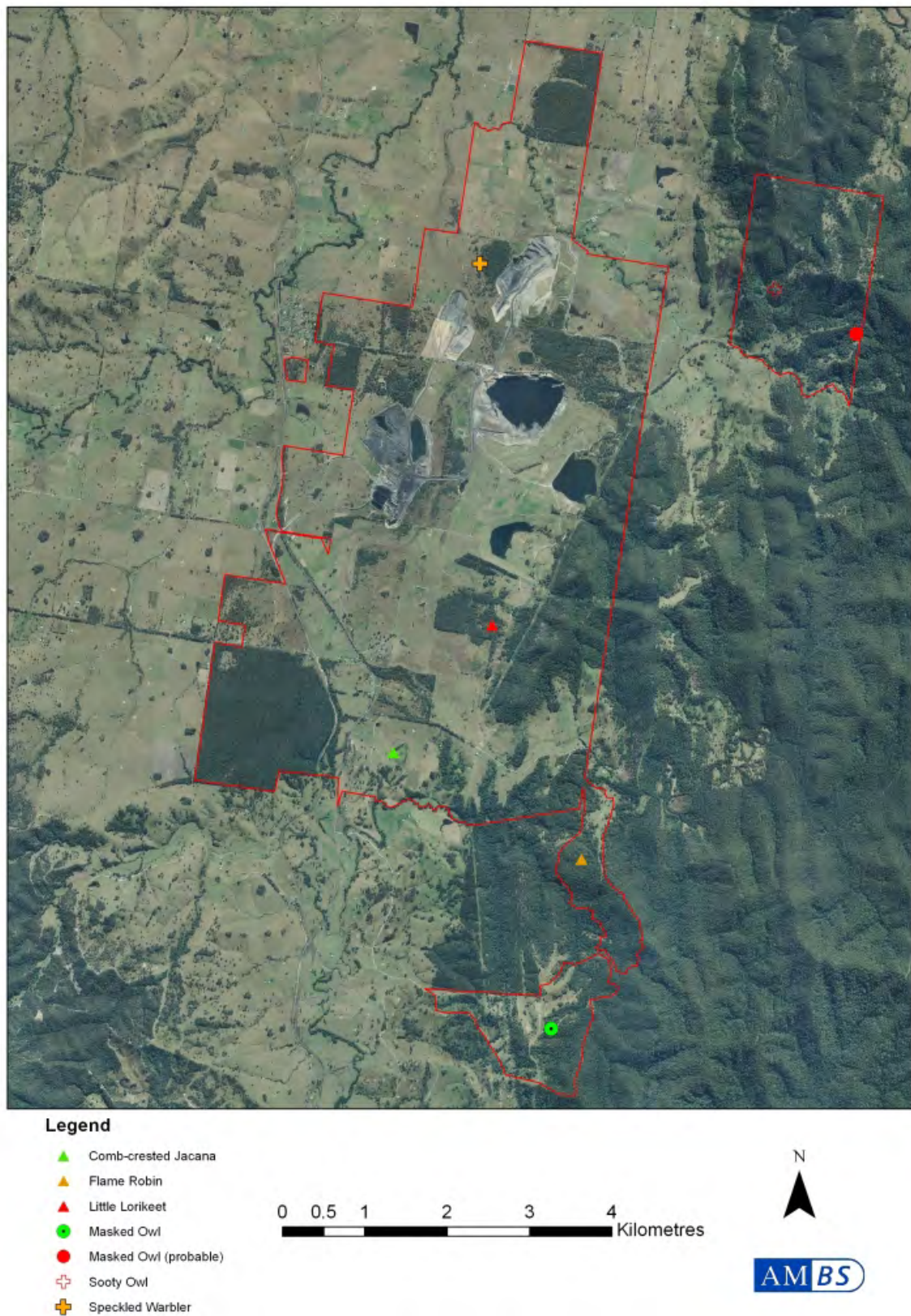


Figure 11: Threatened fauna locations (Comb-crested Jacana, Flame Robin, Little Lorikeet, Masked Owl, Sooty Owl, Speckled Warbler, Grey-headed Flying-fox).

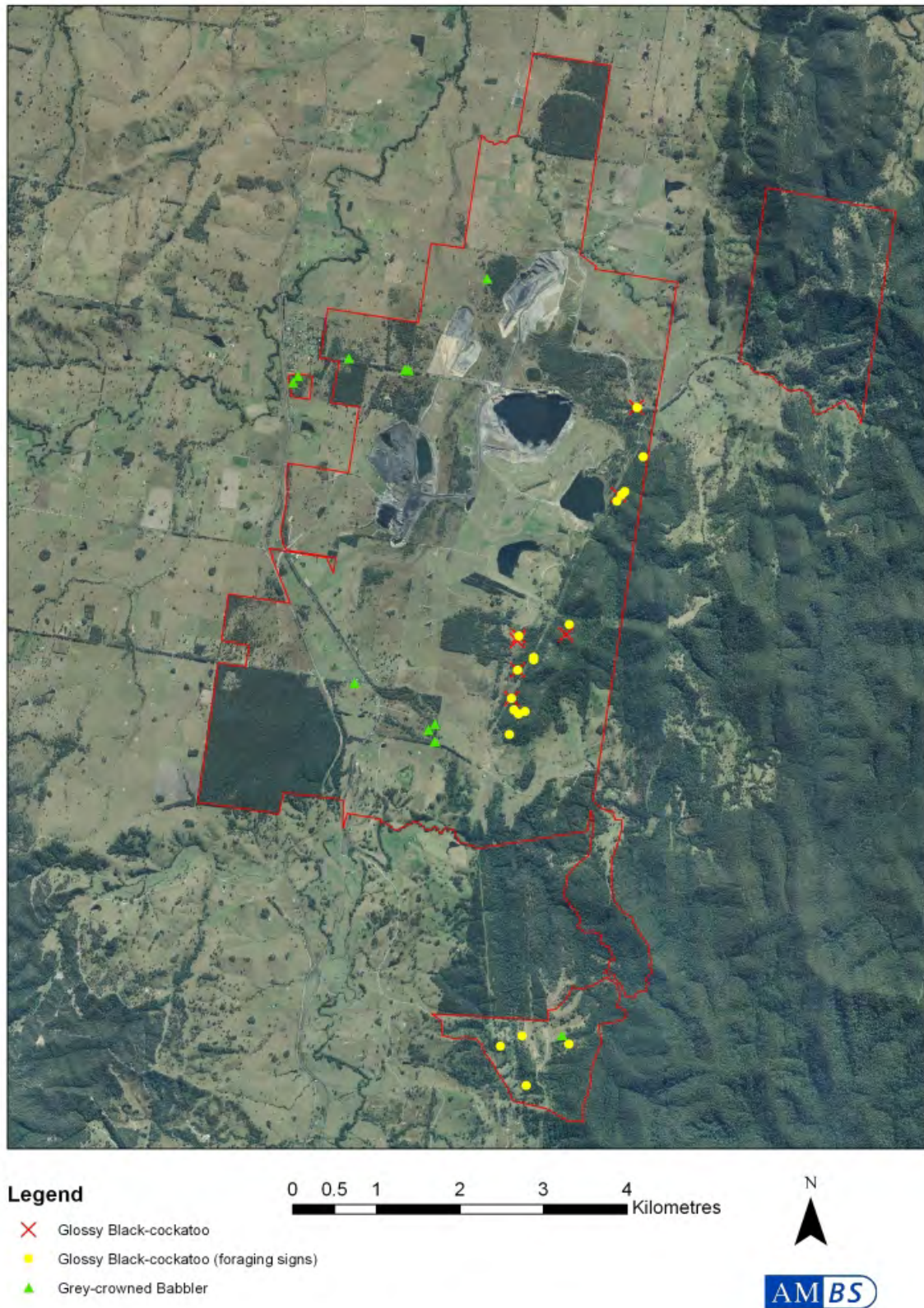


Figure 12: Glossy Black-cockatoo and Grey-crowned Babbler (eastern subspecies) locations.

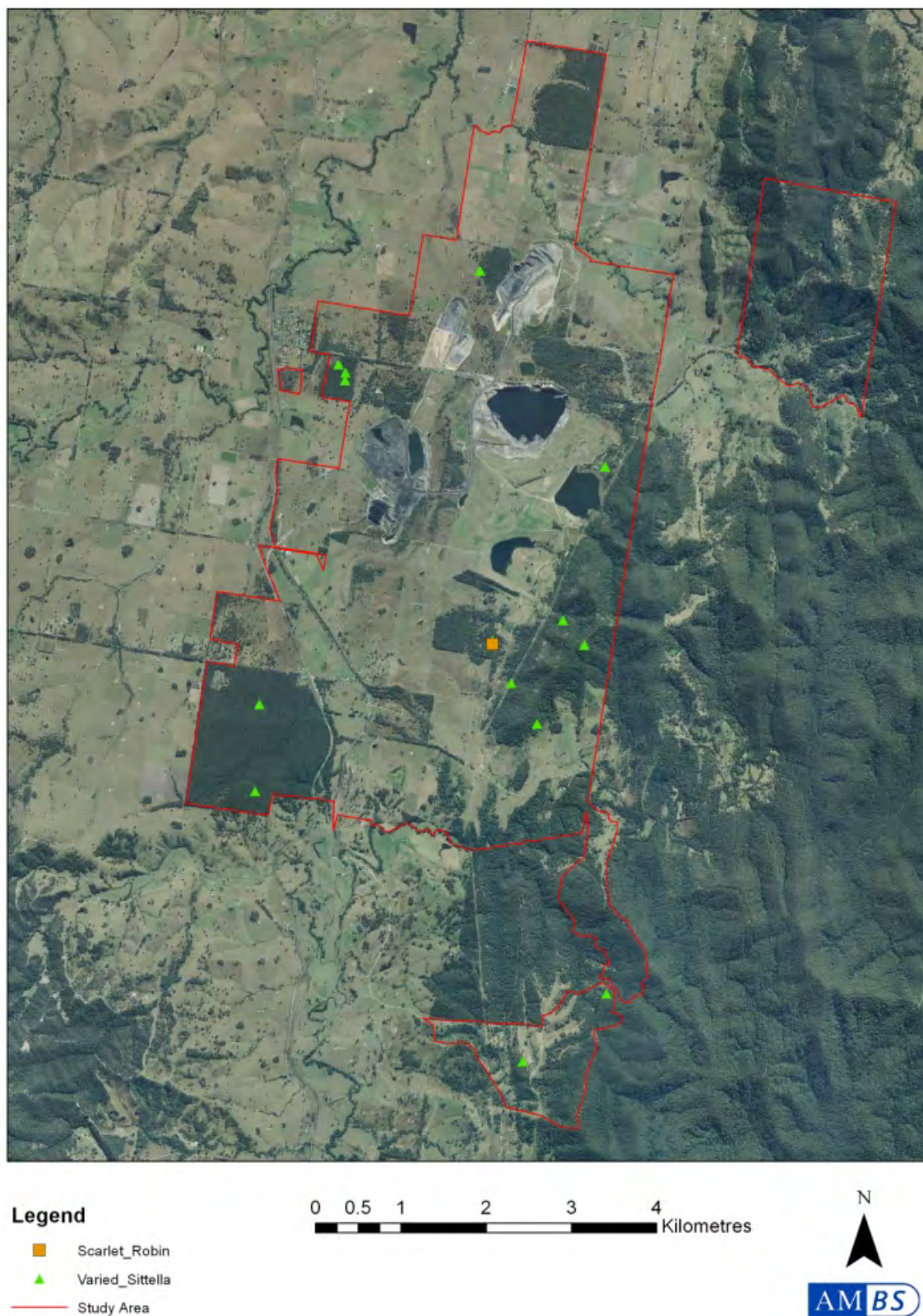


Figure 13: Scarlet Robin and Varied Sittella locations.

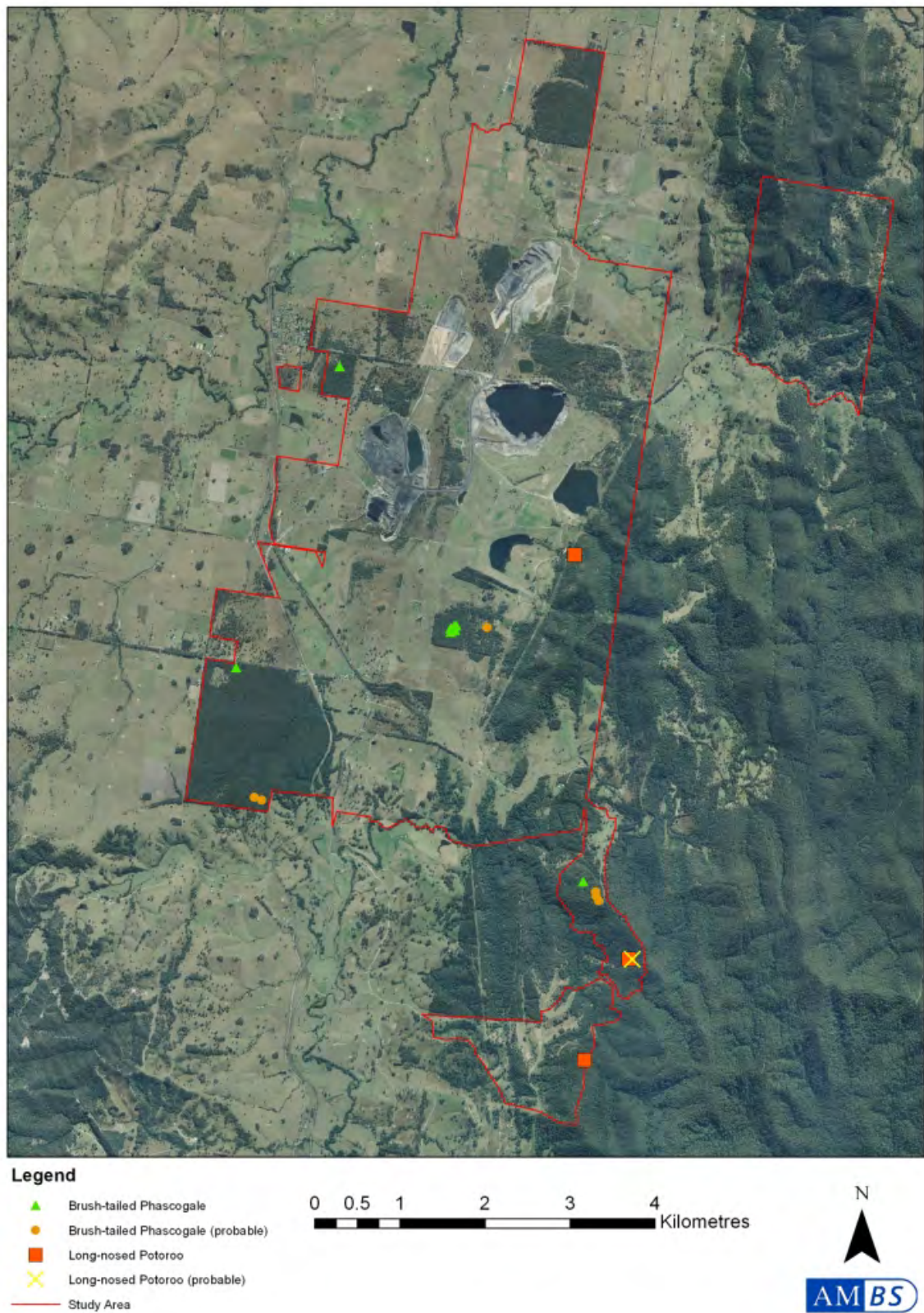


Figure 14: Brush-tailed Phascogale and Long-nosed Potoroo locations.

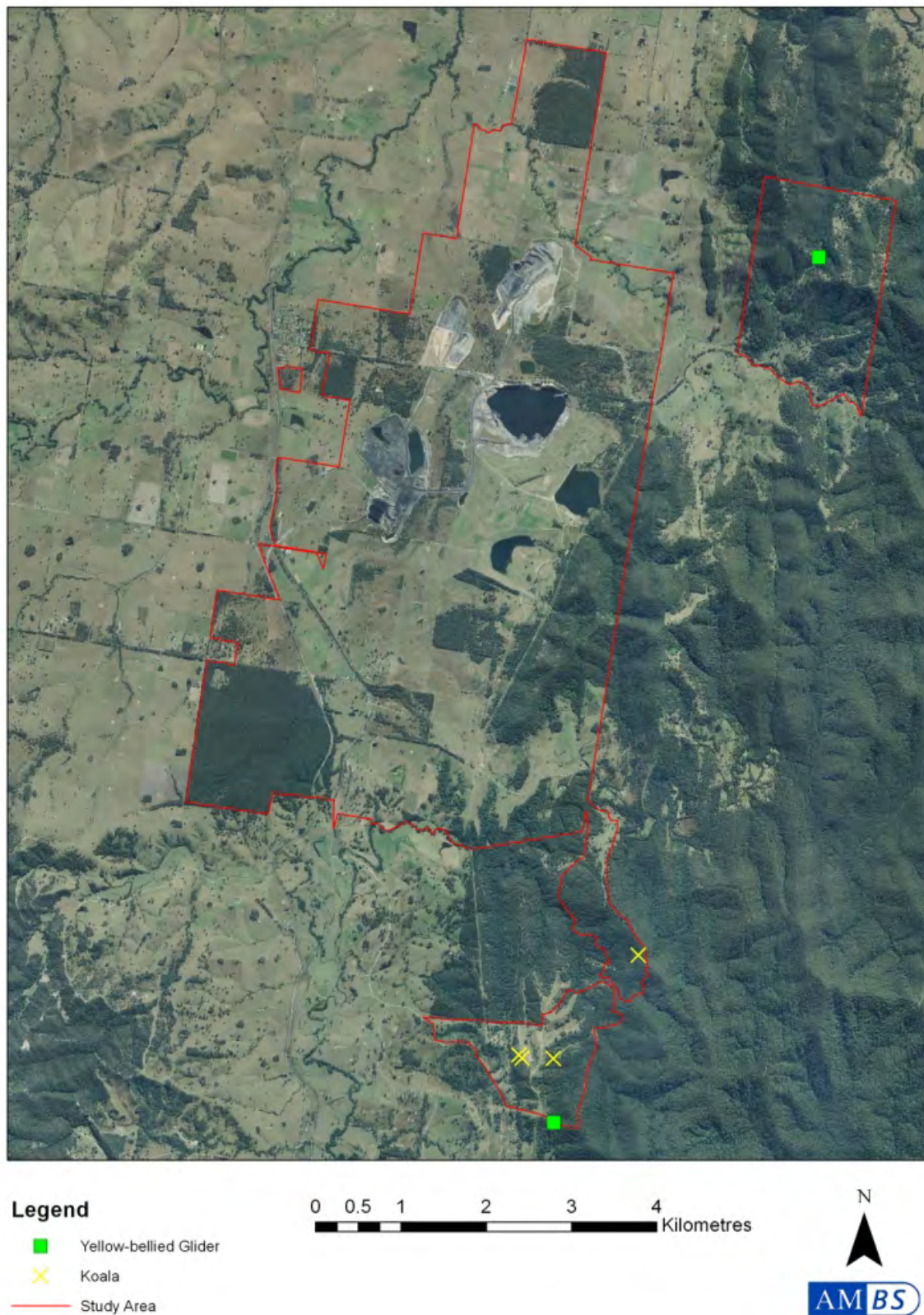


Figure 15: Yellow-bellied Glider and Koala locations.

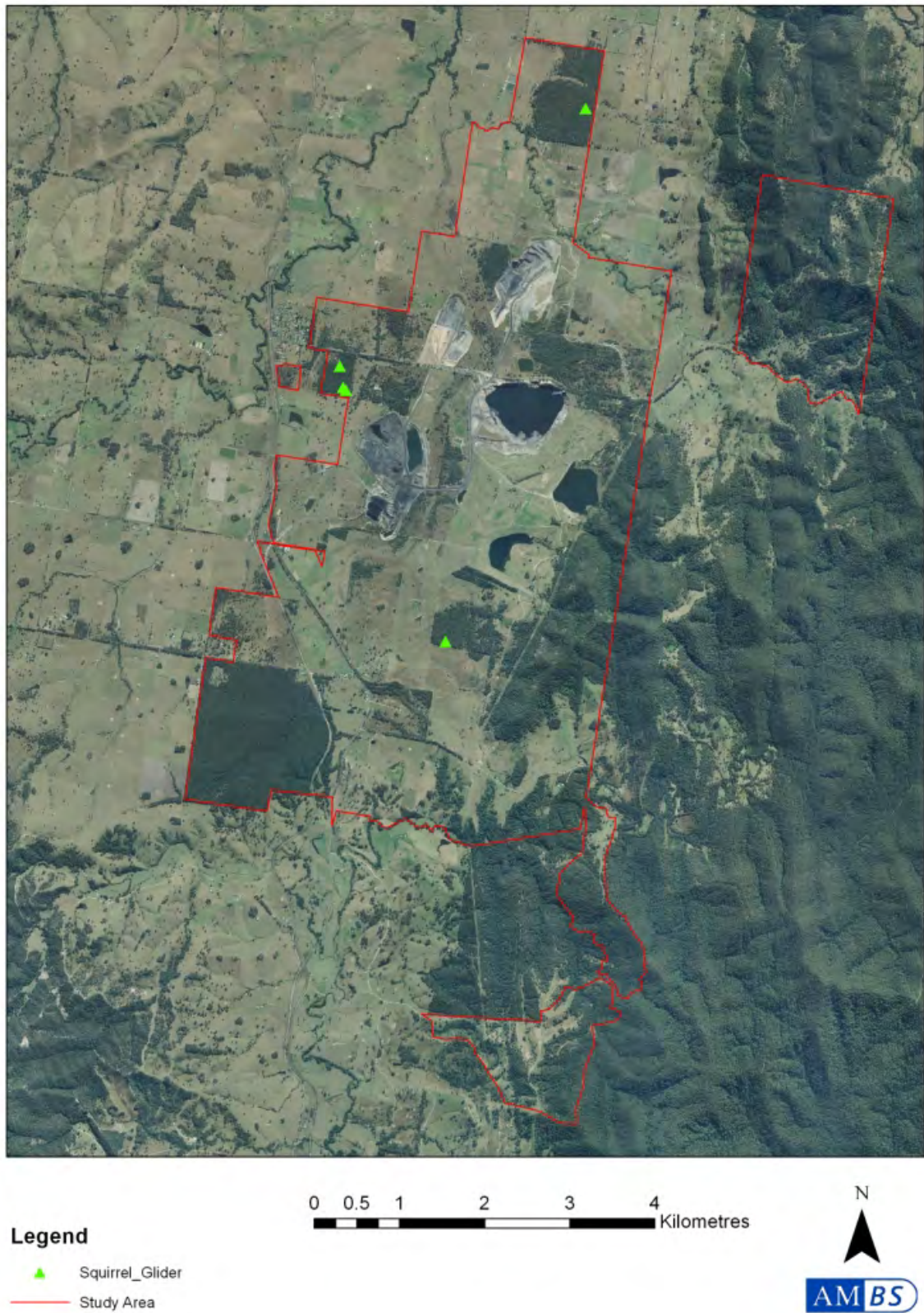


Figure 16: Squirrel Glider locations.

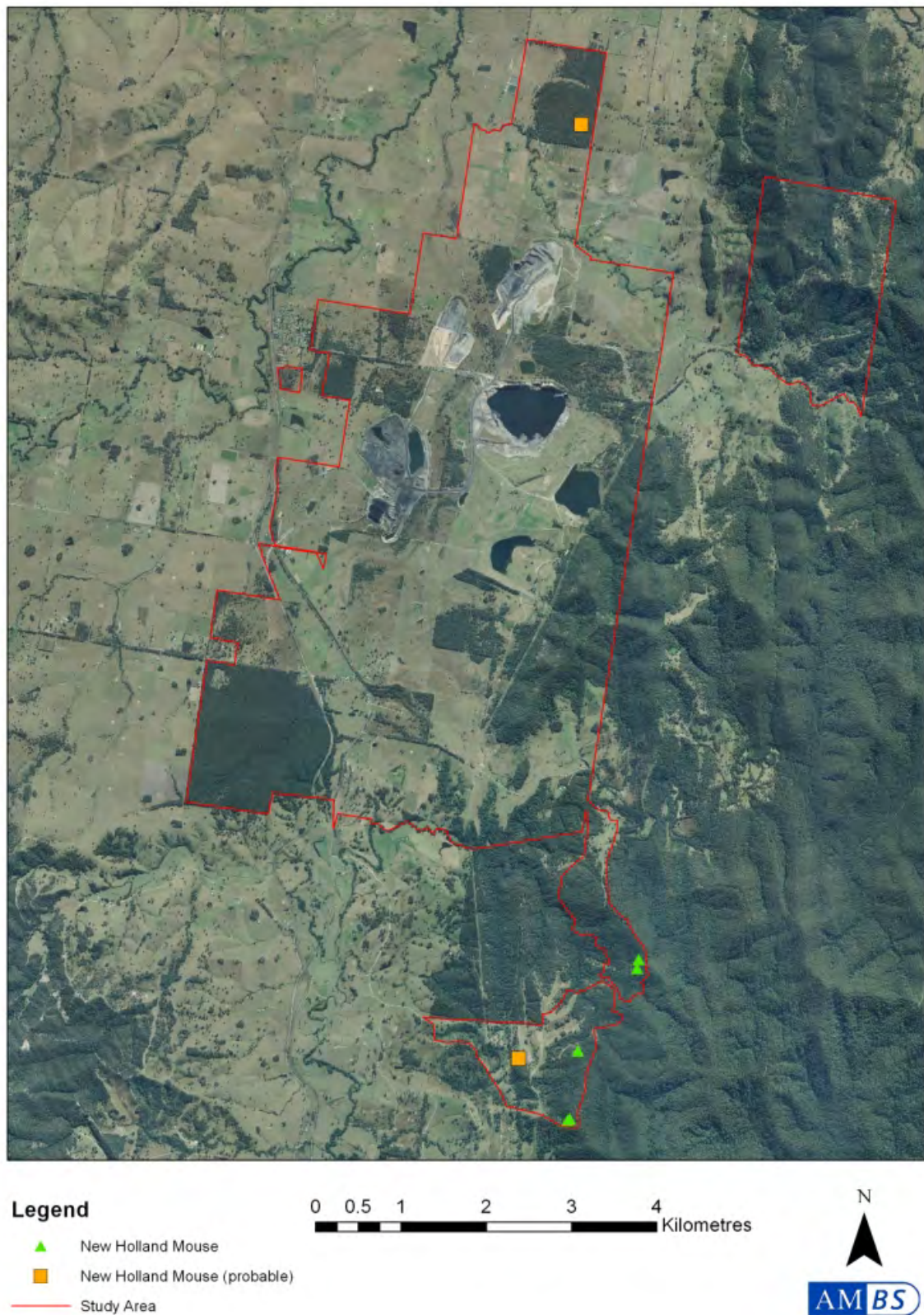


Figure 17: New Holland Mouse locations.

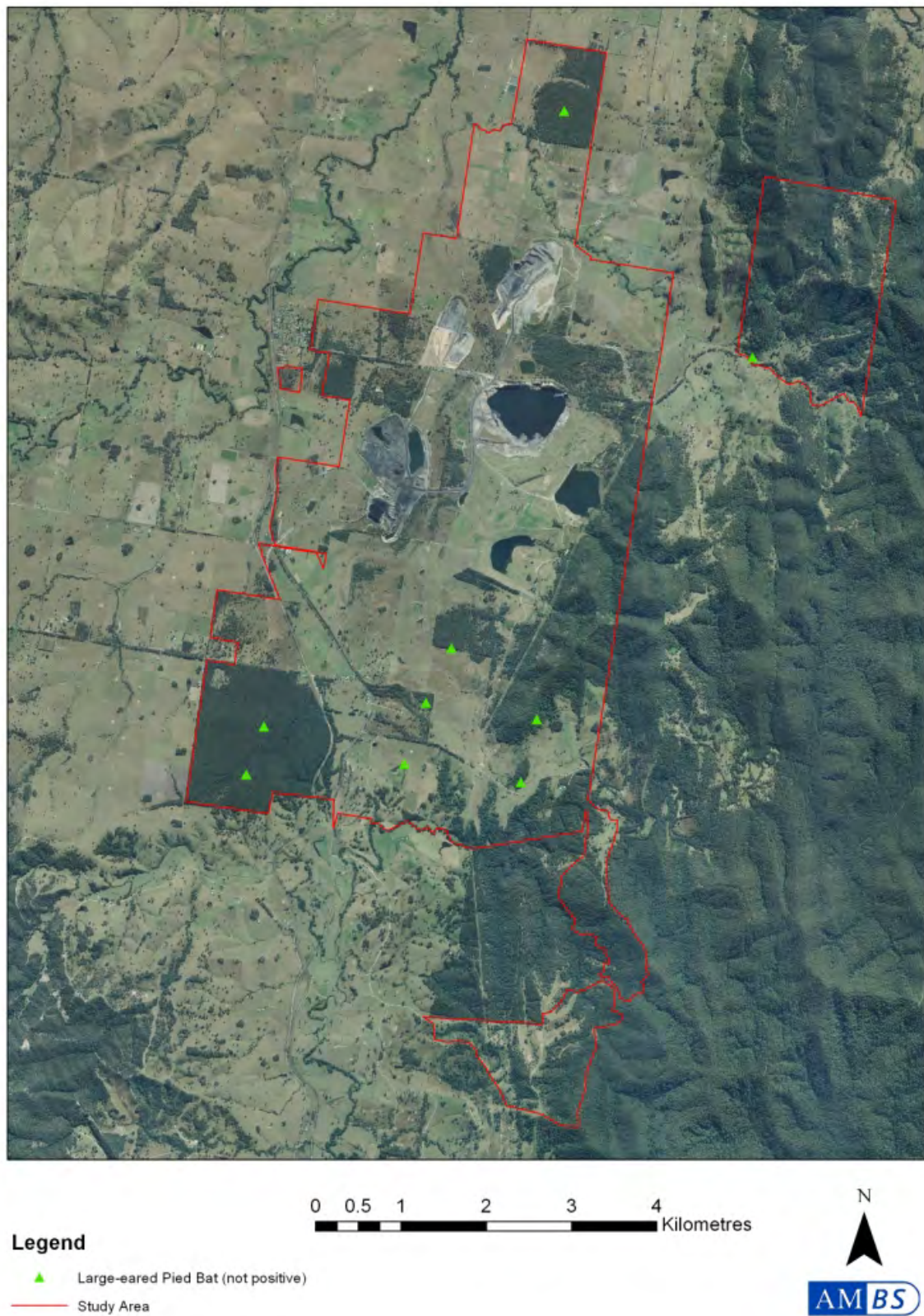


Figure 18: Large-eared Pied Bat locations.

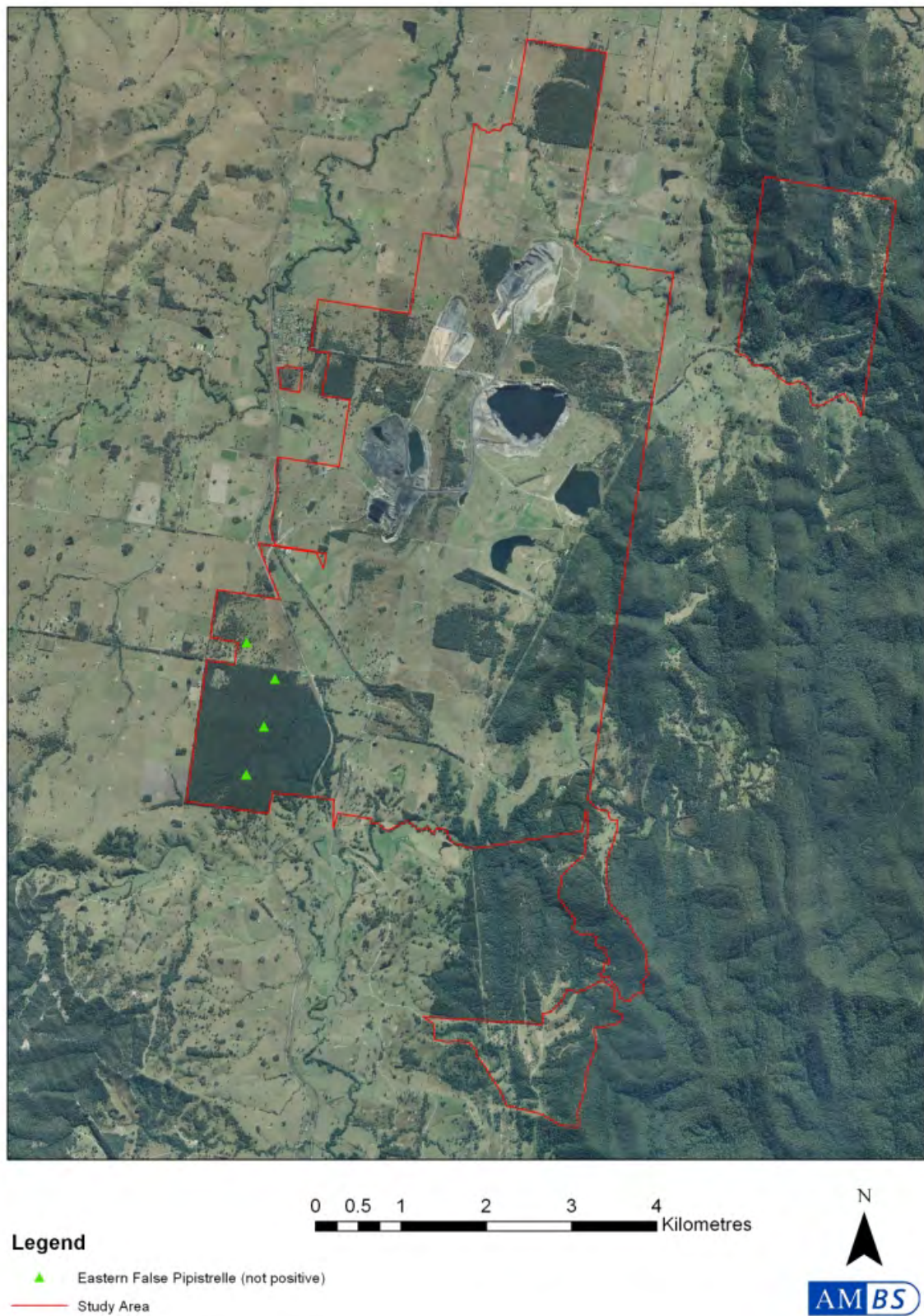


Figure 19: Eastern False Pipistrelle locations.

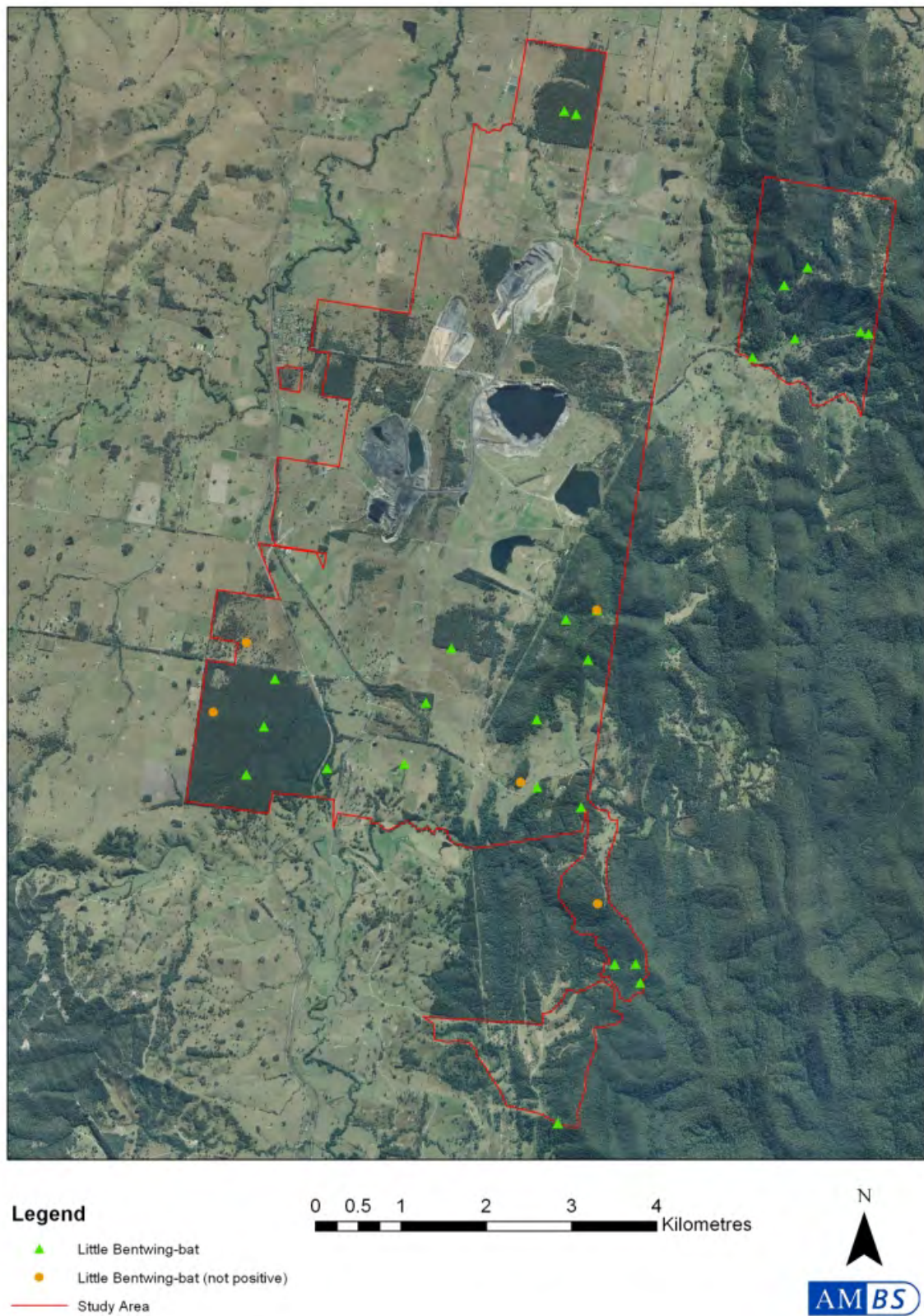


Figure 20: Little Bentwing-bat locations.

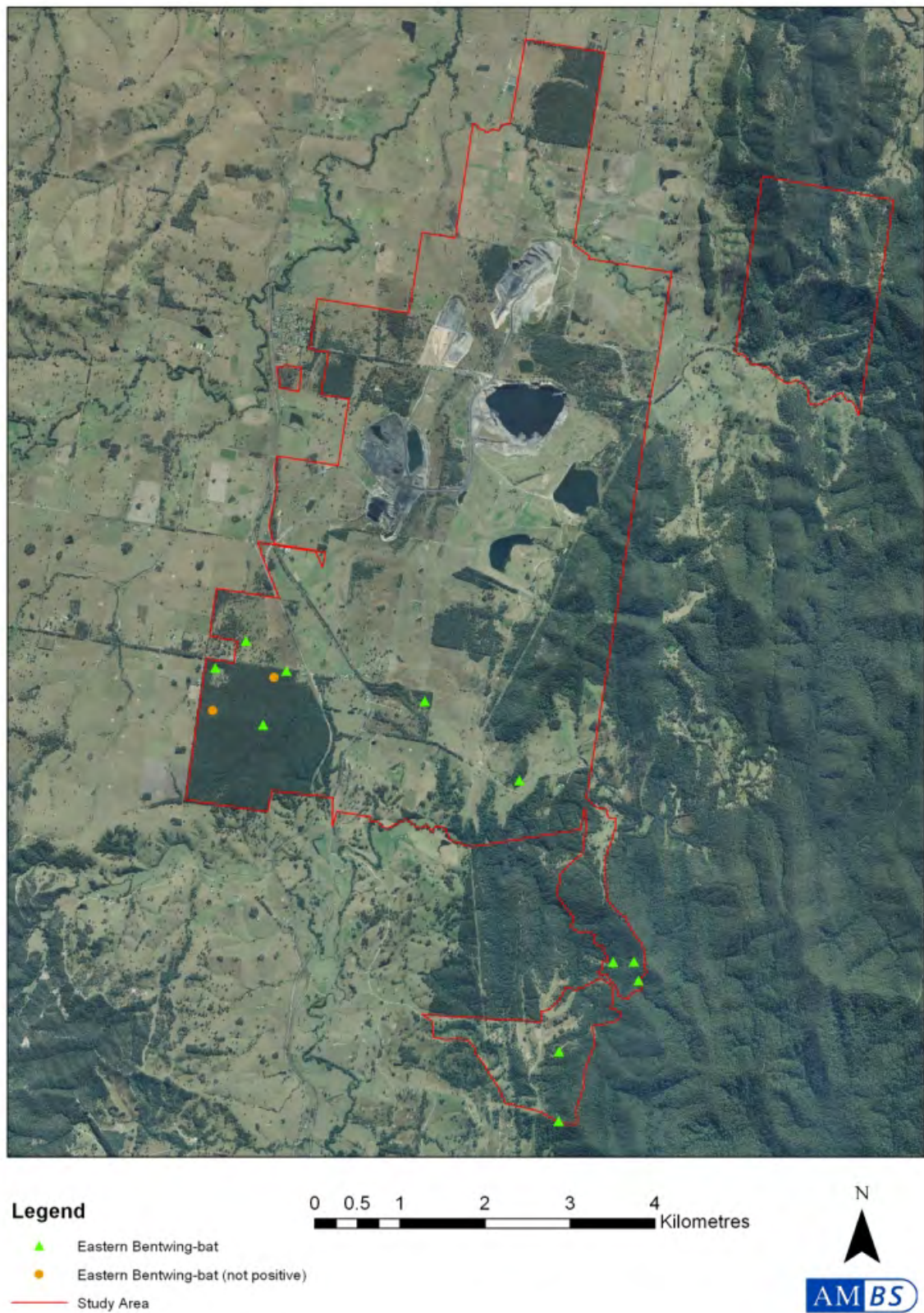


Figure 21: Eastern Bentwing-bat locations.

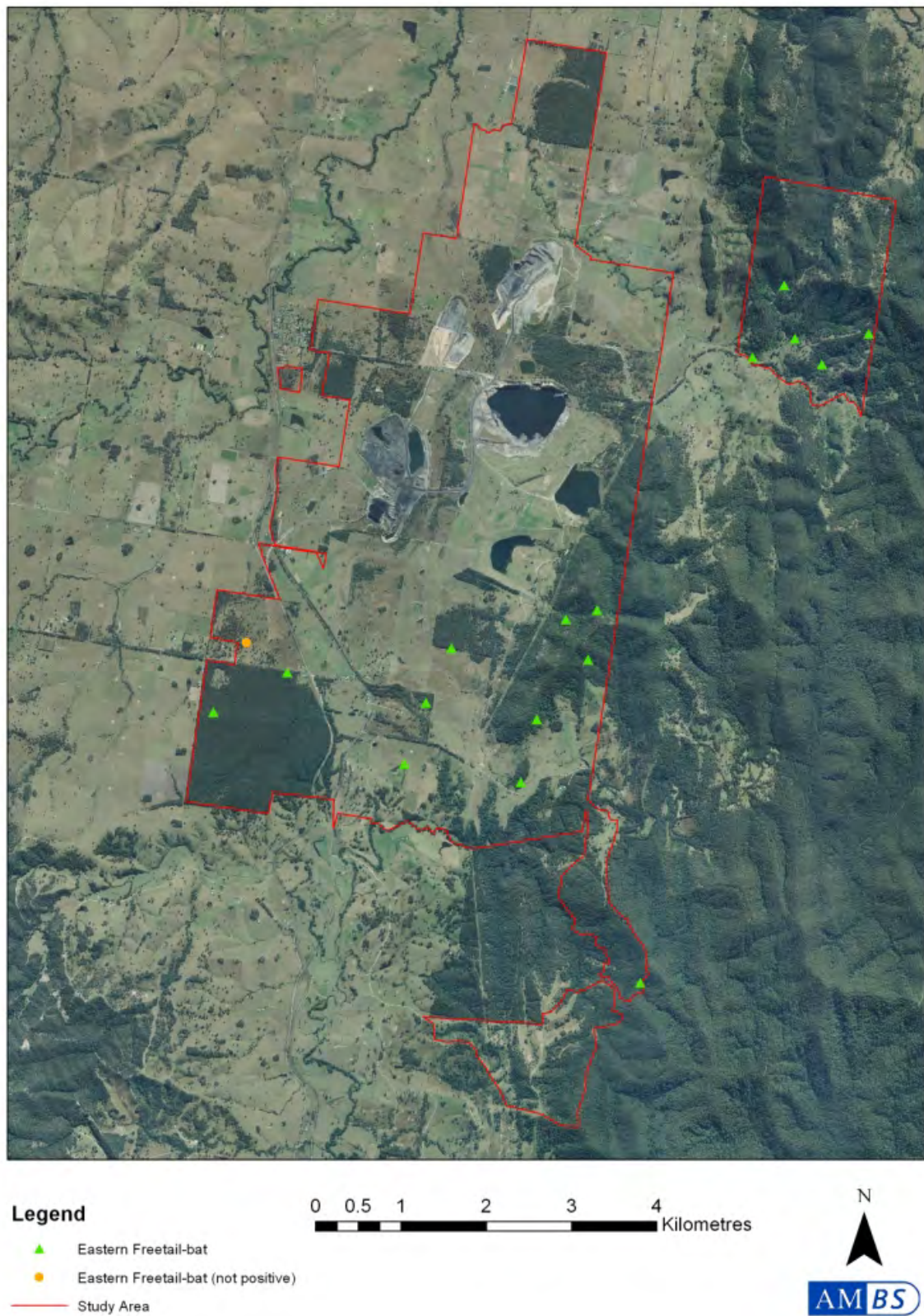


Figure 22: Eastern Freetail-bat locations.

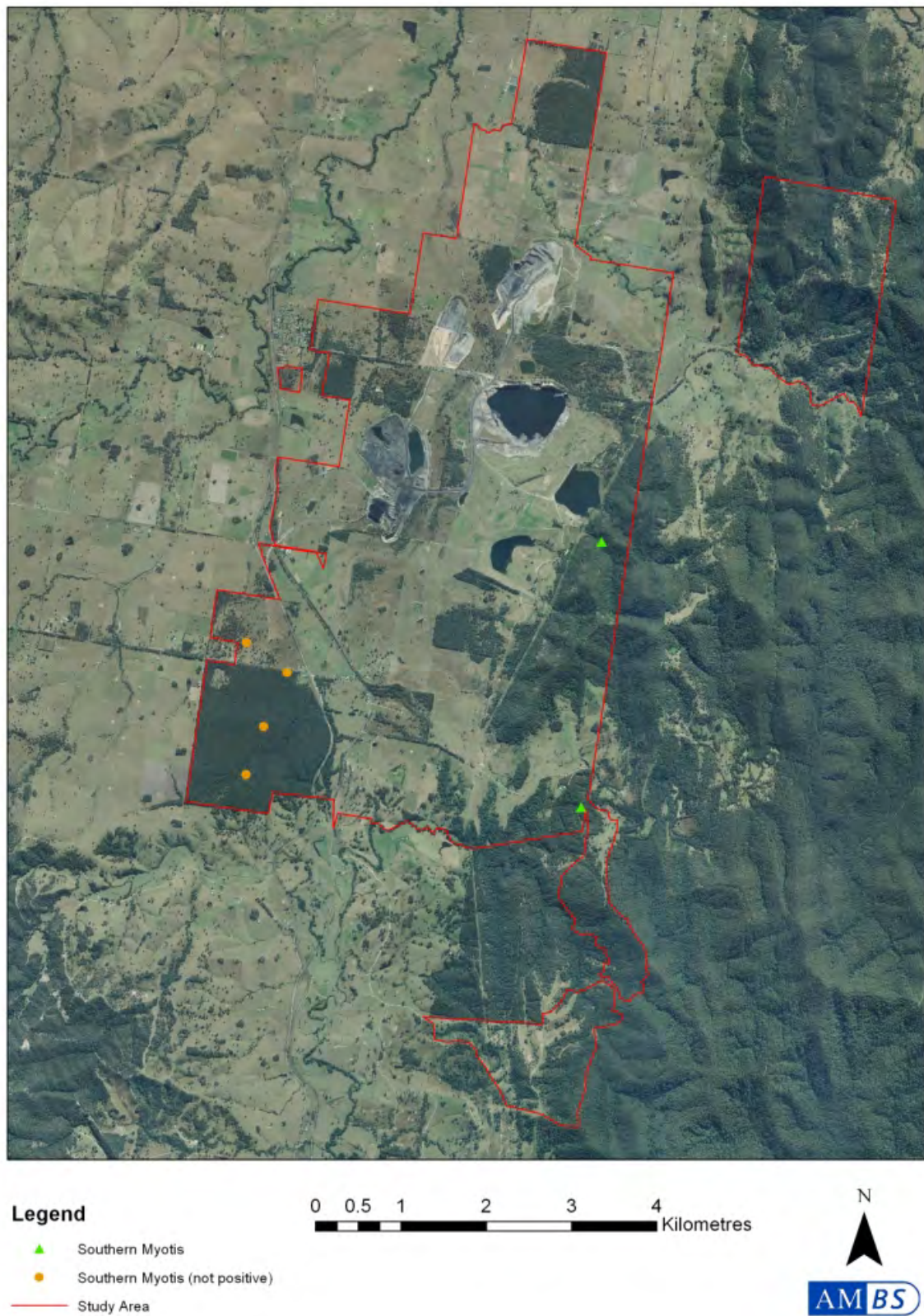


Figure 23: Southern Myotis locations.

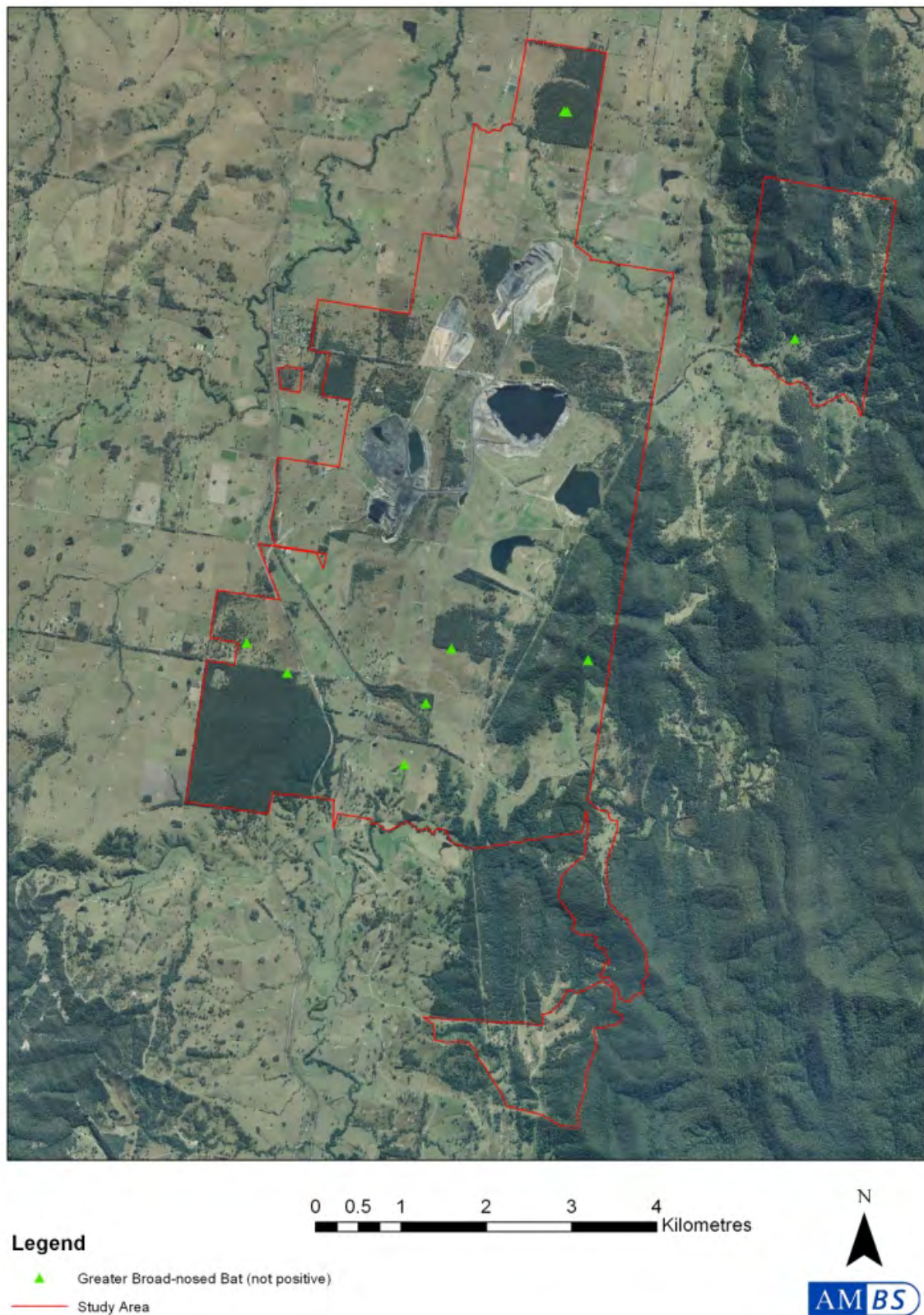


Figure 24: Greater Broad-nosed Bat locations.

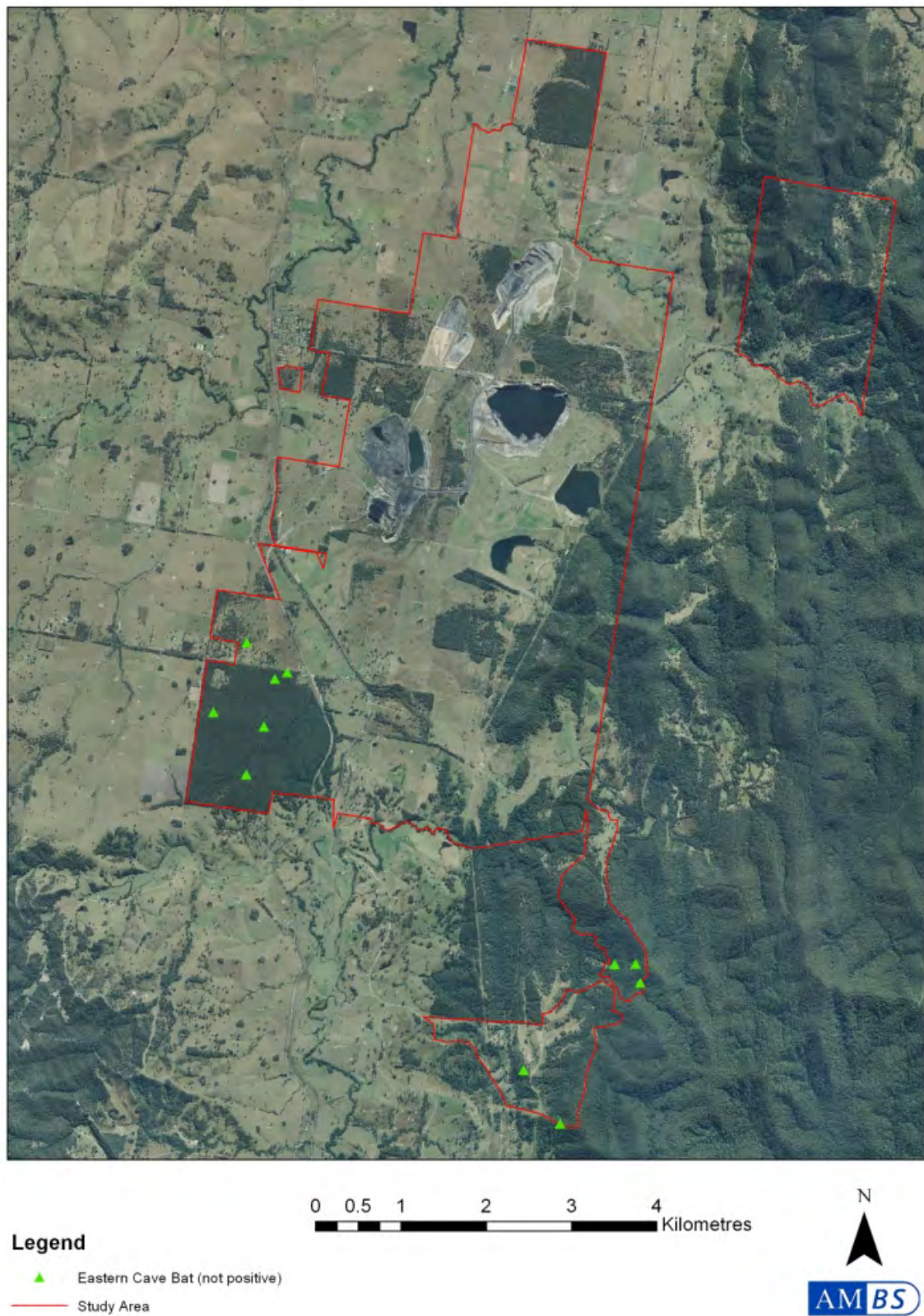


Figure 25: Eastern Cave Bat locations.

Sooty Owl *Tyto tenebricosa*

The Sooty Owl was recorded on 3 October 2011 during a vehicle spotlighting transect (Figure 11). One individual was observed flying from a tree across the track before landing in another tree. The individual was observed with a spotlight for approximately one minute before flying off again. The Sooty Owl can occur in a variety of habitats including rainforest, subtropical and warm temperate rainforest, and wet eucalypt forests. They require large tree hollows for nesting. The species could potentially occur throughout most of the study area.

Masked Owl *Tyto novaehollandiae*

The Masked Owl was recorded on 14 September 2011 during a standard call playback survey in the south eastern section of the study area (Figure 11). One individual responded to conspecific call broadcast. Due to the species being positively recorded, call broadcasting of the Masked Owl was not undertaken during subsequent surveys at this location.

A probable record of the species was also recorded on 3 October 2011 during vehicle spotlighting transect in the north eastern section of the study area. A very large light-coloured forest owl was observed flying across in front of the vehicle. Based on the colouration, size and flight pattern it is probable the individual was a Masked Owl.

The Masked Owl inhabits primarily dry sclerophyll forest and woodlands, but may roost and breed in wet eucalypt forests and gullies. They require large tree hollows for nesting. Potential habitat for this species exists throughout most locations of the study area.

Speckled Warbler *Pyrholaemus sagittatus*

The Speckled Warbler was recorded on 29 June 2011 during a standard diurnal bird survey (Figure 11). Two individuals were recorded in dry forest/woodland in the northern area of the study area. The Speckled Warbler inhabits a variety of eucalypt dominated communities, usually with a grassy understorey and sparse shrub layer. They require large undisturbed remnants. Habitat for this species is not likely to be extensive throughout the study area.

Flame Robin *Petroica phoenicea*

The Flame Robin was recorded during September 2011 from a remote monitoring camera (Figure 11). The species was recorded on at least two different days from the same camera, and it is possible it was the same individual. The camera was positioned in Wet Sclerophyll Forest in the southern area of the study area. The Flame Robin breeds in tall wet eucalypt forest, usually in areas with an understorey dominated by native grasses and sparse shrubs. They migrate to drier lowland habitats during winter. Potential habitat for the species occurs throughout most of the study area.

Scarlet Robin *Petroica boodang*

The Scarlet Robin was recorded on 29 June 2011 during a standard diurnal bird survey (Figure 13). One individual was recorded within Dry Sclerophyll Forest in the southern area of the study area. The Scarlet Robin inhabits dry eucalypt forests and woodlands, usually with an open grassy understorey. Potential habitat for the species occurs throughout most of the dry lowland habitats in the study area.

Grey-crowned Babbler (eastern subspecies) *Pomatostomus temporalis temporalis*

The Grey-crowned Babbler (eastern subspecies) was recorded on 11 occasions during the current surveys (Figure 12). Group sizes ranged from two individuals to seven, and mostly occurred within Dry Sclerophyll Forest in lowland areas. Nests were observed in locations north of the study area. Potential habitat for the species occurs throughout most of the dry lowland habitats in the study area.

Varied Sittella *Daphoenositta chrysoptera*

The Varied Sittella was recorded on 14 occasions during the current surveys, within dry and wet eucalypt forest (Figure 13). The species inhabits dry or wet eucalypt forests and woodlands, particularly areas with rough-barked species or trees with many dead branches. Potential habitat for the species occurs throughout most of the study area.

Brush-tailed Phascogale *Phascogale tapoatafa*

The Brush-tailed Phascogale was positively recorded on seven occasions during the current surveys with a variety of methods (Figure 14). These records were obtained through trapping, hair analysis, scat identification and camera monitoring. In addition, hair analysis and scat identification has provided probable identification in six other locations. The species inhabits primarily dry sclerophyll open forest or woodland, with sparse groundcover and abundant fallen timber. Potential habitat for the species is extensive in the lowland woodland habitats, but patchier throughout other locations of the study area.

Koala *Phascolarctos cinereus*

The Koala was recorded on four occasions during the current study from both dry and wet sclerophyll forest (Figure 15). Two of the records were from the identification of scats and one was from a monitoring camera. The final record was of the species bellowing during forest owl call broadcasting (two individuals were heard). The Koala inhabits dry or wet eucalypt forests and woodlands. Potential food trees for the species occur throughout most of the study area in varying densities.

Yellow-bellied Glider *Petaurus australis*

The Yellow-bellied Glider was recorded on two occasions during the current study within wet sclerophyll forest (Figure 15). The first was on 14 September 2010, in which one individual was heard during a call-playback session conducted in the southern section of the study area. In the same location but during spotlighting on the same evening, a second individual was heard. On 3 October 2011, two individuals were heard in the northern section of the study area. They were heard prior to the commencement of a call playback session. The species inhabits tall wet eucalypt forest and requires tree hollows for nesting. Potential food trees for the species occur throughout most of the wet sclerophyll forested locations of the study area.

Squirrel Glider *Petaurus norfolcensis*

The Squirrel Glider was recorded on five occasions during the current survey within dry sclerophyll forest (Figure 16). On 21 September 2011, the species was recorded responding to conspecific call broadcasting. On all other occasions the individuals were observed during spotlighting. On one occasion (16 September 201), within the small bushland block in the north-west of the study area, one individual was observed carrying leaves in its tail to a tree hollow. The species inhabits mature dry woodlands, preferring mixed species stands and a diverse shrub understorey, including *Acacia* spp. Potential habitat for the species occurs throughout most of the dry lowland habitats in study area, but is patchy elsewhere.

Long-nosed Potoroo *Potorous tridactylus*

The Long-nosed Potoroo was positively recorded from three locations using remote monitoring cameras (Figure 14). In the southern section of the study area, individuals were recorded within wet sclerophyll forest and more than once at each camera during the monitoring period. In the eastern section of the Proposed Offset Investigation Area, two individuals were recorded in the same image on several occasions. Here, they were recorded in dry sclerophyll forest adjacent to wet sclerophyll forest with a dense ferny understorey. The species inhabits coastal heaths, or dry and wet sclerophyll forests. They require a dense understorey with occasional open areas for foraging. Potential habitat for the species is patchy throughout the study area.

New Holland Mouse *Pseudomys novaehollandiae*

The New Holland Mouse was positively recorded on five occasions in the southern section of the study. This included four individuals, as one individual was recaptured (Figure 17). In each location, habitat for the species was classified as wet or dry eucalypt forest with a sparse shrub layer and grassy understorey. In two other locations, a *Pseudomys* sp. was recorded from a hair sample. It is considered likely these were from the New Holland Mouse. Potential habitat for the species is patchy throughout the study area.

Grey-headed Flying-fox *Pteropus poliocephalis*

The Grey-headed Flying-fox was recorded on 22 September 2011, foraging within a flowering *Eucalyptus* sp. (Figure 11). Three individuals were observed. This species inhabits a variety of habitats, foraging on the nectar and pollen of native trees (particularly *Eucalyptus* spp.), but also *Melaleuca* spp. and *Banksia* spp. and fruits of rainforest species. Potential habitat for the species occurs throughout most of the study area.

Large-eared Pied Bat *Chalinolobus dwyeri*

The Large-eared Pied Bat was possibly recorded from Anabat units during the current study (Figure 18). The species produces calls similar to Gould's Wattled Bat, but several brief and noisy calls were considered highly likely to be attributable to the Large-eared Pied Bat. The species roosts primarily in caves which are limited throughout the study area. It is possible that the species would forage throughout most habitats within the study area.

Eastern False Pipistrelle *Falsistrellus tasmaniensis*

The Eastern False Pipistrelle was possibly/probably recorded from Anabat units during the current study (Figure 19). The species prefers moist habitats, and roost primarily in tree hollows, but may also roost under bark or in buildings. Potential roosting and foraging habitat occurs throughout most of the study area.

Little Bentwing-bat *Miniopterus australis*

The Little Bentwing-bat was recorded from 25 locations throughout the study area, including both wet and dry sclerophyll forest (Figure 20). Three of these locations caught a total of six individuals in Harp traps, the remainder were from Anabat units. The species roosts in caves, tree hollows and potentially a variety of man-made structures (e.g. buildings and mines). Potential roosting and foraging habitat occurs throughout most of the study area.

Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*

The Eastern Bentwing-bat was positively recorded from 11 locations throughout the study area from Anabat units, including both wet and dry sclerophyll forest (Figure 21). Two additional locations recorded possible calls from the species. They primarily roost in maternity caves, but may disperse up to 300 km. Potential foraging habitat for the species occurs throughout most of the study area.

Eastern Freetail-bat *Mormopterus norfolkensis*

The Eastern Freetail-bat was positively recorded from 16 locations throughout the study area from Anabat units, including both wet and dry sclerophyll forest (Figure 22). One additional location recorded possible calls from the species. They primarily roost in tree hollows, but may also utilise man-made structures or loose bark. Potential foraging and roosting habitat for the species occurs throughout most of the study area.

Southern Myotis *Myotis macropus*

The Southern Myotis was positively recorded from two locations, from Harp traps within creeks (Figure 23). Ten individuals were caught at one location on 22 September 2011 and two individuals were trapped at the second location on 14 October 2011. The species was possibly recorded from Anabat units from four other locations, although these identifications are considered unlikely due to the type of habitat present. The species roosts in hollow trees, under bridges, mine shafts or dense vegetation. Foraging occurs over water and potential foraging and roosting habitat is considered limited throughout the study area.

Greater Broad-nosed Bat *Scoteanax rueppellii*

The Greater Broad-nosed Bat was possibly recorded from nine locations from Anabat units during the current study (Figure 24). The species inhabits mainly wet sclerophyll forest, but may also occur in dry woodlands and forests. They roost in tree hollows. It is possible the species could forage and roost in locations throughout the study area.

Eastern Cave Bat *Vespadelus troughtoni*

The Eastern Cave Bat was possibly recorded from nine locations from Anabat units during the current study (Figure 25). The species roosts in caves and forages primarily within dry open forest. The Eastern Cave Bat is unlikely to roost in the study area, but potential foraging habitat exists.

3.3 Habitat Descriptions

Classification of broad habitat types was initially based on information from the vegetation type mapping (Figure 10). Within each vegetation type, the structural features of the vegetation and other habitat features were used to identify potential resources for threatened fauna. The broad fauna habitats identified are described in the following sections.

3.3.1 Rainforest

Within the study area rainforest habitats are composed of two vegetation types (Figure 10):

1. Giant Stinging Tree – Fig dry subtropical rainforest of the north Coast and Brigalow Belt South (HU548)
2. Weeping Lilly Pilly – Water gum Riparian Rainforest of the Southern North Coast (HU651)

Photographs showing typical rainforest habitat within the study area are shown on Plate 1.



Plate 1: Rainforest habitat within the Study Area.

Rainforest habitats have a relatively limited distribution within the study area and Vegetation Type 1 occurs in a small patch in the east of the current study area (Figure 10). It is a moist closed forest with a dense canopy, midstorey and understorey composed of rainforest species. The canopy was approximately 20 m high. Vines and small ferns were common throughout and leaf litter was abundant. A rocky creek extended through the centre but despite recent rains water was limited. Leaf litter was present but thin.

Vegetation Type 2 occurs in the south-west of the study area (Figure 10). The canopy was approximately 20 to 35 m tall and common species included Stringybarks, Spotted Gums and Ironbarks. The midstorey and understorey were sparse, composed mainly of rainforest species including Grey Myrtle (*Backhousia myrtifolia*) and *Pittosporum* spp. Leaf litter was thin and sparse. A creek extended through the centre. The banks were steep, composed of soil and erosion was evident. Water was present throughout most of the creek.

Rainforest habitat similar to this rainforest type occurred in the north-eastern area of the study area. The canopy was tall and dense, composed of a mixture of *Eucalyptus* spp. and rainforest species. The midstorey and understorey varied from dense to sparse, was composed mainly of rainforest species and vines were common. Leaf litter also varied from sparse to abundant. No water bodies occurred within this habitat in this section of the study area.

3.3.2 Riparian Forest

Riparian Forest habitat occurs north of the Project area, along Avon River and Dog Trap Creek (Figure 10) and is consistent with Vegetation Type 3 (Plate 2). This area of habitat has been significantly disturbed by previous vegetation clearing and is now entirely surrounded by farmland. Most of the tree and shrub cover has been removed from the edges of the banks, leaving a narrow strip of vegetation. The previous vegetation clearing combined with the impact of cattle accessing the creeks has led to the further degradation of the creek bank, with erosion evident throughout. Overall the condition of fauna habitat in this area was poor. The area was not considered to provide any potential habitat for threatened frogs that could occur in the locality. Connectivity with other areas of native vegetation is poor.



Plate 2 Riparian Forest habitat within the Study Area – Vegetation Type 3

3.3.3 Dry Sclerophyll Forest

Within the study area dry sclerophyll forests are composed of the following vegetation types (Figure 10):

10. Spotted Gum – Grey Ironbark dry open forest of the lower foothills of the Barrington Tops, North Coast (HU630).
11. Smooth-barked Apple – White Stringybark Shrubby Forest;
12. Rough-barked Apple Grassy Open Forest on Valley Flats of the North Coast and Sydney Basin (HU605).

Dry sclerophyll forests are widespread throughout the study area. In most areas there was evidence of previous clearing events. Impacts from other disturbances, such as cattle grazing or weeds, were variable throughout. Photographs showing Dry Sclerophyll Forest habitat are shown on Plates 3 to 5.

Vegetation Type 10 (Plate 3) was widespread throughout the east, north and south-west study area (Figure 10) of the current Stratford mining lease.

In the eastern portion of the study area, the habitat was generally composed of open forest between 20 to 35 m high (average approximately 30 m), with most areas classified as early mature to mature. Some areas contained emergent mature or late mature trees but these were not dominant across the landscape. The canopy trees were a mixture of *Eucalyptus* spp., with common species including Ironbarks, Spotted Gum (*Corymbia maculate*), Stringybarks and Mahoganies. The midstorey and understorey varied from sparse to mid-dense and provided good structural diversity in patches. Regrowth *Eucalyptus* spp. were common throughout, as were other understorey species *Exocarpus* sp., *Podolobium* sp., *Persoonia* sp. and *Acacia* spp. The abundance of *Allocasuarina* spp. varied from absent to common, being more common lower on the western slope than the ridge top. The ground cover was also variable, dominated by native grasses in some areas and bare rock in others. Weeds were occasional throughout, although some areas contained patches of dense Lantana thickets. Hollow bearing trees and fallen logs were scattered throughout but were considered uncommon. Rock crevices were mostly absent, with the exception of some areas on the eastern side of the ridge, where rocky outcrops occur. There was little evidence of cattle grazing.



Plate 3: Dry Sclerophyll Forest Habitat, eastern slope – Vegetation Type 10



Plate 4: Dry Sclerophyll Forest Habitat, valley – Vegetation Type 10.



Plate 5: Dry Sclerophyll Forest – Vegetation Type 11.

Dry Sclerophyll Forest throughout the valley areas were similar age and structure in comparison to the habitats on the slope. The canopy trees were similar, being a mixture of *Eucalyptus* spp. The midstorey was sparse, dominated by regrowth *Eucalyptus* spp. or *Melaleuca* spp. Where *Melaleuca* spp. were present the midstorey increased in density. Small shrub composition was slightly different, with species such as *Bursaria* sp., *Ozothamnus* sp. and *Daviesia* spp becoming more common. Other small shrubs such as *Persoonia* sp. and *Acacia* spp were still present. *Allocasuarina* spp. were mostly absent but occurred occasionally.

The ground cover was sparse, mostly composed of native grasses and leaf litter, with weeds being rare. Similar to the slope habitat, hollow bearing trees were mostly uncommon, however in some locations (e.g. woodland in southern Stratford mining lease and AGL site) more were recorded than anywhere else in the study area. Similarly, the abundance of fallen logs throughout the study area was variable, with some locations containing less than 30 m per 0.5 ha, and others containing greater than 100 m. Rock crevices were mostly absent, and there was little evidence of cattle grazing.

The understorey was very sparse, in some locations appearing as though it was recovering from a recent clearing event. In these locations, the ground cover had been moderately to severely impacted by grazing.

The area of land to the north of the current Stratford mining lease (owned by AGL), is very similar to this community in terms of the habitat structure and features.

Vegetation Type 11 (Plate 5) occurred in one small area north of the study area. It was characterised as an early to mature woodland with canopy height of 20 to 35 m (average approximately 20 m). Stringybarks dominated the canopy, and *Melaleuca* spp. were present in the very sparse midstorey. The shrub layer was dense providing good structure and was dominated by *Banksia* spp. and *Leptospermum* spp. with other shrubs being less common (e.g. *Acacia* spp., *Persoonia* spp.). The ground cover was heavily dominated by native grasses, with grass trees scattered throughout. *Allocasuarina* spp. was absent, leaf litter was sparse and weeds were rare. There was no evidence of grazing by cattle. Hollow bearing trees, fallen logs and rock crevices were very uncommon.

Vegetation Type 12 occurred in the eastern portion of the study area (Figure 10). It was highly fragmented and degraded due to extensive historical clearing. Currently the fauna habitat is limited to scattered paddock trees. There was no understorey and ground cover features were mostly absent.

3.3.4 Wet Sclerophyll Forest

Within the study area wet sclerophyll forests are composed of the following vegetation types (Figure 10):

4. Tallowwood – Brush Box – Sydney Blue Gum moist shrubby forest on coastal foothills of the Southern North Coast;
5. Grey Gum – Tallowwood Spotted Gum Forest and Woodland;
6. Tallowwood – Small-fruited Grey Gum dry grassy open forest of the foothills of the North Coast;
7. Spotted Gum – Red Mahogany – Grey Gum Forest and Woodland.

Photographs showing wet sclerophyll forest habitat are shown on Plates 5 to 7.

Vegetation Type 4, 5 and 6 (Plate 6) occurred in the eastern portion of study area (Figure 10). Generally composed of open forest between 20 to 35 m high (average approximately 30 m), most areas were classified as early mature to mature. Some areas contained emergent mature or late mature trees but these were not dominant across the landscape. Canopy trees were a mixture of *Eucalyptus* spp. Common species included Tallowwoods, Ironbarks, Stringybarks, Mahoganies, Spotted Gums and *Angophora* spp. The midstorey was a dominant feature of the habitat and was composed of small trees, mostly regrowth *Eucalyptus* spp., *Allocasuarina* spp. and Turpentines. The shrub layer was generally sparse, but diverse (e.g. *Acacia* spp., *Leucopogon* spp., *Persoonia* spp., *Podolobium* spp.). The ground cover was highly variable; in some locations thick native grasses dominated, in others there was a dense ferny understorey. In some locations the ground cover was sparse, with a mixture of rock, thin litter and grasses.



Plate 6: Wet Sclerophyll Forest Habitat, eastern slope - Vegetation Type 4, 5 and 6.

Hollow bearing trees were mostly uncommon, but were present in varying sizes. Fallen logs were abundant but rock crevices were not observed. Weeds were generally rare on the west facing slope, becoming more common on the eastern side of the ridge and the south facing slope. There was little evidence of cattle grazing with the exception of the south facing slope.

Vegetation Types 5 and 6 (Plate 7) occurred in the southern section of the study area (Figure 10). Habitat throughout these vegetation types was highly variable. Age and structure was generally similar to the forest on the eastern slope. Habitat was open forest between 20 to 35 m high (average approximately 30 m), most areas were classified as early mature to mature. Some areas contained emergent mature or late mature trees but these were not dominant across the landscape. Similarly, some locations contained forest dominated by young to early mature regrowth. Canopy trees were a mixture of *Eucalyptus* spp., with common species including Ironbarks, Spotted Gums, Grey Gum (*Corymbia maculata*) and Stringybarks. The midstorey was composed of regrowth *Eucalyptus* spp., *Allocasuarina* spp. and Turpentines. The *Allocasuarina* spp. were less widespread compared with locations on the eastern slope, but did occur in several dense stands in which chewed cones were observed. The shrub layer was generally sparse, but diverse (e.g. *Acacia* spp., *Persoonia* spp., *Podolobium* sp.). In the gullies or near creeks, rainforest species became more common including Grey Myrtle (*Backhousia myrtifolia*) and *Pittosporum* spp. The ground cover was mostly composed of a variety of native grass and leaf litter, with Blady Grass (*Imperata cylindrica*) being particularly widespread. Hollow bearing trees were mostly uncommon, but were present in varying sizes.

Fallen logs were abundant, with greater than 100 m per 0.5 hectare (ha) recorded in several locations. Rock crevices were generally uncommon. Weeds were mostly rare with the exception of some gully areas in the southern section of the study area. There was little evidence of grazing.



Plate 7: Wet Sclerophyll Forest Habitat, southern study area – Vegetation Types 5 and 6.

Vegetation Type 7 occurred in the central section of the study area. It was associated with disturbed gullies, having been severely degraded by previous land clearing. *Eucalyptus* spp. were present in the canopy, but the understorey contained weedy components. A variety of native shrubs were recorded however on the edge of the cleared land and lower within the gully habitat.

Undescribed vegetation communities occur within the property in the north eastern section of the study area (Plate 8). Wet Sclerophyll Forest communities occurred throughout most of the property. The gentle slopes and ridge tops have been severely impacted by land clearing and cattle grazing. Most of the forest was classified as young to early mature due to previous clearing, however some hollow bearing large old trees were scattered throughout the landscape, providing habitat for a range of fauna. The understorey and ground cover was mostly absent due to previous disturbance and ongoing grazing by cattle. The best areas of habitat occurred within the gully systems. These areas have not been as severely impact by previous land clearing or ongoing cattle grazing. Canopy trees were generally 20 to 35 m high (average approximately 30 m), with most areas classified as early mature to mature. Canopy trees were a mixture of *Eucalyptus* spp., with species including Blue Gums, Tallowwoods, Ironbarks and Spotted Gums. Regrowth *Eucalyptus* spp. were present in the midstorey along with other mesic species. The understorey varied from sparse to dense, depending on the composition of natives (e.g. *Acacia* spp.) or weeds (e.g. *Lantana*). *Allocasuarina* spp. varied from absent to occasional throughout the habitat.

The ground cover was a mixture of leaf litter, grasses and weeds, which were generally common throughout. Vines were common in the gully areas. The abundance of fallen logs varied with location, some areas contained none, while others contained more than 70 m per 0.5 ha. Similarly, tree hollow numbers were variable, indicating they are present but not evenly distributed.



Plate 8: Wet Sclerophyll Forest Habitat, north eastern Study Area.

3.3.5 Grassy Woodland

Within the study area grassy woodlands are composed of the following vegetation types (Figure 10):

8. Cabbage Gum open forest or woodland on flats of the North Coast and new England Tablelands (HU526); and
9. Grey Box – Forest Red Gum – Grey Ironbark open forest of the hinterland ranges of the North Coast (HU549).

Vegetation Type 8 occurred in the valley, in central locations of the study area (Plate 9). The habitat within this community was relatively simple and homogenous. The canopy averaged approximately 20 m high but was very sparse, composed of young Cabbage Gums and other scattered *Eucalyptus* spp. The midstorey was dense, dominated by *Melaleuca* spp. averaging approximately 15 m high. Shrubs were mostly absent, and the ground cover was heavily dominated by grasses, most of which were native. No hollow bearing trees were observed, and ground cover features such as rock crevices, fallen logs and branches, were mostly absent.

Photographs showing grassy woodland habitat within the study area are shown on Plates 8 and 9.



Plate 9: Grassy Woodland Habitat, central study area – Vegetation Type 8.

Vegetation Type 9 was patchily distributed throughout the southern area of the study area (Figure 10). Most of the vegetation type was classified as early to mature, but some areas of young vigorous regrowth were observed. The canopy ranged from 15 to 35 m high, averaging approximately 30 m. Common species included Forest Red Gum (*Eucalyptus tereticornis*), Ironbarks, Stringybarks, Grey Gums and Spotted Gum (*Corymbia maculate*). The midstorey and understorey were generally open and sparse, composed of regrowth *Eucalyptus* spp., *Allocasuarina* sp., *Exocarpus* sp., and a variety of native shrubs (e.g. *Acacia* spp., *Personia* spp., *Podolobium* sp.). The ground cover was mostly a mixture of native grasses (e.g. *Imperata cylindrical*), leaf litter and bracken, but some rocky open areas were observed. Tree hollows were uncommon, but small hollows were observed in a few locations. Fallen logs were abundant in some locations and absent in others. Weeds were generally rare throughout.



Plate 10: Grassy Woodland Habitat – Vegetation Types 8 and 9.

3.3.6 Aquatic habitats

The quality of riparian habitats was generally low throughout the study area. The most widespread habitat type was artificial dams. These occurred throughout most of the lowland areas. They varied from containing dense aquatic vegetation (e.g. *Typha* sp.) to being completely devoid of any type of vegetation. In most case, the dams are fairly isolated within the landscape, and the banks were often impacted by cattle. The one large dam present (dam where the Comb-crested Jacanas were recorded) contained a reasonable amount of floating vegetation. Several large artificial dams occur within the study area, which provide some potential habitat for threatened water birds that could occur in the study area.

Creek systems within the study area also generally low quality (e.g. Vegetation Type 9). Much of the lowland areas have been cleared, and this has affected the quality of the streams. The creek banks now only contain narrow strips of riparian vegetation, and have often been impacted by cattle, leading to ongoing erosion. In many locations there is little fringing vegetation. However, there were several locations within the study area in which the creek systems provided reasonable habitat for native fauna (e.g. the creeks where the Southern Myotis were captured). There are areas within the creek systems which contain reasonable habitat, such as abundant fallen logs and deep leaf litter, but these areas are small, isolated and patchy throughout the landscape. Furthermore, in locations where these habitat features are more extensive, the creek was usually observed to be dry. Due to this, potential habitat for threatened frogs is limited within the study area. Nonetheless, the aquatic habitats throughout the study area provide habitat for a reasonable diversity of native frogs. Aquatic habitats within the study area are shown on Plate 11.



Plate 11: Aquatic Habitats within the Study Area.

3.3.7 Disturbed Vegetation Types

In some locations throughout the study area the habitat has been severely disturbed or modified by land clearing. These areas generally contained no understorey with canopy trees. In some locations where vegetation did occur, it was restricted to very young vigorous regrowth, recovering from clearing approximately 10 years ago. Ground cover features were mostly absent (e.g. fallen logs, fallen branches), and no tree hollows or rock crevices were observed. In some locations the impact of land clearing has been worsened by ongoing cattle grazing, preventing the re-establishment of a native understorey. This was observed in Dry Sclerophyll Forests and Grassy Woodlands within the study area. Photographs of disturbed dry sclerophyll forest within the study area are shown on Plate 12.



Plate 12: Disturbed Dry Sclerophyll Forest within the Study Area.

In other locations throughout the study area the habitat has been severely modified due to weed invasions (e.g. Lantana). This often occurred in gully areas, or on land which was impacted by cattle. These processes reduce the suitability of habitat for most threatened fauna which could occur in the study area.

Most of the gully habitat east of the current Stratford mining lease is badly impacted by weeds. Fauna habitat in the north-eastern section of the study area has been severely impacted by cattle grazing, reducing most of the native ground cover. In locations where cattle cannot access (e.g. gullies) most of the habitat has been invaded by weeds. Photographs of habitat impacted by grazing and weeds are shown on Plate 13.



Plate 13: Habitat Impacted by Grazing (left) and Weed Invasion (right).

3.3.8 Cleared Land

Heavily disturbed habitat occurs in the north-eastern section of the study area shown as Vegetation Type 13 (Figure 10). Despite previous clearing, this area is now dominated by dense grassy ground cover or dense thickets of *Leptospermum* sp. and scattered canopy trees. This provides habitat for a range of native fauna.

Vegetation Type 14 (Figure 10) has a very limited distribution in the centre of the valley within study area. It occurs adjacent to an area of Grassy Woodland and Dry Sclerophyll Forest. Given the small size, it mainly provides additional habitat resources for fauna which may use the areas of bushland it is adjacent to.

Vegetation Type 15 (Figure 10) has a very limited distribution in the centre of the study area. Canopy trees were sparse, restricted to scattered *Melaleuca* spp. The ground cover was composed of a variety of grasses, sedges and rushes. Little water was present at the time of the surveys. The habitat is very isolated within the landscape.

3.4 Threatened Species Habitat

The desktop review found that 57 threatened species listed under the TSC Act and/or EPBC Act, have been previously recorded or were predicted as having the potential to occur within a 20 km radius of the study area. Based on the habitat assessments it is considered that 40 of these species have potential to occur within the study area, although for some species this would be very unlikely (Table 8).

While hollow bearing trees were present across the landscape, they were variable in numbers, unevenly distributed, and were considered to be uncommon. In total, 84 trees with potential hollows were observed. These trees contained 134 potential small hollows, 78 potential medium hollows and 30 potential large hollows. Most locations throughout the study area contained less than 10 hollows per 0.5 hectare; however there were areas that contained more than 20 hollows per 0.5 hectare. The average densities of hollow bearing trees throughout the study area are mapped on Figure 27. The presence of hollow bearing trees provides important habitat for hollow-dependant threatened fauna species such as the Squirrel Glider, Glossy Black-cockatoo, Masked Owl and Sooty Owl, all of which have been recorded in the study area.

Other important habitat features such as fallen timber and old logs were present in varying densities throughout the study area. Some of the lowland woodland areas were abundant with fallen timber, providing excellent habitat for species such as the Brush-tailed Phascogale. However, old growth features suitable for species such as the Spotted-tailed Quoll may be limited in the study area. Nonetheless, it is possible this species could occasionally occur within the study area.

Table 8: Threatened fauna known or with potential to occur within the study area.

Group	Common Name	Scientific Name	Previously Recorded in Locality?	Potential Habitat in the Study Area
Frogs	Davies' Tree Frog	<i>Litoria daviesae</i>	Yes	Only known to occur above 400 m altitude, study area is less than 300 m. Unlikely to occur.
	Giant Barred Frog	<i>Mixophyes iteratus</i>	Yes	Marginal potential habitat occurs, has potential to occur.
	Green-thighed Frog	<i>Litoria brevipalmata</i>	Yes	Potential habitat limited, has some potential to occur. Very few recorded from the locality.
	Booroolong Frog	<i>Litoria booroolongensis</i>	Yes	No potential habitat observed during the surveys, unlikely to occur.
	Green and Golden Bell Frog	<i>Litoria aurea</i>	Yes	Potential habitat limited. Very few records from the locality, unlikely to occur.
	Stuttering Frog	<i>Mixophyes balbus</i>	Yes	Marginal potential habitat occurs, unlikely to occur in the study area.
Reptiles	Stephens' Banded Snake	<i>Hoplocephalus stephensii</i>	Yes	Potential habitat occurs, but is patchy throughout the study area. Has potential to occur.
Birds	Bush Stone-curlew	<i>Burhinus grallarius</i>	Yes	Potential habitat limited, unlikely to occur.
	Comb-crested Jacana	<i>Irediparra gallinacea</i>	Yes	Potential habitat limited.
	Australian Painted Snipe	<i>Rostratula australis</i>	No (predicted to occur)	Potential habitat limited, unlikely to occur.
	Flame Robin	<i>Petroica phoenicea</i>	Yes	Potential habitat throughout most of study area. Recorded during the current surveys.
	Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	Yes	Potential habitat throughout study area, although few historical records. Has potential to occur.
	Barking Owl	<i>Ninox connivens</i>	Yes	Potential habitat occurs. Very few records from the locality, unlikely to occur.
	Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	Yes	Potential foraging and nesting habitat occurs, recorded during the current surveys.
	Brown Treecreeper	<i>Climacteris picumnus</i>	Yes	Potential habitat throughout the lowland areas of the study area. Has not been recorded in the study area and few records exist from the locality. Unlikely to occur.
	Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	Yes	Potential habitat limited, unlikely to occur.
	Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	Yes	Potential habitat occurs throughout much of the lowland areas. Recorded during the current surveys.
	Little Eagle	<i>Hieraaetus morphnoides</i>	Yes	Potential habitat occurs.
	Little Lorikeet	<i>Glossopsitta pusilla</i>	Yes	Potential habitat occurs, recorded during the current surveys.
	Magpie Goose	<i>Anseranas semipalmata</i>	Yes	Potential habitat limited, although has potential to occur. Recorded during previous surveys.

Group	Common Name	Scientific Name	Previously Recorded in Locality?	Potential Habitat in the Study Area
	Masked Owl	<i>Tyto novaehollandiae</i>	Yes	Potential habitat occurs, recorded during the current surveys.
	Olive Whistler	<i>Pachycephala olivacea</i>	Yes	No potential habitat observed during current surveys, unlikely to occur.
	Powerful Owl	<i>Ninox strenua</i>	Yes	Potential habitat occurs.
	Regent Honeyeater	<i>Anthochaera phrygia</i>	Yes	Potential foraging habitat occurs, although very few records for the study area, unlikely to occur.
	Rose-crowned Fruit-Dove	<i>Ptilinopus regina</i>	Yes	Limited potential habitat, although has potential to occur in rainforest habitat or sheltered wet sclerophyll forest gullies.
	Scarlet Robin	<i>Petroica multicolor</i>	Yes	Potential habitat occurs, recorded during the current surveys.
	Sooty Owl	<i>Tyto tenebricosa</i>	Yes	Potential habitat occurs, particularly in rainforest habitat or sheltered wet sclerophyll forest gullies. Recorded during the current surveys.
	Superb Fruit-Dove	<i>Ptilinopus superbus</i>	Yes	Limited potential habitat, although has potential to occur in rainforest habitat or sheltered wet sclerophyll forest gullies.
	Turquoise Parrot	<i>Neophema pulchella</i>	Yes	Potential habitat occurs, very few records from the locality, unlikely to occur.
	White-fronted Chat	<i>Epthianura albifrons</i>	Yes	Potential habitat limited, very few records from the locality, unlikely to occur.
	Wompoo Fruit-Dove	<i>Ptilinopus magnificus</i>	Yes	Potential habitat limited, although has potential to occur.
	Swift Parrot	<i>Lathamus discolor</i>	Yes	Potential foraging habitat occurs. Could forage throughout the study area on occasion.
	Speckled Warbler	<i>Pyrrholaemus saggitatus</i>	Yes	Potential habitat patchy, limited largely to lowland valley areas. Recorded during the current surveys.
	Spotted Harrier	<i>Circus assimilis</i>	Yes	Potential habitat occurs.
	Varied Sittella	<i>Daphoenositta chrysoptera</i>	Yes	Potential habitat occurs throughout most of the study area, recorded during the current surveys.
	Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	Yes	Potential foraging habitat occurs, recorded during the current surveys. No known maternity caves in study area and these are unlikely to occur.
	Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	Yes	Potential roost sites and foraging habitat occurs. Recorded during current surveys.
	Golden-tipped Bat	<i>Kerivoula papuensis</i>	Yes	Potential habitat limited, although has potential to occur within some creek systems.
	Eastern Cave Bat	<i>Vespadelus troughtoni</i>	Yes	Potential foraging habitat occurs, possibly recorded during current surveys. No known maternity caves in study area and these are unlikely to occur.
	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	Yes	Potential roost sites and foraging habitat occurs. Possibly recorded during the current surveys.

Group	Common Name	Scientific Name	Previously Recorded in Locality?	Potential Habitat in the Study Area
	Little Bentwing-bat	<i>Miniopterus australis</i>	Yes	No known maternity caves in study area and these are unlikely to occur. Potential foraging habitat occurs, record during current surveys.
	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	Yes	Potential roost sites and foraging habitat occurs. Possibly recorded during current surveys.
	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Yes	Roosting caves limited unlikely to occur in the study area. Potential foraging habitat occurs, possibly recorded during the current surveys.
	Southern Myotis	<i>Myotis macropus</i>	Yes	Potential habitat occurs, recorded during the current surveys.
	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Yes	Potential foraging habitat occurs, recorded during the current surveys.
	Rufous Bettong	<i>Aepyprymnus rufescens</i>	Yes	Potential habitat is patchy throughout the study area. Very few records from the locality, has potential to occur.
	Common Planigale	<i>Planigale maculata</i>	Yes	Potential habitat is patchy throughout the study area, very few records from the locality. Unlikely to occur.
	Eastern Pygmy-possum	<i>Cercartetus nanus</i>	Yes	Potential habitat limited, unlikely to occur.
	Parma Wallaby	<i>Macropus parma</i>	Yes	Potential habitat occurs and is patchy throughout the study area. Very few records for the study area although has potential to occur.
	Red-legged Pademelon	<i>Thylogale stigmatica</i>	Yes	Potential habitat occurs.
	Yellow-bellied Glider	<i>Petaurus australis</i>	Yes	Potential habitat occurs, particularly in rainforest habitat or sheltered wet sclerophyll forest gullies. Recorded during the current surveys.
	Long-nosed Potoroo	<i>Potorous tridactylus</i>	Yes	Potential habitat is patchy throughout the study area. Recorded during the current surveys.
	Squirrel Glider	<i>Petaurus norfolcensis</i>	Yes	Potential habitat occurs, mostly within the lowland woodlands, elsewhere patchy. Recorded during the current surveys.
	Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	Yes	Habitat occurs throughout most of the study area, particularly the lowland woodlands. Has been recorded during current surveys.
	Brush-tailed Rock-wallaby	<i>Petrogale penicillata</i>	Yes	Potential habitat limited, unlikely to occur.
	Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	Yes	Potential habitat occurs.
	Koala	<i>Phascolarctos cinereus</i>	Yes	Potential habitat throughout most of study area. Recorded during the current surveys.
	Hastings River Mouse	<i>Pseudomys oralis</i>	No (predicted to occur)	No potential habitat observed during the current surveys, unlikely to occur.
	New Holland Mouse	<i>Pseudomys novaehollandiae</i>	Yes	Potential habitat is patchy throughout the study area, recorded during the current surveys.

Note: All species predicted to occur were only recorded in the EPBC Act Protected Matters Search (SEWPAC, 2011).

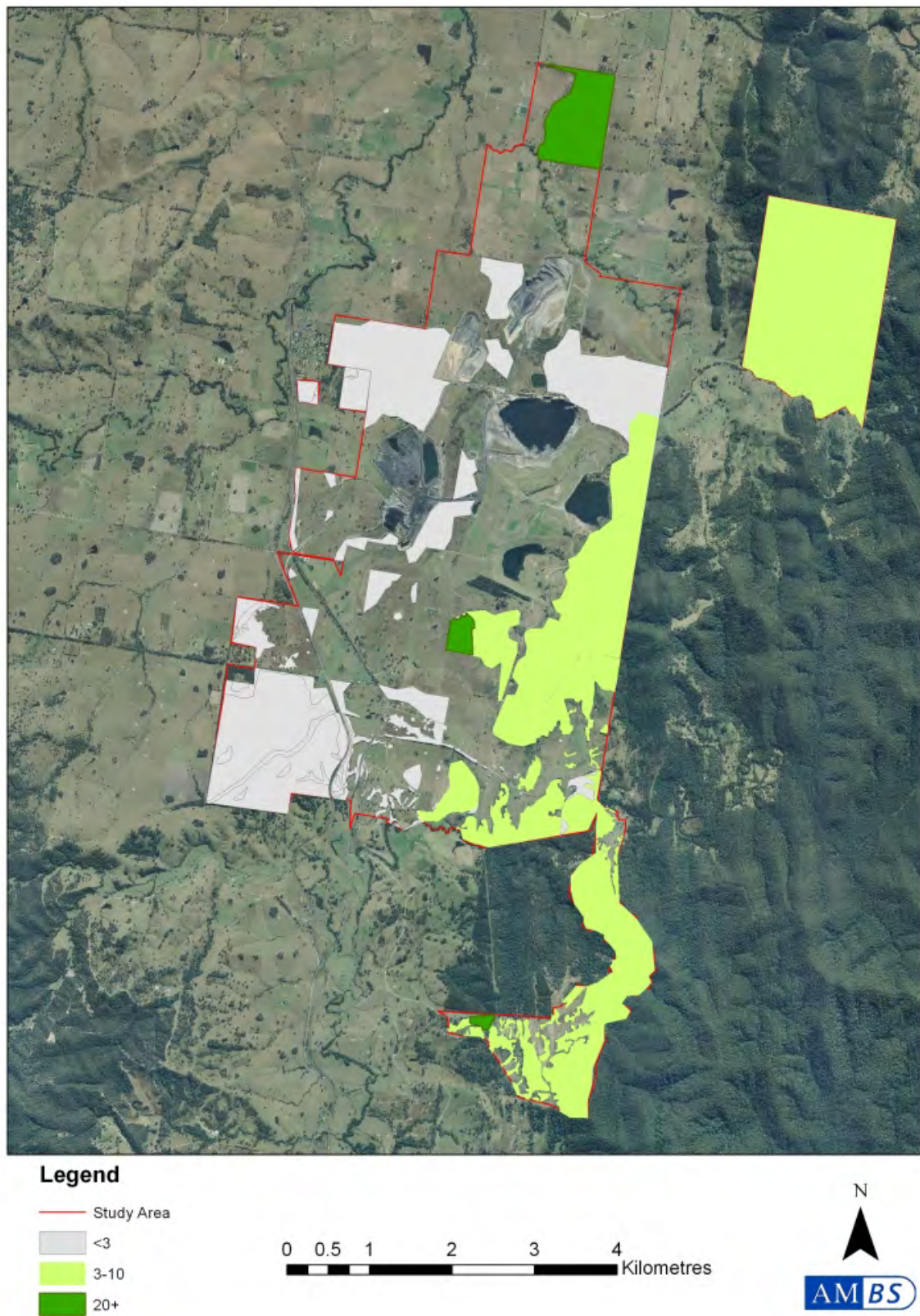


Figure 26: Density of hollow bearing trees per 0.5 hectare throughout the study area.

Despite extensive searches throughout the study area, no caves were observed. Ecobiological (2010b) found two small rock crevices in bushland east of the study area. The caves were small, and their potential to provide roosting habitat for threatened bats or large mammals (e.g. Spotted-tailed Quoll) was limited or nil. It is possible more features like this occur in areas where rocky outcrops occur, but these are unlikely to be significant habitat resources for threatened fauna which could occur in the study area.

Throughout the study area, a number of key plant species that are important for threatened fauna were recorded. A summary of these are shown in Table 9.

Table 9: Plant species within the study area which provide important habitat for threatened fauna.

Plant species	Importance
Wattles (<i>Acacia</i> spp.)	Squirrel Glider feed trees
Lilly Pilly (<i>Acmena smithii</i>)	Native fruit-bearing tree
Forest She-oak (<i>Allocasuarina torulosa</i>)	Glossy Black-cockatoo feed tree
Red Ash (<i>Alphitonia excels</i>)	Native fruit-bearing tree
Broad-leaved Apple (<i>Angophora subvelutina</i>)	Yellow-bellied Glider sap feed tree
Spotted Gum (<i>Corymbia maculata</i>)	Yellow-bellied Glider sap feed tree
Cabbage Gum (<i>Eucalyptus amplifolia</i>)	Primary Koala food tree
Thick-leaved Mahogany (<i>Eucalyptus carnea</i>)	Potential winter flowering tree
Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>)	Potential winter flowering tree
Thin-leaved Stringybark (<i>Eucalyptus eugenioides</i>)	Yellow-bellied Glider sap feed tree
Red Ironbark (<i>Eucalyptus fibrosa</i>)	Potential winter flowering tree
White Stringybark (<i>Eucalyptus globoidea</i>)	Potential winter flowering tree
Tallowwood (<i>Eucalyptus microcorys</i>)	Primary Koala food tree
Grey Box (<i>Eucalyptus moluccana</i>)	Yellow-bellied Glider sap feed tree, secondary Koala food tree
Small-fruited Grey Gum (<i>Eucalyptus propinqua</i>)	Yellow-bellied Glider sap feed tree, secondary Koala food tree
Sydney Blue Gum (<i>Eucalyptus saligna</i>)	Yellow-bellied Glider sap feed tree
Grey Ironbark (<i>Eucalyptus siderophloia</i>)	Potential winter flowering tree
Forest Red Gum (<i>Eucalyptus tereticornis</i>)	Yellow-bellied Glider sap feed tree, primary Koala food tree, Potential winter flowering tree
Figs (<i>Ficus</i> spp.)	Native fruit-bearing tree
Brush Box (<i>Lophostemon confertus</i>)	Yellow-bellied Glider sap feed tree
Scrub Turpentine (<i>Rhodamnia rubescens</i>)	Native fruit-bearing tree
Scentless Rosewood (<i>Synoum glandulosum</i>)	Native fruit-bearing tree
Brush Cherry (<i>Syzygium australe</i>)	Native fruit-bearing tree
Native Peach (<i>Trema tomentose</i>)	Native fruit-bearing tree
Tree Heath (<i>Trochocarpa laurina</i>)	Native fruit-bearing tree

4 Conclusion

A fauna study was undertaken throughout the study area between June and October 2011. The study included a desktop review, targeted surveys and habitat assessments.

The desktop review found that 57 threatened species listed under the TSC Act and/or EPBC Act have been previously recorded or were predicted as having the potential to occur within a 20 km radius of the study area. This includes 23 mammals, 27 birds, one reptile and six frogs. Forty of these species are considered to have potential to occur, although for some species this would be very unlikely.

A total of 213 vertebrate fauna species were recorded during the surveys comprising 16 frogs, 19 reptiles, 131 birds and 47 mammals. Five of the mammals were non-positive identifications from Anabat recordings and seven were introduced species.

Twenty-five species recorded during the surveys are listed as threatened under the TSC Act and/or EPBC Act. Species positively recorded include the Comb-crested Jacana, Glossy Black-cockatoo, Little Lorikeet, Sooty Owl, Masked Owl, Speckled Warbler, Flame Robin, Scarlet Robin, Grey-crowned Babbler (eastern subspecies), Varied Sittella, Brush-tailed Phascogale, Koala, Yellow-bellied Glider, Squirrel Glider, Long-nosed Potoroo, New Holland Mouse, Grey-headed Flying-fox, Little Bentwing-bat, Eastern Bentwing-bat, Eastern Freetail-bat and Southern Myotis. Four threatened fauna species, the Large-eared Pied Bat, Eastern False Pipistrelle, the Greater Broad-nosed Bat and the Eastern Cave Bat were only possibly identified.

The habitat assessments suggest that habitat for threatened fauna occurs throughout most of the study area. In some parts of the study area habitat features are extensive, in others they are patchy and limiting.

5 References

AMBS 2011a. Gloucester Valley Terrestrial Fauna Survey. Report prepared for Gloucester Coal Limited by Australian Museum Business Services.

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Ecobiological 2010b. Fauna Survey Report. Report prepared by Ecobiological for Gloucester Coal Limited, December 2010.

Ecobiological 2011. Arboreal Mammal Targeted Survey Programme. Report prepared by Ecobiological for Gloucester Coal Limited, July 2011.

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OEH 2011. Office of Environment and Heritage Threatened Species Profiles
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Appendix A: Fauna Species Recorded

Key: * = not positive, # = introduced species, † = Vulnerable TSC Act, ‡ = Vulnerable EPBC Act. Note: microbats recorded during the surveys only from Anabat units were not assigned an abundance category.

Group	Common Name	Scientific Name	Abundance
Frogs	Tusked Frog	<i>Adelotus brevis</i>	common
	Common Eastern Froglet	<i>Crinia signifera</i>	abundant
	Brown-striped Frog	<i>Limnodynastes peronii</i>	uncommon
	Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>	uncommon
	Mountain Stream Frog	<i>Litoria barringtonensis</i>	uncommon
	Bleating Tree Frog	<i>Litoria dentata</i>	one sighting only
	Eastern Dwarf Tree Frog	<i>Litoria fallax</i>	abundant
	Broad-palmed Rocket Frog	<i>Litoria latopalmata</i>	uncommon
	Peron's Tree Frog	<i>Litoria peronii</i>	abundant
	Tyler's Tree Frog	<i>Litoria tyleri</i>	uncommon
	Verreaux's Tree Frog	<i>Litoria verreauxii verreauxii</i>	common
	Stoney Creek Frog	<i>Litoria wilcoxii</i>	abundant
	Great Barred Frog	<i>Mixophyes fasciolatus</i>	one sighting only
	Red-backed Toadlet	<i>Pseudophryne coriacea</i>	uncommon
	Dusky Toadlet	<i>Uperoleia fusca</i>	one sighting only
	Smooth Toadlet	<i>Uperoleia laevigata</i>	uncommon
Reptiles	Snake-necked Turtle	<i>Chelodina longicollis</i>	uncommon
	Robust Velvet Gecko	<i>Oedura robusta</i>	one sighting only
	Leaf-tailed Gecko	<i>Saltuarius moritzi</i>	uncommon
	Common Scaly-foot	<i>Pygopus lepidopodus</i>	one sighting only
	Red-tailed Calyptotis	<i>Calyptotis ruficauda</i>	uncommon
	Tree Skink	<i>Egernia striolata</i>	uncommon
	Eastern Water-skink	<i>Eulamprus quoyii</i>	one sighting only
	Barred-sided Skink	<i>Eulamprus tenuis</i>	one sighting only
	Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>	abundant
	Jacky Lizard	<i>Amphibolurus muricatus</i>	one sighting only
	Eastern Water Dragon	<i>Physignathus lesueurii</i>	common
	Bearded Dragon	<i>Pogona barbata</i>	uncommon
	Lace Monitor	<i>Varanus varius</i>	abundant
	Diamond Python	<i>Morelia spilota spilota</i>	uncommon
	Dwarf-crowned Snake	<i>Cacophis krefftii</i>	one sighting only
	Yellow-faced Whip Snake	<i>Demansia psammophis</i>	uncommon
	Black-bellied Swamp Snake	<i>Hemiaspis signata</i>	uncommon
	Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	uncommon
	Eastern Brown Snake	<i>Pseudonaja textilis</i>	uncommon
Birds	Australian Brush-turkey	<i>Alectura lathamii</i>	one sighting only
	Brown Quail	<i>Coturnix ypsilophora</i>	uncommon
	King Quail	<i>Coturnix chinensis</i>	one sighting only
	Grey Teal	<i>Anas gracilis</i>	uncommon

Group	Common Name	Scientific Name	Abundance
	Pacific Black Duck	<i>Anas superciliosa</i>	common
	Australian Wood Duck	<i>Chenonetta jubata</i>	abundant
	Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	uncommon
	White-necked Heron	<i>Ardea pacifica</i>	one sighting only
	White-faced Heron	<i>Egretta novaehollandiae</i>	common
	Cattle Egret	<i>Ardea ibis</i>	uncommon
	Great Egret	<i>Ardea alba</i>	uncommon
	Intermediate Egret	<i>Ardea intermedia</i>	uncommon
	Black-shouldered Kite	<i>Elanus axillaris</i>	one sighting only
	Pacific Baza	<i>Aviceda subcristata</i>	one sighting only
	Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	one sighting only
	Brown Goshawk	<i>Accipiter fasciatus</i>	uncommon
	Wedge-tailed Eagle	<i>Aquila audax</i>	uncommon
	Australian Hobby	<i>Falco longipennis</i>	uncommon
	Buff-banded Rail	<i>Gallirallus philippensis</i>	one sighting only
	Dusky Moorhen	<i>Gallinula tenebrosa</i>	uncommon
	Purple Swamphen	<i>Porphyrio porphyrio</i>	common
	Eurasian Coot	<i>Fulica atra</i>	uncommon
	Painted Button-quail	<i>Turnix varia</i>	one sighting only
	Comb-crested Jacana†	<i>Irediparra gallinacea</i>	one sighting only
	Masked Lapwing	<i>Vanellus miles</i>	common
	Bar-shouldered Dove	<i>Geopelia humeralis</i>	common
	Brown Cuckoo-Dove	<i>Macropygia amboinensis</i>	common
	Common Bronzewing	<i>Phaps chalcoptera</i>	uncommon
	Wonga Pigeon	<i>Leucosarcia melanoleuca</i>	abundant
	Glossy Black-Cockatoo†	<i>Calyptorhynchus lathami</i>	uncommon
	Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	common
	Galah	<i>Eolophus roseicapillus</i>	uncommon
	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	one sighting only
	Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	uncommon
	Little Lorikeet†	<i>Glossopsitta pusilla</i>	uncommon
	Musk Lorikeet	<i>Glossopsitta concinna</i>	uncommon
	Australian King-Parrot	<i>Alisterus scapularis</i>	abundant
	Crimson Rosella	<i>Platycercus elegans</i>	abundant
	Eastern Rosella	<i>Platycercus eximius</i>	abundant
	Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	abundant
	Horsfield's Bronze-Cuckoo	<i>Chalcites basalus</i>	uncommon
	Shining Bronze-Cuckoo	<i>Chalcites lucidus</i>	uncommon
	Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>	uncommon
	Pheasant Coucal	<i>Centropus phasianinus</i>	uncommon
	Southern Boobook	<i>Ninox novaeseelandiae</i>	common
	Sooty Owl†	<i>Tyto tenebricosa</i>	one sighting only
	Masked Owl†	<i>Tyto novaehollandiae</i>	uncommon
	Tawny Frogmouth	<i>Podargus strigoides</i>	uncommon
	Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	common

Group	Common Name	Scientific Name	Abundance
	White-throated Nightjar	<i>Eurostopodus mystacalis</i>	uncommon
	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	abundant
	Sacred Kingfisher	<i>Todiramphus sanctus</i>	uncommon
	Rainbow Bee-eater	<i>Merops ornatus</i>	one sighting only
	Dollarbird	<i>Eurystomus orientalis</i>	uncommon
	Noisy Pitta	<i>Pitta versicolor</i>	one sighting only
	Superb Lyrebird	<i>Menura novaehollandiae</i>	one sighting only
	White-throated Treecreeper	<i>Cormobates leucophaea</i>	abundant
	Superb Fairy-wren	<i>Malurus cyaneus</i>	abundant
	Variegated Fairy-wren	<i>Malurus lamberti</i>	abundant
	Southern Emu-wren	<i>Stipiturus malachurus</i>	uncommon
	Spotted Pardalote	<i>Pardalotus punctatus</i>	abundant
	Striated Pardalote	<i>Pardalotus striatus</i>	abundant
	White-browed Scrubwren	<i>Sericornis frontalis</i>	abundant
	Yellow-throated Scrubwren	<i>Sericornis citreogularis</i>	uncommon
	Large-billed Scrubwren	<i>Sericornis magnirostra</i>	uncommon
	Speckled Warbler†	<i>Pyrrholaemus sagittatus</i>	one sighting only
	Brown Gerygone	<i>Gerygone mouki</i>	abundant
	White-throated Gerygone	<i>Gerygone olivacea</i>	abundant
	Brown Thornbill	<i>Acanthiza pusilla</i>	abundant
	Red-backed Fairy-wren	<i>Malurus melanocephalus</i>	uncommon
	Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	abundant
	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	uncommon
	Striated Thornbill	<i>Acanthiza lineata</i>	abundant
	Yellow Thornbill	<i>Acanthiza nana</i>	abundant
	Weebill	<i>Smicrornis brevirostris</i>	uncommon
	Red Wattlebird	<i>Anthochaera carunculata</i>	common
	Noisy Friarbird	<i>Philemon corniculatus</i>	abundant
	Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>	uncommon
	Bell Miner	<i>Manorina melanophrys</i>	abundant
	Noisy Miner	<i>Manorina melanocephala</i>	abundant
	Lewin's Honeyeater	<i>Meliphaga lewinii</i>	abundant
	Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	abundant
	White-eared Honeyeater	<i>Lichenostomus leucotis</i>	uncommon
	Fuscous Honeyeater	<i>Lichenostomus fuscus</i>	uncommon
	White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	uncommon
	Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>	abundant
	White-naped Honeyeater	<i>Melithreptus lunatus</i>	abundant
	Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	abundant
	Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>	common
	Jacky Winter	<i>Microeca fascinans</i>	abundant
	Flame Robin†	<i>Petroica phoenicea</i>	one sighting only
	Scarlet Robin†	<i>Petroica boodang</i>	one sighting only
	Rose Robin	<i>Petroica rosea</i>	common
	Eastern Yellow Robin	<i>Eopsaltria australis</i>	abundant

Group	Common Name	Scientific Name	Abundance
	Australian Logrunner	<i>Orthonyx temminckii</i>	uncommon
	Grey-crowned Babbler (eastern subspecies) [†]	<i>Pomatostomus temporalis temporalis</i>	abundant
	Eastern Whipbird	<i>Psophodes olivaceus</i>	abundant
	Varied Sittella [†]	<i>Daphoenositta chrysoptera</i>	common
	Crested Shrike-tit	<i>Falcunculus frontatus</i>	uncommon
	Golden Whistler	<i>Pachycephala pectoralis</i>	abundant
	Rufous Whistler	<i>Pachycephala rufiventris</i>	abundant
	Grey Shrike-thrush	<i>Colluricincla harmonica</i>	abundant
	Black-faced Monarch	<i>Monarcha melanopsis</i>	common
	Spectacled Monarch	<i>Symposiachrus trivirgatus</i>	one sighting only
	Satin Flycatcher	<i>Myiagra cyanoleuca</i>	uncommon
	Leaden Flycatcher	<i>Myiagra rubecula</i>	uncommon
	Willie Wagtail	<i>Rhipidura leucophrys</i>	common
	Grey Fantail	<i>Rhipidura albiscapa</i>	abundant
	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	abundant
	White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	one sighting only
	Cicada bird	<i>Coracina tenuirostris</i>	one sighting only
	White-winged Triller	<i>Lalage sueurii</i>	one sighting only
	Olive-backed Oriole	<i>Oriolus sagittatus</i>	uncommon
	Dusky Woodswallow	<i>Artamus cyanopterus</i>	uncommon
	Grey Butcherbird	<i>Cracticus torquatus</i>	abundant
	Pied Butcherbird	<i>Cracticus nigrogularis</i>	abundant
	Magpie-lark	<i>Grallina cyanoleuca</i>	abundant
	Australian Magpie	<i>Gymnorhina tibicen</i>	abundant
	Pied Currawong	<i>Strepera graculina</i>	abundant
	Australian Raven	<i>Corvus coronoides</i>	abundant
	White-winged Chough	<i>Corcorax melanorhamphos</i>	abundant
	Green Catbird	<i>Ailuroedus crassirostris</i>	uncommon
	Satin Bowerbird	<i>Chlamydera violaceus</i>	abundant
	Red-browed Finch	<i>Neochmia temporalis</i>	abundant
	Double-barred Finch	<i>Taeniopygia bichenovii</i>	uncommon
	Red-browed Finch	<i>Neochmia temporalis</i>	abundant
	Mistletoebird	<i>Dicaeum hirundinaceum</i>	uncommon
	Welcome Swallow	<i>Hirundo neoxena</i>	common
	Tree Martin	<i>Petrochelidon nigricans</i>	uncommon
	Tawny Grassbird	<i>Megalurus timoriensis</i>	uncommon
	Silvereye	<i>Zosterops lateralis</i>	uncommon
Mammals	Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	uncommon
	Brush-tailed Phascogale [†]	<i>Phascogale tapoatafa</i>	uncommon
	Brown Antechinus	<i>Antechinus stuartii</i>	abundant
	Northern Brown Bandicoot	<i>Isodon macrourus</i>	uncommon
	Long-nosed Bandicoot	<i>Perameles nasuta</i>	common
	Koala [†]	<i>Phascolarctos cinereus</i>	uncommon

Group	Common Name	Scientific Name	Abundance
	Short-eared Brushtail Possum	<i>Trichosurus caninus</i>	uncommon
	Common Brushtail Possum	<i>Trichosurus vulpecular</i>	abundant
	Sugar Glider	<i>Petaurus breviceps</i>	uncommon
	Squirrel Glider†	<i>Petaurus norfolcensis</i>	uncommon
	Yellow-bellied Glider†	<i>Petaurus australis</i>	uncommon
	Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	one sighting only
	Long-nosed Potoroo††	<i>Potorous tridactylus</i>	uncommon
	Eastern Grey Kangaroo	<i>Macropus giganteus</i>	common
	Red-necked Wallaby	<i>Macropus rufogriseus</i>	abundant
	Red-necked Pademelon	<i>Thylogale thetis</i>	uncommon
	Grey-headed Flying-fox††	<i>Potorous poliocephalus</i>	one sighting only
	Eastern Horseshoe-bat	<i>Rhinolophus megaphyllus</i>	uncommon
	Large-eared Pied Bat*††	<i>Chalinolobus dwyeri</i>	unknown
	Gould's Wattled Bat	<i>Chalinolobus gouldi</i>	unknown
	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	uncommon
	Eastern False Pipistrelle*†	<i>Falsistrellus tasmaniensis</i>	unknown
	Little Bentwing-bat†	<i>Miniopterus australis</i>	uncommon
	Eastern Bentwing-bat†	<i>Miniopterus schreibersii oceanensis</i>	unknown
	Eastern Freetail-bat†	<i>Mormopterus norfolkensis</i>	unknown
	–	<i>Mormopterus species 2</i>	unknown
	–	<i>Mormopterus species 4*</i>	unknown
	Southern Myotis†	<i>Myotis macropus</i>	uncommon
	Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	common
	Gould's Long-eared Bat	<i>Nyctophilus gouldi</i>	common
	Greater Broad-nosed Bat*††	<i>Scoteanax rueppellii</i>	–
	Eastern Broad-nosed Bat*	<i>Scotorepens orion</i>	–
	White-striped Free-tailed Bat	<i>Tadarida australis</i>	unknown
	Large Forest Bat	<i>Vespadelus darlingtoni</i>	unknown
	Eastern Forest Bat	<i>Vespadelus pumilus</i>	uncommon
	Little Forest Bat	<i>Vespadelus vulturnus</i>	common
	Eastern Cave Bat*†	<i>Vespadelus troughtoni</i>	–
	Water-rat	<i>Hydromys chryogaster</i>	one sighting only
	House Mouse #	<i>Mus musculus</i>	uncommon
	New Holland Mouse†	<i>Pseudomys novaehollandiae</i>	uncommon
	Swamp Rat	<i>Rattus lutreolus</i>	uncommon
	Bush Rat	<i>Rattus fuscipes</i>	abundant
	Black Rat #	<i>Rattus rattus</i>	uncommon
	Red Fox #	<i>Vulpes vulpes</i>	uncommon
	Dog/Dingo #	<i>Canis lupus familiaris/dingo</i>	uncommon
	Feral Cat #	<i>Felis catus</i>	uncommon
	European Hare #	<i>Lepus europeus</i>	common
	European Rabbit #	<i>Oryctolagus cuniculus</i>	uncommon

Appendix B: Co-ordinates of Threatened Species Recorded

Species	Date	Number	Easting	Northing
Brush-tailed Phascogale	17/09/2011	1	400587	6445549
Brush-tailed Phascogale	14/10/2011	1	401962	6442493
Brush-tailed Phascogale	Jul/Aug 2011	1	399368	6442000
Brush-tailed Phascogale	29/07/2011	1	403458	6439476
Brush-tailed Phascogale	10/08/2011	1	403458	6439476
Brush-tailed Phascogale	Sep/Oct 2011	1	401938	6442489
Brush-tailed Phascogale	Sep/Oct 2011	1	401947	6442436
Brush-tailed Phascogale	Sep/Oct 2011	1	401895	6442462
Brush-tailed Phascogale	Sep/Oct 2011	1	401894	6442416
Brush-tailed Phascogale (probable)	Jul/Aug 2011	1	399583	6440469
Brush-tailed Phascogale (probable)	Jul/Aug 2011	1	399671	6440437
Brush-tailed Phascogale (probable)	Jul/Aug 2011	1	403644	6439250
Brush-tailed Phascogale (probable)	Jul/Aug 2011	1	403615	6439301
Brush-tailed Phascogale (probable)	Jul/Aug 2011	1	403608	6439355
Brush-tailed Phascogale (probable)	Jul/Aug 2011	1	402332	6442473
Eastern Bentwing-bat	Anabat		403811	6438524
Eastern Bentwing-bat	Anabat		399483	6442313
Eastern Bentwing-bat	Anabat		404110	6438306
Eastern Bentwing-bat	Anabat		399688	6441323
Eastern Bentwing-bat	Anabat		399963	6441959
Eastern Bentwing-bat	Anabat		403172	6437470
Eastern Bentwing-bat	Anabat		404055	6438528
Eastern Bentwing-bat	Anabat		403167	6436651
Eastern Bentwing-bat	Anabat		399122	6441994
Eastern Bentwing-bat	Anabat		402708	6440667
Eastern Bentwing-bat	Anabat		401592	6441603
Eastern Bentwing-bat (not positive)	Anabat		399816	6441881
Eastern Bentwing-bat (not positive)	Anabat		399091	6441492
Eastern Cave Bat (not positive)	Anabat		403811	6438524
Eastern Cave Bat (not positive)	Anabat		399816	6441881
Eastern Cave Bat (not positive)	Anabat		399483	6442313
Eastern Cave Bat (not positive)	Anabat		404110	6438306
Eastern Cave Bat (not positive)	Anabat		399688	6441323
Eastern Cave Bat (not positive)	Anabat		399478	6440757
Eastern Cave Bat (not positive)	Anabat		399963	6441959
Eastern Cave Bat (not positive)	Anabat		404055	6438528
Eastern Cave Bat (not positive)	Anabat		399091	6441492
Eastern Cave Bat (not positive)	Anabat		402742	6437283
Eastern Cave Bat (not positive)	Anabat		403167	6436651
Eastern False Pipistrelle (not positive)	Anabat		399483	6442313
Eastern False Pipistrelle (not positive)	Anabat		399688	6441323
Eastern False Pipistrelle (not positive)	Anabat		399478	6440757

Species	Date	Number	Easting	Northing
Eastern False Pipistrelle (not positive)	Anabat		399816	6441881
Eastern Freetail-bat	Anabat		404110	6438306
Eastern Freetail-bat	Anabat		399963	6441959
Eastern Freetail-bat	Anabat		399091	6441492
Eastern Freetail-bat	Anabat		405929	6445888
Eastern Freetail-bat	Anabat		403602	6442692
Eastern Freetail-bat	Anabat		402708	6440667
Eastern Freetail-bat	Anabat		405429	6445666
Eastern Freetail-bat	Anabat		401891	6442245
Eastern Freetail-bat	Anabat		401592	6441603
Eastern Freetail-bat	Anabat		406795	6445943
Eastern Freetail-bat	Anabat		403238	6442584
Eastern Freetail-bat	Anabat		402895	6441403
Eastern Freetail-bat	Anabat		403497	6442108
Eastern Freetail-bat	Anabat		405805	6446513
Eastern Freetail-bat	Anabat		406247	6445582
Eastern Freetail-bat	Anabat		401334	6440885
Eastern Freetail-bat (not positive)	Anabat		399483	6442313
Eastern Freetail-bat (not positive)	Anabat		406701	6445969
Eastern Freetail-bat (not positive)	Anabat		405929	6445888
Eastern Freetail-bat (not positive)	Anabat		402708	6440667
Eastern Freetail-bat (not positive)	Anabat		401592	6441603
Eastern Freetail-bat (not positive)	Anabat		406795	6445943
Eastern Freetail-bat (not positive)	Anabat		403238	6442584
Eastern Freetail-bat (not positive)	Anabat		403497	6442108
Eastern Freetail-bat (not positive)	Anabat		405805	6446513
Glossy Black-cockatoo (foraging signs)	13/07/2011	2	402599	6442018
Glossy Black-cockatoo (foraging signs)	14/07/2011	2	402526	6441680
Glossy Black-cockatoo	15/07/2011	2	402591	6442372
Glossy Black-cockatoo (foraging signs)	12/08/2011	5	402610	6442429
Glossy Black-cockatoo (foraging signs)	30/06/2011	2	404018	6445166
Glossy Black-cockatoo	12/10/2011	1	403176	6442447
Glossy Black-cockatoo	13/10/2011	2	403807	6444118
Glossy Black-cockatoo (foraging signs)	28/06/2011	–	402687	6441524
Glossy Black-cockatoo (foraging signs)	28/06/2011	–	402552	6441541
Glossy Black-cockatoo (foraging signs)	13/07/2011	–	402499	6441247
Glossy Black-cockatoo (foraging signs)	14/07/2011	–	402605	6441496
Glossy Black-cockatoo (foraging signs)	15/07/2011	–	404100	6444570
Glossy Black-cockatoo (foraging signs)	20/07/2011	–	404024	6445162
Glossy Black-cockatoo (foraging signs)	26/07/2011	–	403212	6437541
Glossy Black-cockatoo (foraging signs)	11/08/2011	–	402393	6437518
Glossy Black-cockatoo (foraging signs)	11/08/2011	–	402703	6437045
Glossy Black-cockatoo (foraging signs)	11/08/2011	–	402652	6437641
Glossy Black-cockatoo (foraging signs)	12/08/2011	–	403788	6444042
Glossy Black-cockatoo (foraging signs)	22/09/2011	–	402790	6442171

Species	Date	Number	Easting	Northing
Glossy Black-cockatoo (foraging signs)	22/09/2011	–	402788	6442142
Glossy Black-cockatoo (foraging signs)	22/09/2011	–	403214	6442565
Glossy Black-cockatoo (foraging signs)	11/10/2011	–	403842	6444117
Glossy Black-cockatoo (foraging signs)	11/10/2011	–	403877	6444154
Greater Broad-nosed Bat (not positive)	Anabat		399963	6441959
Greater Broad-nosed Bat (not positive)	Anabat		399483	6442313
Greater Broad-nosed Bat (not positive)	Anabat		405929	6445888
Greater Broad-nosed Bat (not positive)	Anabat		401891	6442245
Greater Broad-nosed Bat (not positive)	Anabat		403217	6448565
Greater Broad-nosed Bat (not positive)	Anabat		401592	6441603
Greater Broad-nosed Bat (not positive)	Anabat		403497	6442108
Greater Broad-nosed Bat (not positive)	Anabat		403253	6448557
Greater Broad-nosed Bat (not positive)	Anabat		401334	6440885
Grey-crowned Babbler	28/06/2011	7	401606	6441161
Grey-crowned Babbler	29/06/2011	4	401290	6445608
Grey-crowned Babbler	29/06/2011	4	402229	6446704
Grey-crowned Babbler	29/06/2011	3	401607	6441370
Grey-crowned Babbler	30/06/2011	3	401290	6445608
Grey-crowned Babbler	2/07/2011	5	401290	6445608
Grey-crowned Babbler	2/07/2011	6	402229	6446704
Grey-crowned Babbler	12/07/2011	6	401526	6441301
Grey-crowned Babbler	19/07/2011	3	401248	6445612
Grey-crowned Babbler	20/07/2011	7	401602	6441158
Grey-crowned Babbler	21/07/2011	2	400644	6441862
Grey-crowned Babbler	22/07/2011	2	399967	6445540
Grey-crowned Babbler	23/07/2011	2	399906	6445462
Grey-crowned Babbler	23/07/2011	7	401606	6441161
Grey-crowned Babbler	9/08/2011	1+	400576	6445750
Grey-crowned Babbler	11/08/2011	3	403130	6437645
Grey-headed Flying-fox		3	402144	6440855
Koala	14/09/2011	1	402724	6437432
Koala	15/09/2011	2	403090	6437425
Koala	15/09/2011	1	404088	6438639
Koala	Sept/Oct 2011	1	402689	6437470
Large-eared Pied Bat (not positive)	Anabat		399688	6441323
Large-eared Pied Bat (not positive)	Anabat		399478	6440757
Large-eared Pied Bat (not positive)	Anabat		402708	6440667
Large-eared Pied Bat (not positive)	Anabat		405429	6445666
Large-eared Pied Bat (not positive)	Anabat		401891	6442245
Large-eared Pied Bat (not positive)	Anabat		403217	6448565
Large-eared Pied Bat (not positive)	Anabat		401592	6441603
Large-eared Pied Bat (not positive)	Anabat		402895	6441403
Large-eared Pied Bat (not positive)	Anabat		401334	6440885
Little Bentwing-Bat	15/09/2011	1	403138	6436656

Species	Date	Number	Easting	Northing
Little Bentwing-Bat	22/09/2011	2	403414	6440375
Little Bentwing-Bat	23/09/2011	2	403414	6440375
Little Bentwing-Bat	12/10/2011	1	403359	6448525
Little Bentwing-Bat	14/10/2011	1	400427	6440829
Little Bentwing-bat	Anabat		403811	6438524
Little Bentwing-bat	Anabat		399816	6441881
Little Bentwing-bat	Anabat		404110	6438306
Little Bentwing-bat	Anabat		399688	6441323
Little Bentwing-bat	Anabat		399478	6440757
Little Bentwing-bat	Anabat		404055	6438528
Little Bentwing-bat	Anabat		406701	6445969
Little Bentwing-bat	Anabat		405929	6445888
Little Bentwing-bat	Anabat		403602	6442692
Little Bentwing-bat	Anabat		405429	6445666
Little Bentwing-bat	Anabat		401891	6442245
Little Bentwing-bat	Anabat		403217	6448565
Little Bentwing-bat	Anabat		402898	6440607
Little Bentwing-bat	Anabat		401592	6441603
Little Bentwing-bat	Anabat		405805	6446513
Little Bentwing-bat	Anabat		406795	6445943
Little Bentwing-bat	Anabat		403238	6442584
Little Bentwing-bat	Anabat		402895	6441403
Little Bentwing-bat	Anabat		403497	6442108
Little Bentwing-bat	Anabat		405805	6446513
Little Bentwing-bat	Anabat		406076	6446727
Little Bentwing-bat	Anabat		401334	6440885
Little Bentwing-bat (not positive)	Anabat		399483	6442313
Little Bentwing-bat (not positive)	Anabat		399091	6441492
Little Bentwing-bat (not positive)	Anabat		403615	6439238
Little Bentwing-bat (not positive)	Anabat		403602	6442692
Little Bentwing-bat (not positive)	Anabat		405814	6446515
Little Bentwing-bat (not positive)	Anabat		402708	6440667
Long-nosed Potoroo	26/07/2011 – 12/08/2011	2	403362	6443329
Long-nosed Potoroo	22/09/2011	1	403479	6437372
Long-nosed Potoroo	29/09/2011 – 30/10/2011	1	404001	6438566
Long-nosed Potoroo (probable)	Sep/Oct 2011	1	404035	6438561
New Holland Mouse	14/09/2011	1	403262	6436699
New Holland Mouse	15/09/2011	1	403285	6436711
New Holland Mouse	15/09/2011	1	404093	6438590
New Holland Mouse	16/09/2011	1	403380	6437513
New Holland Mouse	17/09/2011	1	404077	6438484
New Holland Mouse (probable)	Sep/Oct 2011	1	402683	6437426
New Holland Mouse (probable)	Sep/Oct 2011	1	403419	6448407
Southern Myotis	22/09/2011	10	403414	6440375

Species	Date	Number	Easting	Northing
Southern Myotis	23/09/2011	7	403414	6440375
Southern Myotis	13/10/2011	3	403654	6443494
Southern Myotis	14/10/2011	2	403654	6443494
Southern Myotis (not positive)	Anabat		399483	6442313
Southern Myotis (not positive)	Anabat		399688	6441323
Southern Myotis (not positive)	Anabat		399478	6440757
Southern Myotis (not positive)	Anabat		399963	6441959
Speckled Warbler	29/06/2011	2	402229	6446704
Squirrel Glider	16/09/2011	1	400600	6445540
Squirrel Glider	16/09/2011	1	400637	6445288
Squirrel Glider	16/09/2011	1	400669	6445253
Squirrel Glider	21/09/2011	2	401842	6442298
Squirrel Glider	12/10/2011	1	403493	6448571
Varied Sittella	28/06/2011	8	402595	6441852
Varied Sittella	29/06/2011	4	402229	6446704
Varied Sittella	29/06/2011	4	403702	6444403
Varied Sittella	29/06/2011	5	402375	6442314
Varied Sittella	30/06/2011	4	402229	6446704
Varied Sittella	1/07/2011	4	402229	6446704
Varied Sittella	2/07/2011	4	402229	6446704
Varied Sittella	2/07/2011	6	403701	6444403
Varied Sittella	21/07/2011	2	403716	6438196
Varied Sittella	23/07/2011	10+	403716	6438196
Varied Sittella	9/08/2011	1+	403453	6442300
Varied Sittella	9/08/2011	1+	400565	6445600
Varied Sittella	10/08/2011	1+	399583	6440582
Varied Sittella	10/08/2011	1+	399631	6441602
Varied Sittella	12/08/2011	1+	402371	6442359
Varied Sittella	14/09/2011	4	400645	6445505
Varied Sittella	15/09/2011	2	402728	6437401
Varied Sittella	16/09/2011	3	400641	6445412
Varied Sittella	11/10/2011	3	403204	6442592
Varied Sittella	12/10/2011	3	402897	6441371
Yellow-bellied Glider	14/09/2011	1	403098	6436671
Yellow-bellied Glider	14/09/2011	1	403098	6436671
Yellow-bellied Glider	4/10/2011	2	406214	6446846

Appendix C: Co-ordinates of Survey Locations

Survey Method	Season	Easting	Northing
Anabat	Spring	403172	6437470
	Spring	402742	6437283
	Spring	403167	6436651
	Spring	403456	6437362
	Spring	400585	6445506
	Spring	404055	6438528
	Spring	404110	6438306
	Spring	403615	6439238
	Spring	403039	6437134
	Spring	403811	6438524
	Spring	399688	6441323
	Spring	399478	6440757
	Spring	399816	6441881
	Spring	399963	6441959
	Spring	399483	6442313
	Spring	399091	6441492
	Spring	399122	6441994
	Spring	406249	6445574
	Spring	405805	6446513
	Spring	406076	6446727
	Spring	406701	6445969
	Spring	406812	6446098
	Spring	406013	6445461
	Spring	405929	6445888
	Spring	405814	6446515
	Spring	406795	6445943
	Spring	406247	6445582
	Spring	405429	6445666
	Spring	405779	6445474
	Spring	403619	6443534
	Spring	401891	6442245
	Spring	403238	6442584
	Spring	403619	6443534
	Spring	403350	6440526
	Spring	402895	6441403
	Spring	403253	6448557
	Spring	403268	6441686
	Spring	403217	6448565
	Spring	403497	6442108
	Spring	403602	6442692
	Spring	402898	6440607
	Spring	403818	6444119

Survey Method	Season	Easting	Northing
	Spring	401334	6440885
	Spring	402708	6440667
	Spring	401592	6441603
	Spring	400449	6440906
	Spring	401824	6440915
Birds	Winter	401290	6445608
	Winter	402229	6446704
	Winter	403268	6445842
	Winter	404019	6445166
	Winter	403702	6444403
	Winter	402375	6442314
	Winter	401607	6441370
	Winter	400577	6445605
	Winter	399449	6442012
	Winter	403577	6438074
	Winter	403716	6438197
	Winter	404060	6438574
	Winter	403760	6439897
	Winter	399906	6445462
	Winter	400979	6444063
	Winter	402439	6442005
	Winter	402595	6441852
	Winter	401611	6441201
	Winter	403212	6437541
	Winter	403690	6439259
	Winter	403500	6440087
	Winter	402721	6440691
	Winter	403114	6442698
	Spring	403619	6443534
	Spring	403253	6440539
	Spring	403204	6442592
	Spring	402846	6441300
	Spring	401889	6442266
	Spring	403504	6437412
	Spring	404082	6438415
	Spring	403614	6439252
	Spring	400645	6445505
	Spring	399605	6441349
	Spring	399545	6440696
	Spring	399785	6441938
	Spring	401338	6440856
	Spring	406094	6446034
	Spring	406603	6447624
	Spring	406076	6446727
	Spring	405795	6446520

Survey Method	Season	Easting	Northing
	Spring	406236	6447025
	Spring	406812	6446098
	Spring	406262	6445587
	Spring	406094	6446034
	Spring	406177	6446459
	Spring	406148	6445799
	Spring	403148	6437437
	Spring	402728	6437401
	Spring	403176	6436640
	Spring	403336	6448720
	Spring	403896	6444141
Call Playback	Spring	403092	6437423
	Spring	399689	6441292
	Spring	404020	6445105
	Spring	406812	6446098
	Spring	403092	6437423
	Spring	399689	6441292
	Spring	404020	6445105
	Spring	406812	6446098
	Spring	403098	6436671
	Spring	402697	6437394
	Spring	404069	6438570
	Spring	403521	6437424
	Spring	400598	6445545
	Spring	399408	6440774
	Spring	399807	6441859
	Spring	401842	6442298
	Spring	403614	6439252
	Spring	403092	6437423
	Spring	402846	6441300
	Spring	403202	6442499
	Spring	403778	6444105
	Spring	403428	6440447
Trap Lines	Spring	403148	6437437
	Spring	403334	6437510
	Spring	403361	6437460
	Spring	402709	6437492
	Spring	402709	6437324
	Spring	402781	6437155
	Spring	403176	6436640
	Spring	403289	6436767
	Spring	403388	6436861
	Spring	403504	6437412
	Spring	403380	6437179
	Spring	404082	6438415

Survey Method	Season	Easting	Northing
	Spring	404081	6438563
	Spring	404027	6438697
	Spring	403614	6439252
	Spring	403594	6439429
	Spring	403478	6439577
	Spring	400578	6445549
	Spring	400577	6445381
	Spring	400487	6445258
	Spring	399605	6441349
	Spring	399804	6441092
	Spring	399545	6440696
	Spring	399260	6440900
	Spring	399785	6441938
	Spring	400113	6441600
	Spring	402846	6441300
	Spring	402877	6441469
	Spring	402854	6441601
	Spring	403210	6442521
	Spring	403117	6442418
	Spring	403188	6442289
	Spring	401889	6442266
	Spring	401970	6442502
	Spring	402248	6442601
	Spring	403779	6444107
	Spring	403896	6444141
	Spring	404022	6444122
	Spring	403253	6440539
	Spring	403428	6440447
	Spring	403477	6440363
	Spring	403302	6448539
	Spring	403336	6448720
	Spring	403289	6448393
Hair tubes	Winter	402696	6441837
	Winter	402732	6441820
	Winter	402721	6441756
	Winter	402710	6441716
	Winter	402712	6441658
	Winter	402642	6441706
	Winter	402614	6441681
	Winter	402567	6441687
	Winter	402510	6441533
	Winter	402476	6441509
	Winter	399716	6441921
	Winter	399742	6441839
	Winter	399763	6441779

Survey Method	Season	Easting	Northing
	Winter	399771	6441686
	Winter	399735	6441651
	Winter	399669	6441724
	Winter	399652	6441793
	Winter	399646	6441858
	Winter	399602	6441921
	Winter	399549	6441993
	Winter	399368	6442000
	Winter	399389	6441990
	Winter	399406	6441925
	Winter	399381	6441864
	Winter	399376	6441809
	Winter	399443	6441763
	Winter	399552	6441769
	Winter	399523	6441888
	Winter	399485	6441951
	Winter	399478	6441997
	Winter	403671	6438042
	Winter	403706	6438031
	Winter	403750	6438024
	Winter	403773	6438062
	Winter	403800	6438089
	Winter	403862	6438136
	Winter	403848	6438193
	Winter	403759	6438225
	Winter	403713	6438166
	Winter	403668	6438093
	Winter	399577	6440595
	Winter	399575	6440559
	Winter	399572	6440525
	Winter	399583	6440469
	Winter	399594	6440437
	Winter	399671	6440437
	Winter	399675	6440479
	Winter	399662	6440555
	Winter	399684	6440614
	Winter	399723	6440671
	Winter	403644	6439250
	Winter	403567	6439243
	Winter	403615	6439301
	Winter	403608	6439355
	Winter	403585	6439414
	Winter	403591	6439466
	Winter	403545	6439470
	Winter	403520	6439410

Survey Method	Season	Easting	Northing
	Winter	403473	6439358
	Winter	403506	6439278
	Winter	403051	6437435
	Winter	403260	6437397
	Winter	403071	6437352
	Winter	403010	6437312
	Winter	403079	6437234
	Winter	403040	6437189
	Winter	403180	6437442
	Winter	403253	6437490
	Winter	403314	6437480
	Winter	403305	6437412
	Winter	400695	6445526
	Winter	400670	6445545
	Winter	400628	6445565
	Winter	400563	6445532
	Winter	400513	6445506
	Winter	400491	6445467
	Winter	400566	6445426
	Winter	400594	6445392
	Winter	400659	6445372
	Winter	400705	6445400
	Winter	402425	6442601
	Winter	402367	6442536
	Winter	402332	6442473
	Winter	402274	6442389
	Winter	402175	6442384
	Winter	402112	6442460
	Winter	402140	6442592
	Winter	402149	6442660
	Winter	402256	6442672
	Winter	402342	6442669
	Winter	403134	6442638
	Winter	403179	6442608
	Winter	403227	6442595
	Winter	403283	6442587
	Winter	403284	6442555
	Winter	403304	6442512
	Winter	403283	6442433
	Winter	403314	6442373
	Winter	403295	6442310
	Winter	403361	6442297
Hair funnels	Spring	403328	6437503
	Spring	403202	6437453
	Spring	402743	6437291

Survey Method	Season	Easting	Northing
	Spring	402708	6437494
	Spring	403248	6436739
	Spring	403161	6436652
	Spring	404062	6438656
	Spring	404064	6438517
	Spring	403568	6439420
	Spring	403593	6439254
	Spring	400576	6445418
	Spring	400582	6445540
	Spring	400609	6445527
	Spring	400516	6445424
	Spring	399822	6441229
	Spring	399694	6441266
	Spring	399722	6441088
	Spring	399662	6441202
	Spring	399582	6440714
	Spring	399459	6440769
	Spring	399491	6440769
	Spring	399345	6440788
	Spring	399911	6441878
	Spring	399801	6441868
	Spring	399829	6441886
	Spring	399760	6441771
	Spring	402856	6441461
	Spring	402879	6441440
	Spring	402864	6441400
	Spring	402843	6441369
	Spring	402822	6441330
	Spring	402793	6441335
	Spring	402803	6441299
	Spring	402810	6441364
	Spring	402827	6441392
	Spring	402848	6441425
	Spring	402785	6441318
	Spring	402889	6441458
	Spring	402873	6441424
	Spring	402856	6441383
	Spring	402833	6441348
	Spring	402814	6441313
	Spring	402801	6441347
	Spring	402821	6441374
	Spring	402834	6441409
	Spring	402851	6441441
	Spring	402920	6442257
	Spring	402876	6442258

Survey Method	Season	Easting	Northing
	Spring	402854	6442245
	Spring	402833	6442221
	Spring	402818	6442190
	Spring	402830	6442148
	Spring	402797	6442159
	Spring	402852	6442179
	Spring	402870	6442202
	Spring	402895	6442226
	Spring	402824	6442132
	Spring	402893	6442264
	Spring	402864	6442257
	Spring	402842	6442235
	Spring	402826	6442206
	Spring	402808	6442175
	Spring	402835	6442157
	Spring	402863	6442189
	Spring	402880	6442214
	Spring	402912	6442240
	Spring	403594	6443090
	Spring	403556	6443072
	Spring	403552	6443033
	Spring	403544	6442987
	Spring	403542	6442950
	Spring	403585	6442946
	Spring	403541	6442914
	Spring	403586	6442986
	Spring	403593	6443023
	Spring	403597	6443051
	Spring	403589	6442924
	Spring	403556	6443093
	Spring	403555	6443054
	Spring	403556	6443007
	Spring	403546	6442976
	Spring	403539	6442928
	Spring	403583	6442964
	Spring	403589	6443005
	Spring	403597	6443036
	Spring	403592	6443072
	Spring	401955	6442457
	Spring	401900	6442482
	Spring	401890	6442443
	Spring	401892	6442396
	Spring	401889	6442366
	Spring	401915	6442275
	Spring	401878	6442326

Survey Method	Season	Easting	Northing
	Spring	401928	6442328
	Spring	401936	6442373
	Spring	401939	6442414
	Spring	401906	6442251
	Spring	401909	6442492
	Spring	401895	6442462
	Spring	401894	6442416
	Spring	401891	6442382
	Spring	401885	6442351
	Spring	401920	6442300
	Spring	401929	6442341
	Spring	401938	6442396
	Spring	401947	6442436
	Spring	403970	6444240
	Spring	403934	6444258
	Spring	403904	6444226
	Spring	403871	6444203
	Spring	403846	6444173
	Spring	403857	6444134
	Spring	403822	6444135
	Spring	403884	6444162
	Spring	403924	6444200
	Spring	403946	6444225
	Spring	403848	6444116
	Spring	403944	6444271
	Spring	403914	6444246
	Spring	403882	6444213
	Spring	403858	6444194
	Spring	403832	6444155
	Spring	403871	6444148
	Spring	403903	6444179
	Spring	403935	6444213
	Spring	403959	6444230
	Spring	406327	6446468
	Spring	406326	6446496
	Spring	406287	6446507
	Spring	406259	6446527
	Spring	406228	6446523
	Spring	406205	6446518
	Spring	406217	6446484
	Spring	406253	6446479
	Spring	406278	6446477
	Spring	406305	6446461
	Spring	406204	6446477
	Spring	406331	6446479

Survey Method	Season	Easting	Northing
	Spring	406310	6446499
	Spring	406275	6446515
	Spring	406240	6446525
	Spring	406214	6446504
	Spring	406233	6446484
	Spring	406267	6446480
	Spring	406298	6446469
	Spring	406320	6446463
	Spring	406875	6446153
	Spring	406816	6446182
	Spring	406803	6446159
	Spring	406779	6446115
	Spring	406764	6446081
	Spring	406825	6446065
	Spring	406834	6446089
	Spring	406853	6446114
	Spring	406862	6446133
	Spring	406815	6446056
	Spring	406827	6446193
	Spring	406810	6446164
	Spring	406795	6446148
	Spring	406786	6446129
	Spring	406768	6446100
	Spring	406751	6446068
	Spring	406831	6446078
	Spring	406845	6446102
	Spring	406854	6446120
	Spring	406867	6446140
	Spring	406201	6445567
	Spring	406338	6445594
	Spring	406310	6445594
	Spring	406276	6445598
	Spring	406251	6445607
	Spring	406227	6445614
	Spring	406233	6445571
	Spring	406260	6445564
	Spring	406282	6445572
	Spring	406306	6445567
	Spring	406332	6445566
	Spring	406328	6445597
	Spring	406287	6445595
	Spring	406264	6445603
	Spring	406237	6445618
	Spring	406216	6445569
	Spring	406216	6445605

Survey Method	Season	Easting	Northing
	Spring	406249	6445573
	Spring	406269	6445569
	Spring	406292	6445570
	Spring	406305	6447214
	Spring	406325	6447232
	Spring	406341	6447267
	Spring	406340	6447299
	Spring	406331	6447333
	Spring	406229	6447116
	Spring	406337	6447370
	Spring	406241	6447133
	Spring	406271	6447155
	Spring	406282	6447188
	Spring	406235	6447101
	Spring	406314	6447224
	Spring	406334	6447252
	Spring	406333	6447318
	Spring	406335	6447354
	Spring	406234	6447125
	Spring	406257	6447132
	Spring	406265	6447175
	Spring	406292	6447199
	Spring	403419	6448407
	Spring	403362	6448567
	Spring	403373	6448612
	Spring	403377	6448654
	Spring	403386	6448690
	Spring	403350	6448514
	Spring	403411	6448711
	Spring	403369	6448483
	Spring	403387	6448462
	Spring	403401	6448440
	Spring	403356	6448539
	Spring	403356	6448553
	Spring	403366	6448585
	Spring	403375	6448632
	Spring	403378	6448674
	Spring	403397	6448701
	Spring	403358	6448499
	Spring	403380	6448469
	Spring	403397	6448450
	Spring	403407	6448428
Hair funnels	Winter	402630	6441861
	Winter	402626	6441530
	Winter	402670	6441590

Survey Method	Season	Easting	Northing
	Winter	402674	6441686
	Winter	402621	6441705
	Winter	402630	6441641
	Winter	402581	6441577
	Winter	402537	6441505
	Winter	402465	6441529
	Winter	402516	6441611
	Winter	402548	6441664
	Winter	402671	6441825
	Winter	402586	6441741
	Winter	402714	6441781
	Winter	402750	6441728
	Winter	402730	6441655
	Winter	402729	6441574
	Winter	402678	6441514
	Winter	402634	6441455
	Winter	402594	6441464
	Winter	399765	6441894
	Winter	399585	6441488
	Winter	399660	6441573
	Winter	399686	6441675
	Winter	399577	6441662
	Winter	399485	6441670
	Winter	399457	6441764
	Winter	399559	6441800
	Winter	399656	6441821
	Winter	399686	6441919
	Winter	399584	6441958
	Winter	399770	6441803
	Winter	399479	6441920
	Winter	399786	6441701
	Winter	399784	6441586
	Winter	399768	6441498
	Winter	399672	6441469
	Winter	399608	6441410
	Winter	399539	6441347
	Winter	399511	6441445
	Winter	398984	6441126
	Winter	399065	6440775
	Winter	398962	6440716
	Winter	398971	6440846
	Winter	399088	6440895
	Winter	399226	6440869
	Winter	399297	6440972
	Winter	399179	6441048

Survey Method	Season	Easting	Northing
	Winter	399051	6441046
	Winter	399134	6441137
	Winter	399268	6441120
	Winter	398934	6441046
	Winter	399399	6441099
	Winter	398929	6440926
	Winter	398890	6440774
	Winter	398906	6440631
	Winter	399050	6440653
	Winter	399143	6440694
	Winter	399193	6440678
	Winter	399182	6440795
	Winter	403676	6438033
	Winter	403846	6438399
	Winter	403737	6438467
	Winter	403651	6438383
	Winter	403719	6438279
	Winter	403808	6438209
	Winter	403868	6438204
	Winter	403838	6438119
	Winter	403803	6438091
	Winter	403711	6438095
	Winter	403710	6438165
	Winter	403746	6438017
	Winter	403702	6438242
	Winter	403807	6438016
	Winter	403866	6438026
	Winter	403913	6438064
	Winter	403927	6438140
	Winter	403954	6438214
	Winter	403982	6438272
	Winter	403953	6438343
	Winter	399566	6440583
	Winter	399794	6440613
	Winter	399681	6440604
	Winter	399764	6440516
	Winter	399670	6440503
	Winter	399737	6440406
	Winter	399653	6440416
	Winter	399864	6440571
	Winter	399910	6440669
	Winter	399963	6440803
	Winter	400006	6440931
	Winter	399846	6440958
	Winter	399559	6440716

Survey Method	Season	Easting	Northing
	Winter	399558	6440503
	Winter	399584	6440854
	Winter	399561	6440421
	Winter	399698	6440852
	Winter	399690	6440721
	Winter	399813	6440841
	Winter	399801	6440713
	Winter	403350	6439312
	Winter	403448	6439388
	Winter	403436	6439294
	Winter	403534	6439277
	Winter	403578	6439364
	Winter	403591	6439462
	Winter	403613	6439539
	Winter	403599	6439648
	Winter	403571	6439766
	Winter	403669	6439220
	Winter	403574	6439232
	Winter	403377	6439417
	Winter	403528	6439237
	Winter	403395	6439515
	Winter	403441	6439615
	Winter	403459	6439726
	Winter	403536	6439769
	Winter	403533	6439680
	Winter	403504	6439590
	Winter	403451	6439485
	Winter	403055	6437395
	Winter	402887	6437081
	Winter	403148	6437411
	Winter	403210	6437357
	Winter	403286	6437408
	Winter	403373	6437450
	Winter	403464	6437513
	Winter	403499	6437615
	Winter	403557	6437534
	Winter	403525	6437449
	Winter	403488	6437354
	Winter	402996	6437305
	Winter	403423	6437288
	Winter	403019	6437216
	Winter	403029	6437113
	Winter	403014	6437031
	Winter	403040	6436936
	Winter	403040	6436839

Survey Method	Season	Easting	Northing
	Winter	402972	6436903
	Winter	402933	6436987
	Winter	400714	6445621
	Winter	400568	6445555
	Winter	400571	6445670
	Winter	400483	6445659
	Winter	400449	6445569
	Winter	400451	6445468
	Winter	400449	6445288
	Winter	400375	6445243
	Winter	400390	6445353
	Winter	400398	6445544
	Winter	400726	6445526
	Winter	400720	6445448
	Winter	400699	6445283
	Winter	400679	6445211
	Winter	400572	6445219
	Winter	400570	6445316
	Winter	400449	6445378
	Winter	400416	6445615
	Winter	400713	6445366
	Winter	400566	6445424
	Winter	402383	6442490
	Winter	402310	6442631
	Winter	402158	6442595
	Winter	402027	6442583
	Winter	401934	6442507
	Winter	401910	6442395
	Winter	401891	6442280
	Winter	401742	6442290
	Winter	401781	6442429
	Winter	401830	6442555
	Winter	401930	6442666
	Winter	402335	6442414
	Winter	402235	6442686
	Winter	399455	6440688
	Winter	402288	6442338
	Winter	402224	6442268
	Winter	402172	6442204
	Winter	402045	6442228
	Winter	402111	6442323
	Winter	402182	6442396
	Winter	402244	6442520
	Winter	403114	6442698
	Winter	403344	6442492

Survey Method	Season	Easting	Northing
	Winter	403276	6442481
	Winter	403329	6442386
	Winter	403370	6442322
	Winter	403304	6442278
	Winter	403240	6442329
	Winter	403453	6442300
	Winter	403497	6442431
	Winter	403592	6442490
	Winter	403575	6442626
	Winter	403065	6442620
	Winter	403612	6442746
	Winter	403016	6442561
	Winter	403131	6442612
	Winter	403121	6442550
	Winter	403168	6442481
	Winter	403205	6442552
	Winter	403287	6442634
	Winter	403337	6442567
Harp traps	Spring	403259	6437466
	Spring	402707	6437477
	Spring	403138	6436656
	Spring	403455	6437357
	Spring	404018	6438447
	Spring	403593	6439313
	Spring	400627	6445494
	Spring	403023	6437104
	Spring	399751	6441453
	Spring	399374	6440693
	Spring	399634	6441173
	Spring	403414	6440375
	Spring	399030	6441344
	Spring	405861	6446562
	Spring	405781	6445472
	Spring	405381	6445719
	Spring	405713	6445529
	Spring	401938	6442429
	Spring	403286	6442620
	Spring	403304	6441670
	Spring	403359	6448525
	Spring	403654	6443494
	Spring	403511	6442412
	Spring	403820	6444148
	Spring	400427	6440829
Reptile searches	Spring	403148	6437437
	Spring	402728	6437401

Survey Method	Season	Easting	Northing
	Spring	403176	6436640
	Spring	403504	6437412
	Spring	404082	6438415
	Spring	403614	6439252
	Spring	400645	6445505
	Spring	399605	6441349
	Spring	399545	6440696
	Spring	399785	6441938
	Spring	402846	6441300
	Spring	403204	6442592
	Spring	401889	6442266
	Spring	403253	6440539
	Spring	403336	6448720
Stag watch	Spring	401915	6442451
	Spring	401936	6442643
Remote cameras	Winter	402558	6441801
	Winter	399716	6441908
	Winter	399140	6441118
	Winter	403706	6438031
	Winter	399571	6440602
	Winter	403458	6439476
	Winter	403441	6437314
	Winter	403027	6437122
	Winter	400569	6445533
	Winter	402292	6442637
	Winter	403154	6442594
	Winter	403362	6443329
	Winter	403553	6443678
Frog searches	Spring	406795	6445943
	Spring	403403	6438201
	Spring	403565	6438068
	Spring	403467	6437609
	Spring	403505	6437793
	Spring	400427	6440899
	Spring	400386	6440745
	Spring	403565	6443560
	Spring	403682	6443441
	Spring	401338	6440856
Funnel traps	Spring	403241	6437459
	Spring	402676	6437436
	Spring	403262	6436699
	Spring	403500	6437412
	Spring	404110	6438500
	Spring	403614	6439294
	Spring	400583	6445548

Survey Method	Season	Easting	Northing
	Spring	399641	6441238
	Spring	399416	6440719
	Spring	399820	6441815
	Spring	405867	6446583
	Spring	406780	6446141
	Spring	406073	6445836
	Spring	406262	6445587
	Spring	402826	6441411
	Spring	401912	6442349
	Spring	403219	6442566
	Spring	403864	6444109
	Spring	403327	6448574
	Spring	403458	6440407

Appendix D: Habitat Assessment Data

Key:
Scoring for decortications bark: 0 = absent, 1 = single, 2 = scarce, 3 = abundant.
Shrub: scl = sclerophyll.
Acacia / Banksia / Allocasuarina / Palms / Vines / Weeds / Mistletoe abundance: A = absent, R = rare, O = occasional, C = common, D = dominant.
Age: Y = young vigorous, E = early mature, M = mid-mature, L = late mature, O = old-growth

Site	Easting	Northing	Large Dead Trees	No. Hollow Trees	Small Hollows	Medium Hollows	Large Hollows	Total Hollows	Basal Hollows	Decorticating bark	Stumps	Fallen Branches	Rock Crevices	Total Length Logs (m)	Fire	Clearing	Grazing	Weeds	Shrub	Ground layer	Litter	Humus	Acacia	Banksia	Allocasuarina	Palms	Vines	Weeds	Mistletoe	Age	% cover veg	% cover log > 30 cm	% cover surface rock	% cover outcropping rock	% cover bare soil	% cover litter
1	401544	6441192	0	3	0	3	1	4	1	0	1-2	10-19	0	22	0	3	1-2	1	Scl	herb/grass	Shallow	Absent	O	A	A	A	A	O	A	Y/E	36	0	0	0	12	52
2	401556	6441372	1	0	0	0	0	0	0	2	0	10-19	0	9	0	3	1-2	1	Scl	grass	Shallow	Absent	O	A	A	A	A	O	A	Y/E	95	0	0	0	1	4
3	401617	6441627	0	0	0	0	0	0	0	0	0	3-5	0	31	0	3	1	1	Scl	grass	Shallow	Absent	O	A	R	A	R	R	A	M	96	1	0	0	0	3
4	400459	6445803	0	0	0	0	0	0	0	0	10-19	6-9	0	7	0	3	1	1	Scl	grass	Shallow	Absent	O	A	A	A	A	O	A	Y	96	1	1	0	0	2
5	401317	6446031	1	1	0	0	0	0	0	2	1-2	20+	0	107	0	1	1	0	Scl	herb/grass	Shallow	Absent	O	A	A	A	A	R	A	E/M	44	1	0	0	0	55
6	402499	6441247	0	2	2	1	0	3	1	0	3-5	10-19	0	36	1	2	0	2	Mix	grass/fern	Shallow	Shallow	O	A	O	A	A	O	A	E/M	91	1	0	0	0	8
7	402642	6442090	1	1	1	1	5	7	1	-	1-2	10-19	0	33	2	2	0	2	Mix	grass/fern/herb	Shallow	Shallow	R	A	C	A	R	C	A	E/M	75	1	0	0	0	24
8	402762	6442023	0	6	2	7	1	10	0	0	1-2	6-9	0	26	1	2	0	0	Scl	grass	Shallow	Absent	O	A	C	A	A	O	A	M/L	38	0	0	14	0	48
9	403293	6443107	1	3	1	1	2	4	1	2	1-2	20+	0	69	2	0-1	0	1	Mesic	fern	Mod	Shallow	A	A	O	A	R	A	R	M	50	6	0	3	0	41
10	403459	6443453	0	0	0	0	0	0	0	0	1-2	10-19	0	17	2	0	0	0	Scl	grass	Shallow	Absent	R	A	O	A	A	R	A	M	16	0	0	2	0	82
11	403185	6442596	0	1	2	1	0	3	0	2	1-2	6-9	0	6	2	2	1	2	Mix	grass	Shallow	Shallow	R	A	R	A	R	C	A	E/M	68	0	0	3	4	25
12	403468	6442320	0	1	0	0	0	0	1	3	0	6-9	0	5	0	2	0	2	Mesic	grass	Shallow	Shallow	R	A	A	A	A	O	A	M	81	0	0	0	1	18
13	403578	6442435	1	1	0	1	5	6	1	0	1-2	6-9	0	27	1	1-2	0	2-3	Mes	grass	Shallow	Shallow	R	A	R	A	O	C	A	E/M	59	2	0	0	0	39
14	403567	6442852	0	4	1	3	1	5	1	0	0	10-19	0	14	1	1-2	0	1	Mix	grass	Shallow	Absent	O	A	A	A	A	O	A	M/L	20	0	0	6	3	71
15	403662	6443190	0	2	1	0	1	2	2	0	0	6-9	5	18	2	1	0	0	Mix	grass	Mod	Absent	C	A	A	A	A	O	A	M/L	20	0	0	21	0	59
16	402473	6446802	1	3	1	2	0	3	1	0	0	20+	0	120	1	2	0	0-1	Scl	grass	Shallow	Absent	R	A	A	A	A	R	A	E	47	5	0	0	2	46
17	402223	6446559	0	0	0	0	0	0	0	2	3-5	3-5	0	0	0	3	0-1	2	None	grass	Absent	Absent	A	A	A	A	A	C	A	Y	100	0	0	0	0	0
18	403040	6445581	0	0	0	0	0	0	0	1	0	3-5	0	15	0	2	0	1	Mesic	sedge/rush	Absent	Absent	A	A	A	A	O	O	A	E	98	1	0	0	1	0
19	403141	6445714	0	1	0	0	0	0	1	0	0	10-19	0	15	1	2	0	0	Scl	grass	Shallow	Shallow	C	A	A	A	A	R	A	E	86	0	0	0	0	14
20	403781	6445590	0	0	0	0	0	0	0	0	0	6-9	0	16	0	2	1	0	Scl	grass	Shallow	Absent	O	A	C	A	A	O	A	E/M	81	1	0	0	3	15
21	403202	6446030	0	0	0	0	0	0	0	0	0	6-9	0	0	0	2	0	0	Scl	grass	Shallow	Absent	R	C	A	A	A	R	A	E	96	0	0	0	1	3
22	401201	6445230	1	0	0	0	0	0	0	0	10-19	10-19	0	23	1	2-3	0	1	Scl	grass	Shallow	Absent	R	A	A	A	A	R	A	E/M	87	0	0	0	0	13
23	401929	6444512	1	1	0	0	1	1	0	0	1-2	1-2	0	13	0	3	0	2	Mix	herb/grass	Absent	Absent	A	A	A	A	C	C	A	E	99	1	0	0	0	0
24	404050	6445378	1	0	0	0	0	0	0	0	1-2	6-9	0	7	1	3	0	2	None	grass/fern	Absent	Absent	O	A	A	A	A	C	A	E	95	1	0	0	0	4
25	404096	6444606	0	2	0	0	0	0	2	0	1-2	10-19	0	26	1	2	0	1	Scl	grass	Shallow	Absent	O	A	C	A	A	R	A	E/M	91	1	0	0	0	8
26	399583	6440852	0	0	0	0	0	0	0	0	20+	20+	0	84	0	3	0	1	Scl	grass	Shallow	Shallow	O	A	R	A	R	R	A	E	45	1	0	0	0	54
27	399631	6441602	0	0	0	0	0	0	0	0	20+	20+	0	80	2	3	0	1	Scl	grass	Shallow	Absent	C	A	R	A	A	R	A	E	13	1	0	0	0	86
28	403199	6436654	1	0	0	0	0	0	0	3	-	20+	1	140	1	2	0	1	Mix	grass	Shallow	Absent	C	A	R	A	A	R	A	M	24	1	0	0	0	75
29	403042	6436931	1	3	3	0	0	3	2	3	0	10-19	0	50	0	1-2	1	2	Mix	grass	Shallow	Shallow	O	A	A	A	O	C	A	M	56	1	0	0	0	43
30	403022	6437218	1	1	22	3	2	27	0	3	6-9	20+	0	210	0	2	0	2	Mix	grass	Shallow	Absent	C	A	A	A	O	C	A	M	88	1	0	0	0	11
31	400422	6440891	0	0	0	0	0	0	0	3	20+	20+	2	0	0	0	0	1	Mesic	fern/sedge/bryophyte	Shallow	Absent	A	A	A	A	R	O	A	E/M	12	1	25	44	18	0
32	402115	6437810	2	8	15	15	5	35	2	3	3-5	20+	0	53	0	3	2	1-2	Scl	herb/grass	Shallow	Absent	R	A	R	A	A	C	A	M	100	0	0	0	0	0

Site	Easting	Northing	Large Dead Trees	No. Hollow Trees	Small Hollows	Medium Hollows	Large Hollows	Total Hollows	Basal Hollows	Decorating bark	Stumps	Fallen Branches	Rock Crevices	Total Length Logs (m)	Fire	Clearing	Grazing	Weeds	Shrub	Ground layer	Litter	Humus	Acacia	Banksia	Allocasuarina	Palms	Vines	Weeds	Mistletoe	Age	% cover veg	% cover log > 30 cm	% cover surface rock	% cover outcropping rock	% cover bare soil	% cover litter	
33	402393	6437518	0	0	0	0	0	0	0	2	1-2	1-2	0	20	0	3	2	2-3	Mix	fern/herb/grass	Absent	Absent	O	A	C	A	A	C	A	Y	69	0	0	0	0	0	31
34	402703	6437045	2	1	3	3	1	7	0	1	1-2	20+	3	72	0	3	1	2-3	Scl	grass	Shallow	Absent	O	A	C	A	A	C	R	Y/E	18	3	2	0	0	0	77
35	402652	6437641	0	0	0	0	0	0	0	2	0	3-5	1	10	0	3	1	1	Scl	grass	Shallow	Absent	R	A	D	A	A	O	A	Y	64	0	0	0	0	0	36
36	402725	6437353	4	4	11	1	0	12	0	3	20+	20+	5	260	1	2	1	1	Scl	grass	Shallow	Absent	R	A	O	A	A	R	A	E/M	37	5	10	0	0	0	48
37	403148	6437611	0	0	0	0	0	0	0	2	6-9	20+	0	140	0	2	0	0-1	Scl	grass/herb/ grass	Shallow	Absent	C	A	R	A	O	R	A	Y/E	51	6	0	0	0	0	43
38	403513	6438110	0	0	0	0	0	0	0	3	3-5	20+	5	340	0	0	0	2	Mesic	fern/sedge	Shallow	Shallow	A	A	A	A	O	C/O	A	M	38	4	7	6	20	25	
39	403325	6437471	2	3	5	2	0	7	0	3	1-2	20+	4	180	0	2	0	0	Mix	grass	Shallow	Absent	C	A	A	A	R	R	A	E	77	1	0	0	0	0	22
40	403396	6437173	3	2	4	2	0	6	0	2	3-5	20+	0	70	2	2	0	0-1	Mix	grass	Mod	Absent	O	A	A	A	R	R	A	E/M	49	3	0	0	0	0	48
41	403715	6438174	0	0	0	0	0	0	0	2	10-19	20+	1	145	2	2	0	0-1	Scl	grass	Shallow	Absent	C	A	R	A	A	R	A	E	77	1	0	0	0	0	22
42	404030	6438593	1	2	7	5	0	12	0	2	3-5	20+	5	190	0	0	0	0	Mix	grass	Shallow	Shallow	C	A	R	A	O	R	A	E/M	29	5	0	1	0	0	65
43	403537	6439394	0	0	0	0	0	0	6	0	6-9	20+	2	120	2	2	2	1	Scl	herb/grass	Shallow	Absent	C	A	A	A	R	R	A	Y/E	48	1	0	0	0	0	51
44	403574	6440130	5	0	0	0	0	0	0	0	6-9	20+	2	30	0	2	1	2	Scl	grass	Shallow	Absent	C	A	R	A	R	O	A	Y/E	72	2	3	0	2	2	21
45	403443	6440360	0	0	0	0	0	0	0	0	0	20+	5	180	0	0	0	0-1	Mesic	fern/sedge/ bryophyte	Shallow	Absent	A	A	A	A	R	R	A	E	15	11	0	41	22	11	
46	400618	6445473	0	1	2	1	1	4	0	0	10-19	6-9	0	35	1	3	1	0	Scl	grass	Mod	Shallow	C	A	A	A	A	R	A	E	82	1	0	0	0	0	17
47	402371	6442359	4	1	4	3	0	7	0	0	6-9	20+	0	60	0	3	0	1	Scl	grass	Shallow	Absent	C	A	O	A	O	R	A	Y/E	78	0	0	0	0	0	22
48	403788	6444042	0	1	1	1	0	2	0	0	10-19	20+	5	36	1	2	0	1	Scl	grass	Shallow	Absent	O	A	C	A	R	R	A	E/M	39	1	5	0	0	0	55
49	402746	6440814	4	3	8	2	1	11	0	0	20+	20+	5	65	1	2-3	2-3	1	Scl	herb/grass	Absent	Absent	R	A	O	A	A	R	A	E/M	48	1	3	4	5	5	39
50	402347	6440197	1	1	6	2	0	8	0	3	10-19	20+	0	60	0	3	1-2	3	Mix	grass	Absent	Absent	R	A	A	A	O	C	A	E/M	100	0	0	0	0	0	0
51	401870	6442273	8	8	15	11	3	29	5	0	20+	20+	0	250+	2	3	0	0-1	Scl	herb/grass	Mod	Shallow	C	A	A	A	A	R	A	E/M	20	20	0	0	3	3	57
52	406505	6447588	4	2	5	2	0	7	0	0	10-19	3-5	0	15	0	3	3	1	Scl	fern/herb/grass	Absent	Absent	R	A	A	A	A	O	R	Y/E	61	2	5	2	0	0	30
53	406256	6447127	0	3	2	3	0	5	0	0	0	10-19	0	0	0	2	1	2	Mesic	fern/vine	Mod	Mod	R	A	A	A	D	C	A	E/M	79	0	1	0	0	0	20
54	406236	6445577	0	0	0	0	0	0	0	1	0	0	0	3	0	3	3	1	Mix	grass/fern	Absent	Absent	O	A	A	R	O	O	R	Y/E	87	1	0	1	0	0	11
55	406854	6446073	1	1	1	1	0	2	1	2	1-2	3-5	0	6	0	2	1	2	Mix	grass	Shallow	Absent	C	A	O	A	O	C	A	E/M	53	1	0	0	0	3	43
56	406162	6446077	0	2	2	0	0	2	0	2	0	0	0	13	0	2	2	2	Mix	grass/fern	Shallow	Shallow	O	A	R	A	C	C	A	E/M	93	0	0	0	0	7	0
57	406245	6446476	0	5	7	1	0	8	0	0	0	1-2	0	72	0	2	1-2	1	Mix	grass	Shallow	Shallow	O	A	C	A	R	O	A	M/L	49	4	0	2	3	3	42

Appendix H: Frog survey at Dog Trap Creek, Biosphere Environmental Consultants (2011)

STRATFORD EXTENSION PROJECT
FROG SURVEY AT DOG TRAP CREEK



Biosphere
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1 INTRODUCTION

Dog Trap Creek is a second-order stream that mainly drains into agricultural land, predominately used for grazing near Stratford in the Gloucester valley in eastern New South Wales (NSW). The creek flows across an alluvial plain of degraded clays and silts and forms a deep, narrow channel through this plain. In places, the channel is so deep that it intercepts the groundwater table. Dog Trap Creek flows mainly in a north-westerly direction before merging with the Avon River (part of the upper Manning River catchment).

In January 2011, Biosphere Environmental Consultants Pty Ltd was engaged by Gloucester Coal Limited to undertake a frog survey of a section of Dog Trap Creek that lies north of the Stratford Coal Mine (Figure 1).

2 SURVEY AREA

Figure 1 shows the location of the six survey sites along Dog Trap Creek. Six survey sites were chosen to provide maximum coverage of the creek. The final location of each site was decided after an initial site visit on the morning of 9 February 2011 and site locations were determined according to the availability of creekside vegetation. Along most of Dog Trap Creek the original vegetation has been cleared and only a thin strip of riparian vegetation remains. In many areas, the riparian vegetation had been cleared above the banks, while the remaining riparian vegetation was growing within the steep banks of the watercourse.

3 METHODS

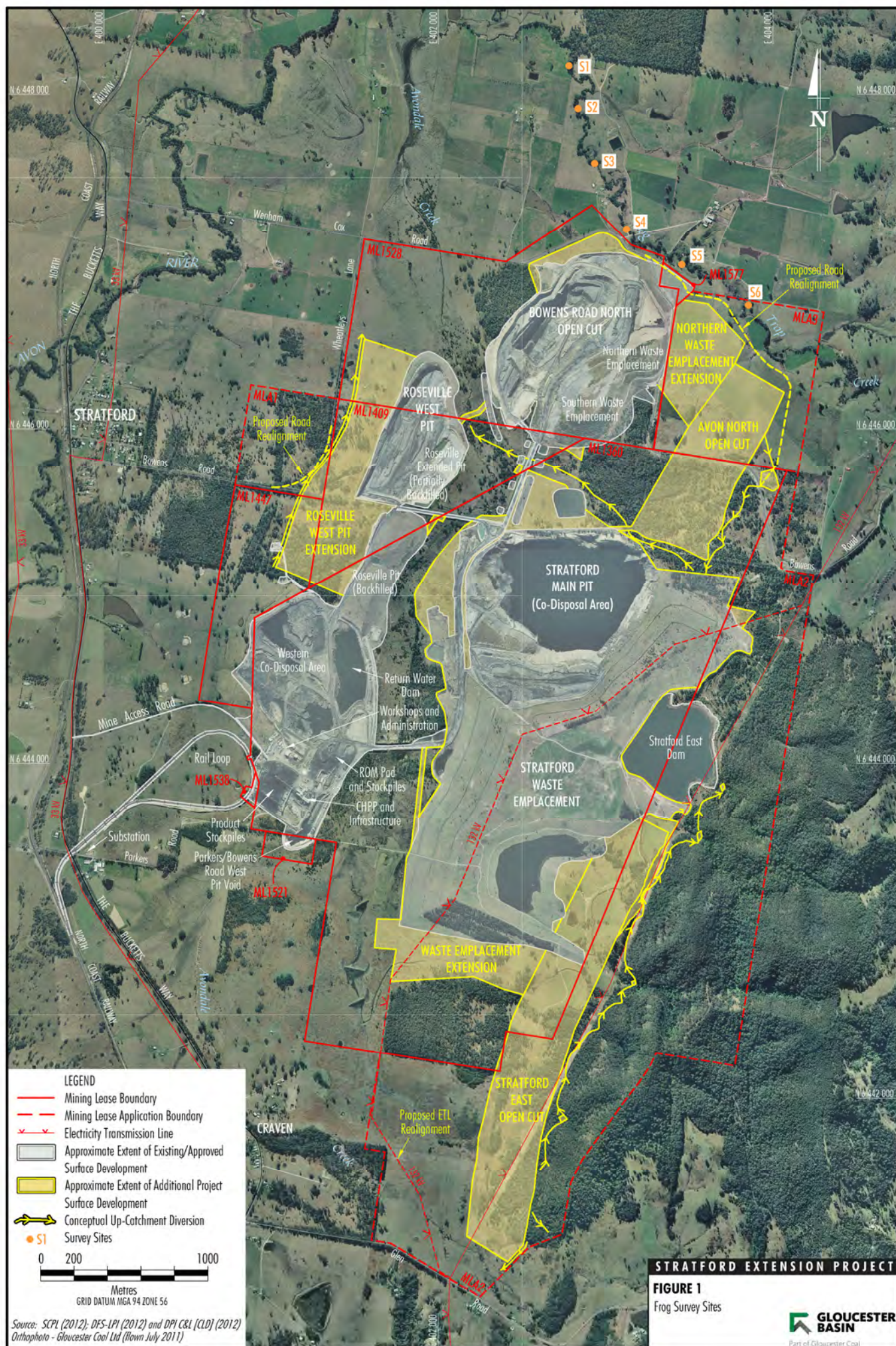
Each site consisted of a 200 metre transect on either side of Dog Trap Creek. The survey sites were equally spaced along a 2 kilometre section of creekline.

The surveys were conducted in consideration of the *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians* (DECC, 2009) and the *Survey Guidelines for Australia's Threatened Frogs* (DEWHA, 2010).

3.1 ADULT FROG SURVEYS

Nocturnal frog surveys were conducted at all six survey sites. Upon arrival at each site, the air temperature was recorded using a digital thermometer and a three minute listening period ensued where any calling frogs were identified. Call playback was undertaken for two minutes each night for two target species: the Giant Barred Frogs (*Mixophyes iteratus*) and the Green and Golden Bell Frog (*Litoria aurea*). After the call playback was completed there was a further 1 minute listening period. Streamside searches were conducted for two hours along each transect (i.e. 200m) to locate non-calling frogs using headlamps.

Surveys for the adult frogs were carried out on the nights of 9 and 10 of February 2011. The sites were surveyed from south to north (i.e. from Site 6 to Site 1) on 9 February and from north to south (i.e. from Site 1 to Site 6) on 10 February.



3.2 TADPOLE SURVEYS

Tadpole surveys were carried out at all six sites during the day where systematic searches for undertaken for 1 hour at each site. Tadpoles were sampled using a long-handled dip net. All tadpoles collected were identified using Anstis (2001), measured and released. The tadpole surveys were carried out during the day on 10 February 2011.

3.3 HABITAT ASSESSMENT

Habitat assessments were undertaken during the day at each survey site for a minimum of one hour each site. Vegetation, topography, land use and other site features were recorded using the proforma in Appendix A. In addition, a stream assessment was conducted which detailed the nature of the banks, stream flow, pools and riffles, obvious sources of habitat degradation or impacts (Appendix B).

In addition, a Yeo-kal Series 6000 Water Meter was used to undertake a series of water quality measurements at each site. The characteristics that were measured were: turbidity, dissolved oxygen content, percent oxygen saturation, oxidation-reduction potential, pH, salinity, conductivity and water temperature.

4 RESULTS

4.1 ADULT FROG SURVEYS

The results of the survey are presented in Table 1. A total of five species were located across all six survey sites. The five species were from two families, Myobatrachidae and Hylidae.

Table 1
Adult Frog Species Detected

Scientific Name	Common Name	Conservation Status ¹		Site Number					
		TSC Act	EPBC Act	1	2	3	4	5	6
MYOBATRACHIDAE									
<i>Crinia signifera</i>	Common Eastern Froglet	P	-	Nil	Nil	2 adults calling	Nil	Nil	1 adult calling
<i>Limnodynastes peronii</i>	Brown-striped Frog	P	-	Nil	1 adult calling	Nil	2 adults calling	2 adults calling	Nil
HYLIDAE									
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	P	-	Adult frogs present not calling	Adult frogs present not calling	Adult frogs present not calling	Adult frogs present not calling	Adult frogs present not calling	Adult frogs present not calling
<i>Litoria latopalmata</i>	Broad-palmed Frog	P	-	1 adult calling	2 adults calling	Nil	Nil	Nil	Nil
<i>Litoria peronii</i>	Peron's Tree Frog	P	-	Nil	Nil	Nil	1 adult calling	Nil	Nil

¹ Threatened species status listed under the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*.

The most species diverse sites were Sites 2 and 4 (three species), followed by Sites 1, 3, 5 and 6 (all with two species).

The Eastern Dwarf Tree Frog (*Litoria fallax*) was the only species recorded at all six survey sites. Peron's Tree Frog (*Litoria peronii*) was the least abundant species with only one recorded at Site 4. No threatened species were observed during the survey.

4.2 TADPOLE SURVEYS

No tadpole was captured at any of the survey sites.

4.3 HABITAT ASSESSMENT

The habitat assessment for the riparian corridor located along Dog Trap Creek has been summarised and is presented in Table 2 below.

Table 2
Riparian Corridor along Dog Trap Creek Habitat Assessment

Site Number	Extent of Riparian Corridor	Continuity of Riparian Corridor	Bank Profile	Streamside Vegetation	Visible Impacts	Availability of Frog Habitat
1	No riparian buffer above banks	Continuous with land to the north	Steep	Patches of <i>Lomandra</i> spp. present	Cattle trampling of vegetation; siltation; cattle chewing of streamside plants; cattle dung in creek.	Limited to small, damaged areas of <i>Lomandra</i> spp. within the banks.
2	No riparian buffer above banks	Discontinuous	Steep	<i>Eleocharis</i> spp. and <i>Typha</i> spp. in channel	Cattle trampling of vegetation; siltation.	Limited to small, damaged areas of <i>Lomandra</i> spp. within the banks.
3	No riparian buffer above banks	Discontinuous	Steep	Patches of <i>Lomandra</i> spp. present	Cattle trampling of vegetation; siltation; cattle chewing of streamside plants; cattle dung in creek	Limited to small, damaged areas of <i>Lomandra</i> spp. within the banks.
4	No riparian buffer above banks	Discontinuous	Steep	Patches of <i>Lomandra</i> spp. present	Cattle trampling of vegetation; siltation; cattle chewing of streamside plants; cattle dung in creek	Limited to small, damaged areas of <i>Lomandra</i> spp. within the banks.
5	No riparian buffer above banks	Discontinuous	Steep	Patches of <i>Lomandra</i> spp. present	Cattle trampling of vegetation; siltation; cattle chewing of streamside plants; cattle dung in creek	Limited to small, damaged areas of <i>Lomandra</i> spp. within the banks.
6	No riparian buffer above banks	Discontinuous	Steep	Patches of <i>Lomandra</i> spp. present	Cattle trampling of vegetation; siltation; cattle chewing of streamside plants; cattle dung in creek	Limited to small, damaged areas of <i>Lomandra</i> spp. within the banks.

At the time of the survey, Dog Trap Creek was not in flow and consisted of a series of shallow and deep pools along the watercourse. The results of the water quality analysis are presented in Table 3 below.

Table 3
Water Quality Results for Dog Trap Creek

Site Number	Turbidity (NTU)	Dissolved Oxygen (mg/ml)	Percent Saturation	ORP (mV)	pH	Salinity (ppt)	Conductivity (Ms/ml)	Water Temp (°C)
1	84	2.1	22.1	84	7.04	0.43	0.9	19.8
2	42	2.2	24.9	59	7.13	0.71	1.4	19.0
3	44	2.3	23.4	170	7.13	0.28	0.6	18.5
4	40	2.2	24.1	-40	6.71	0.32	0.6	19.5
5	29	0.9	5.5	-14	6.83	0.30	0.6	19.5
6	11	2.3	24.4	179	6.51	0.28	0.6	19.5

NTU = nephelometric turbidity units
mg/ml = milligram per millilitre
ORP = Oxidation Reduction Potential
MV = milli volts

ppt = parts per thousand
Ms/ml = milli Siemens / milli Litre
°C = degrees Celsius

5 DISCUSSION

5.1 ADULT FROG SURVEYS

The five frog species detected are species that are typically found in agricultural landscapes. None of these species are classified as threatened or endangered. Many of these frogs were also heard calling in nearby farm dams or ponds.

No threatened frogs were detected. No habitat for either the Giant Barred Frog (*Mixophyes iteratus*) or the Green and Golden Bell Frog (*Litoria aurea*) was present along Dog Trap Creek.

5.2 HABITAT ASSESSMENT

The habitat assessment proformas revealed that the available frog habitat at all six sites along Dog Trap Creek have been severely impacted as a result of several events. The major impact on the creek has been the excessive clearing of vegetation on either side of the creek. Land clearing for agriculture on either side of Dog Trap Creek has resulted in the complete removal of all shrub and tree cover up to the edges of the creek banks (see Figure 1 for an aerial view of the riparian strip). The result is a very slender strip of fringing vegetation that is not continuous between sites.

The fringing vegetation within the watercourse is also badly damaged, mainly as a result of cattle trampling and grazing. This has reduced the effective cover for frogs within the channel. The removal of the native vegetation has also enabled the growth of exotic weeds, primarily Privet and pasture weeds (such as Fire Weed *Senecio madagascarensis*, Fleabane *Conyza bonariensis* and thistles *Onopordum* sp.), which were established along the flanks of the creek. The weeds are not eaten by the cattle and have displaced native fringing plants such as Matt rush (*Lomandra longifolia*).

Cattle have also impacted the creek through the creation of walkways into the creek. These trampled areas are a major source of siltation and act as funnels for erosion.

Dog Trap Creek was surveyed at a time of low flow. Water quality measurement (Table 3) showed a reasonable amount of variation from pool to pool along the creek, but overall the survey sites were turbid, salty and almost stagnant. These factors contribute to poor habitat conditions for amphibian species and may have caused the absence of tadpoles. Streamside frogs are likely to move regularly between Dog Trap Creek and nearby farm dams, depending on water availability.

6 CONCLUSION

The section of Dog Trap Creek that was surveyed was highly disturbed and contained degraded frog habitat, primarily as a result of agricultural impacts on the creek. Five common frog species were detected, all species generally found in agricultural landscapes. No threatened frog species were detected and no habitat for threatened frogs was present in this section of Dog Trap Creek.

7 REFERENCES CITED

- Anstis, M. 2002. *Field Guide to the Tadpoles of South-eastern Australia*. Reed New Holland, Frenchs Forest.
- Department of Environment and Climate Change (DECC) 2009. *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians*.
- Department of Environment, Water, Heritage and Arts (DEWHA) 2010. *Survey Guidelines for Australia's Threatened Frogs*.

APPENDIX HA
SITE ATTRIBUTES PROFORMA

DOG TRAP CREEK				SITE ATTRIBUTES			
Survey Period..... Date: ____/____/____		Surveyor.....		BSS Database Site Code		<div style="display: flex; justify-content: space-between;"><div>1:25,000 map sheet</div><div>map sheet refers to date</div><div>vegetation</div></div>	
Field site no. or name:				Location description (Area of Survey - specific location):			
.....						
.....				Photo no.:			
Map code: ____ - ____ - ____		Map name:		Datum: AGD66 <input type="checkbox"/>		GDA94 <input type="checkbox"/>	
AMGrid ref. from 1:25,000 map:		____ (zone) / ____ (E) / ____ (N)		from GPS reading:		____ (zone) / ____ (E) / ____ (N) EPE <input type="text"/>	
Land tenure &/or reserve name:							
Broad vegetation category: (circle) Closed forest Open forest Woodland Mallee Heath/shrub Sedgeland Grassland							
Physical details							
Slope ____ degrees		Aspect ____ degrees		Altitude ____ metres			
Disturbance History							
Severity (0=no evid., 1=light, 2=mod., 3=severe)		Time since last event (where appropriate)		Accuracy (e.g. +/- 2 years)		Observation type 1=visual est, 2=written record, 3=informant	
Fire							
Clearing/logging (inc. ringbarking)							
Grazing							
Weeds							
Other (specify)							
Soil:							
Depth		<div style="display: flex; justify-content: space-around;">DeepShallowSkeletal</div>		Type		<div style="display: flex; justify-content: space-around;">ClayLoamSandOrganic</div>	
Geology observed in field (if known): <input type="checkbox"/> Not known							
Ground layer							
Projective cover (%) (total % cover = 100%)		% cover vegetation <input type="text"/>		% cover surface rock <input type="text"/>		% cover bare soil <input type="text"/>	
		log <input type="text"/>		outcropping rock <input type="text"/>		litter <input type="text"/>	
Litter							
Litter depth		<div style="display: flex; justify-content: space-around;">>10cm10-2 cm2-0 cm0 cm</div>		Estimate Depth (mm)		Litter <input type="text"/>	
Humus		<div style="display: flex; justify-content: space-around;">DeepMod.ShallowAbsent</div>		Humus		<input type="text"/>	
Trees with hollows in 20x20m plot							
no. trees with large hollows (>15cm diameter)		<input type="text"/>		no. trees with small hollows(<15cm diameter)		<input type="text"/>	
Estimate of projected shrub cover (%)							
all layers combined		<input type="text"/>		%			
Canopy stand density							
number of trees in 20x20 plot		<input type="text"/>		DBH		av. dbh on plot (Estimate) <input type="text"/> cm	
% projected foliage cover: (circle most appropriate class)							
		100-75%		75-50%		50-25%	
		25-5%		<5%, many individuals		<5%, few individuals	
		none					
Tree or shrub Acacias		6		5		4	
Tree or shrub Banksias		6		5		4	
Tree or shrub Allocasuarinas		6		5		4	
Palms		6		5		4	
Vines		6		5		4	
Weeds		6		5		4	
Logged stumps							
Large (>10cm dbh) stags		no. present on 20x20m plot:		no. present on 20x20m plot:			
		<div style="display: flex; justify-content: space-around;">>109 to 63 to 51 to 2none</div>		<div style="display: flex; justify-content: space-around;">>109 to 63 to 51 to 2none</div>			
Dominant shrub growth form							
<div style="display: flex; justify-content: space-around;">MesicSclerophyllMixedHeathyTreefernGrass Tree</div>							

(if circle >1, indicate dominant growth form)

Dominant ground layer growth form

Tussock grass	Hummock grass	Sod grass	Fern	Moss	Herb/ grass
Lichen	Liverwort	Sedge	Rush	Vine	

Strata				
(fill in only for those strata present on the site and add strata when necessary)	Crown Cover (%) (as McDonald et al.)	Height Rnge (see below)	Estimate of average height (m)	Species Present
Emergent	%			
Tree layer 1	%			
Tree layer 2	%			
Shrub	%			
	%			
	%			
	%			

Height range: 0-1m, 1 - 3m, 3 - 5m, 5 - 12m, 12 - 20m, 20 - 35m, >35m

Stream or water body characteristics (at gully sites and other frog survey sites)

(circle appropriate)

Stream order (from map)	1	2	3	4	N/A		
Stream width (between fringing vegetation)	m		OR	Pond/Dam/Swamp diameter m			
Waterbody substrate	gravel	rock	sand	soil			
Riparian Vegetation (circle one or more)	Absent	RF	WSF	DSF	she-oak	swamp scler.	ferns
	grass	sedges	Other				
Fringing ground environment (circle one or more)	Absent	ferns	grass	sedges	floating		
	rocky	soil	sand				
Water Movement	still	flowing					
Water Colour	clear	stained					

Specify (eg Dam/River/Soak)

Water body (circle one)

1) Temporary and Natural (ephemeral soaks, ephemeral streams etc.)	
2) Temporary and Human-made (eg. roadside ditches)	
3) Permanent and natural (streams and swamps with water >80% of time)	
4) Permanent and human made (eg. Dam)	

Topographic Position

(circle best morphology and element)

Morphology	Crest	Simple Sl.	Upper Sl.	Mid Slope	Lower Sl.	Flat	Open Depr.	Closed Depr.
Element	Hillcrest	Streambank	Cliff	Cliff	Cliff-foot	Plain	Gully	Lake
	Summit	Cliff	Hill slope	Hill slope	Hill slope	Valley	Drainage	Lagoon
	Plateau	Hill slope	Scarp	Scarp	Scarp-foot	Fan	Depression	Swamp
		Scarp					Stream channel	
							Stream bed	

Brief site description: (eg rocky, moist veg, unusual characteristics)
Does it match the mapped vegetation type? Flowering events - what species?

APPENDIX HB
STREAM ATTRIBUTES PROFORMA

DOG TRAP CREEK				STREAM ATTRIBUTES																																	
Survey Period.....		Date: ____/____/____		Surveyor.....																																	
Field site no. or name:				BSS Database Site Code		<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> <div style="border: 1px solid black; width: 30px; height: 20px;"></div> </div> <small>1:25000 mapsheet mapsheet series to date vegetation</small>																															
Location description (Area of Survey - specific location):																																					
						Photo no.:																															
Map code: ____ - ____		Map name:																																			
AMGrid ref. from 1:25,000 map:		____ (zone) / ____ (E) / ____ (N)				Datum: AGD66																															
from GPS reading:		____ (zone) / ____ (E) / ____ (N)		EPE <div style="border: 1px solid black; width: 40px; height: 15px;"></div>		GDA94 <div style="border: 1px solid black; width: 20px; height: 15px;"></div>																															
Land tenure &/or reserve name:																																					
Broad vegetation category: (circle) Closed forest Open forest Woodland Mallee Heath/shrub Sedgeland Grassland																																					
Physical details Slope ____ degrees Aspect ____ degrees Altitude ____ metres																																					
PHYSICAL DETAILS <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;"></th> <th style="width: 20%;">STREAM WIDTH (m)</th> <th style="width: 20%;">STREAM DEPTH (m)</th> <th style="width: 20%;">FLOW RATE (m/S)</th> <th colspan="2" style="width: 25%;">PERIODICITY (if known)</th> </tr> </thead> <tbody> <tr> <td>Maximum</td> <td></td> <td></td> <td></td> <td>Permanent</td> <td>Steady Flow</td> </tr> <tr> <td>Minimum</td> <td></td> <td></td> <td></td> <td>Permanent</td> <td>Periodic surges</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Ephemeral</td> <td>Often with water</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Ephemeral</td> <td>Often dry for long periods</td> </tr> </tbody> </table>									STREAM WIDTH (m)	STREAM DEPTH (m)	FLOW RATE (m/S)	PERIODICITY (if known)		Maximum				Permanent	Steady Flow	Minimum				Permanent	Periodic surges					Ephemeral	Often with water					Ephemeral	Often dry for long periods
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EMERGENT VEGETATION																																					
STREAM SOURCES CATCHMENT Area and Location CATCHMENT Land Tenure and Land Use																																					
POTENTIAL IMPACTS <ul style="list-style-type: none"> Siltation/ Land Clearing Alteration to Water Flow Potential Pollution Sources Introduced Species Altered Ecological Processes Other 																																					
WATER CHARACTERISTICS <ul style="list-style-type: none"> Water Clarity Water Smell Algae Present Visible Contaminants 																																					
FLOODING HISTORY <ul style="list-style-type: none"> Time since last flood Periodicity of flooding Longevity of flood waters 																																					
RIFFLES and POOLS																																					

Appendix I: New Holland Mouse reports

Attachment I-A: Gloucester Valley Terrestrial Fauna Survey (AMBS)

Gloucester Valley Terrestrial Fauna Survey



Prepared by Australian Museum Business Services
for Gloucester Coal Limited

Final Report

October 2011

AMBS Reference: 110282

Document Information 110282

Citation:	AMBS 2011. Gloucester Valley Terrestrial Fauna Survey. Draft Report prepared for Gloucester Coal Limited by Australian Museum Business Services.
Versions:	Version 1: Draft Report issued 1 September 2011 Version 2: Draft Report issued 26 October 2011 Version 3: Final Report issued 27 October 2011
Recipient:	Tony Dwyer
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Reviewed by:	Adam Smith

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1 Introduction

1.1 Background

Gloucester Coal Limited (GCL) commissioned Australian Museum Business Services (AMBS) to undertake targeted surveys for threatened fauna species in the Gloucester Valley between the Stratford Coal Mine and Duralie Coal Mine.

The surveys were required to gather information regarding threatened fauna in the wider Gloucester Valley. The specific objectives of the surveys were to:

- undertake targeted surveys for the New Holland Mouse *Pseudomys novaehollandiae*, which is listed as a vulnerable species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- undertake vegetation surveys and habitat characterisation of sites where previous trapping surveys had targeted the New Holland Mouse;
- undertake targeted surveys for threatened bird species listed under the *NSW Threatened Species Conservation Act 1995* (TSC Act) and/or EPBC Act; and
- record opportunistic vertebrate fauna sightings.

1.2 Study Area

The study area is located within Gloucester Valley, in mid-northern New South Wales (NSW) (Figure 1). The study area is defined here as the area depicted in Figure 1.

1.3 Authorship and Acknowledgements

This report was prepared by AMBS Ecologists Mark Semeniuk and Belinda Pellow. Dr. Mick Ashcroft undertook some data analysis using Generalised Additive Models. AMBS Project Manager Adam Smith reviewed the report, and Senior Project Manager Glenn Muir provided technical advice and direction for the study.

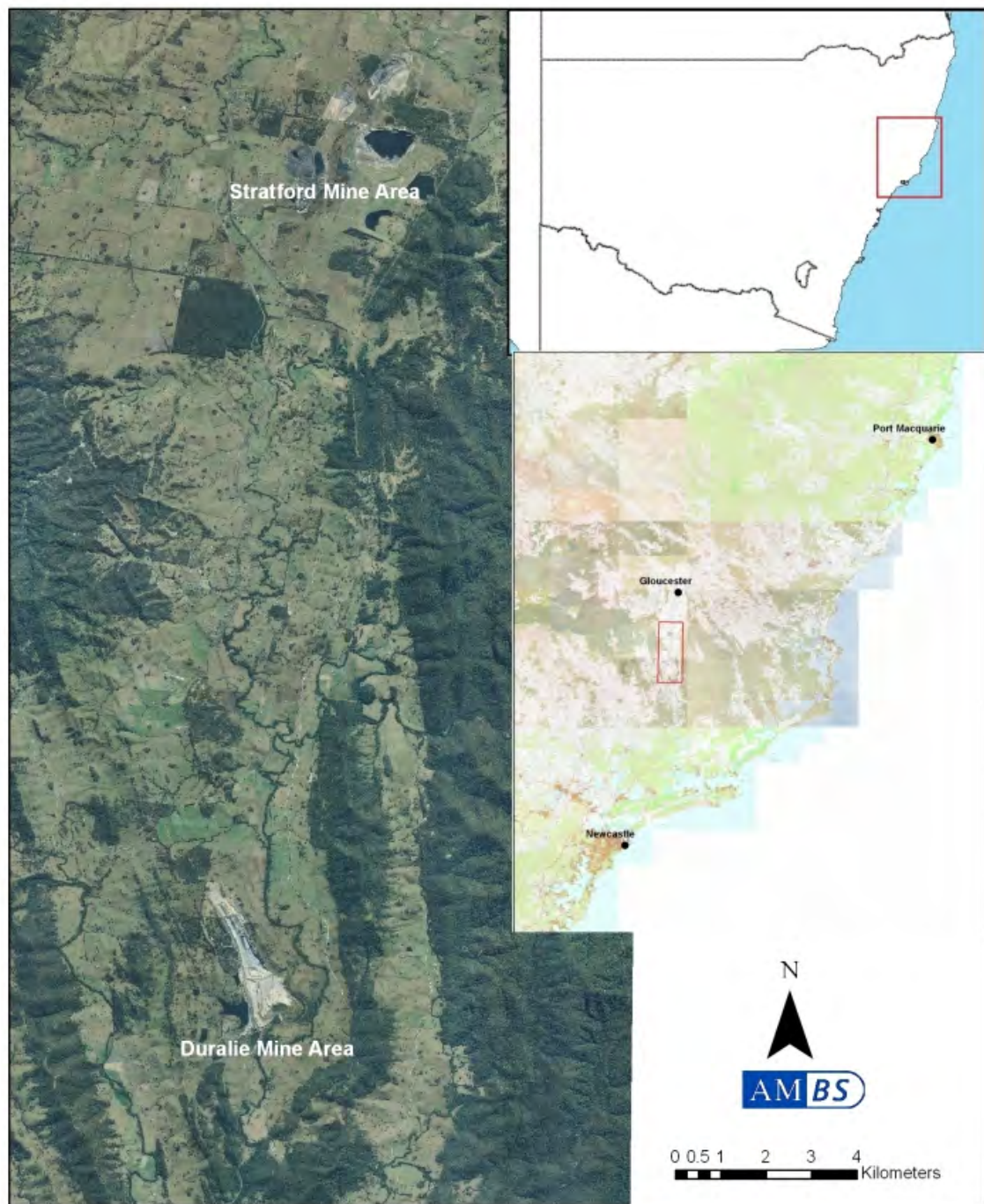


Figure 1: Location of the study area.

2 Methods

The Gloucester Valley Fauna Survey consisted of New Holland Mouse Surveys (Section 2.1), threatened bird surveys (Section 2.2) and recording of opportunistic records (Section 2.3). Methods for these are described in the following sections.

2.1 New Holland Mouse Surveys

The New Holland Mouse surveys consisted of a targeted trapping program and detailed habitat assessments. Methods for these techniques are described in Sections 2.1.1 and 2.1.2.

2.1.1 Targeted Trapping

Two surveys were undertaken targeting the New Holland Mouse, the first in late March to early April 2011 and the second in mid May 2011 (Table 1). Prior to each survey, a preliminary site inspection was undertaken to identify areas of potential habitat to survey. Identification of these areas was based primarily on records from previous surveys in the locality, but also considered known preferred habitat based on the scientific literature. The first of these site inspections was on 10 March 2011 by Glenn Muir and Mark Semeniuk (both AMBS). The second site inspection was undertaken on 16 May 2011 by Mark Semeniuk and Gina Barnett (both AMBS).

Table 1: Details of surveys targeting the New Holland Mouse.

Date	No. sites	AMBS Ecologists
31/03/2011 to 8/04/2011	12	Mark Semeniuk, Dejan Stojanovic
17/05/2011 to 21/05/2011	6	Mark Semeniuk, Gina Barnett

Weather conditions varied between the two survey periods (Table 2). During the first survey, minimum temperatures were about 13-14 degrees Celsius (°C) and maximum temperatures ranged from 20 to 26°C. There was heavy rainfall on 1 April, followed by several dry days, and then heavy rainfall again from 5 to 8 April. During the second survey minimum temperatures ranged from 2 to 7 °C and maximum temperatures ranged from 20 to 24 °C, and there was little rainfall (Table 2).

Table 2: Climate data from the Bureau of Meteorology.

Date	Temp min (°C)*	Temp max (°C)*	Rainfall (mm)**	Moon phase
31/03/2011	14.4	23.5	0.2	Last quarter
01/04/2011	14.6	26.0	15.2	Last quarter
02/04/2011	13.4	24.1	0	Last quarter
03/04/2011	13.9	25.5	0	Last quarter
04/04/2011	12.2	23.9	0	New moon
05/04/2011	15.1	21.2	10.4	New moon
06/04/2011	13.2	21.0	10.8	New moon
07/04/2011	–	19.8	6.8	New moon
08/04/2011	13.4	20.7	19.6	New moon
17/05/2011	2.2	19.9	0	Full moon
18/05/2011	6.9	21.0	0	Full moon
19/05/2011	8.9	21.0	0	Full moon
20/05/2011	7.0	21.8	0.2	Full moon
21/05/2011	6.5	23.6	0.2	Full moon

* data from the Paterson weather station (approximately 60 km from study area)

** data from the Craven weather station (within study area)

A total of 18 sites were surveyed, 12 in the first survey and six in the second (Table 1). At each site (Table 3 and see Appendix A for locations), 25 Elliott traps were deployed for four nights and baited with the 'universal' mixture of peanut butter, rolled oats and honey. Cotton wool was inserted into each trap to provide warmth for any captured animals. Sites were checked each morning for a period of 4 days with all captured animals identified, sexed, marked and released at their point of capture. Animals were marked by shaving a small amount of fur from a unique location on the individual, using a small 'Shear Magic Battery Pet Trimmer'.

Table 3: Coordinates for Elliott trap lines (zone 56, GDA 94).

A = start, B = middle, C= end.

Site	Easting	Northing	Site	Easting	Northing
1A	403705	6438124	10A	402264	6426751
1B	403661	6437995	10B	402238	6426674
1C	403644	6437865	10C	402205	6426540
2A	403505	6438128	11A	401260	6424237
2B	403462	6438005	11B	401233	6424148
2C	403472	6437872	11C	401212	6424026
3A	402146	6438863	12A	401935	6423539
3B	402149	6438995	12B	402009	6423509
3C	402109	6439131	12C	402090	6423442
4A	402599	6438436	13A	396508	6428748
4B	402596	6438557	13B	396391	6428735
4C	402576	6438669	13C	396338	6428648
5A	402280	6437888	14A	396761	6427765
5B	402269	6438012	14B	396727	6427662
5C	402284	6438108	14C	396768	6427569
6A	400691	6434692	15A	399332	6427474
6B	400835	6434697	15B	399350	6427582
6C	400943	6434634	15C	399386	6427708
7A	401914	6432452	16A	402153	6425005
7B	401830	6432386	16B	402074	6424930
7C	401726	6432330	16C	401996	6424843
8A	401599	6429924	17A	403986	6438484
8B	401552	6430032	17B	403874	6438480
8C	401571	6430148	17C	403762	6438492
9A	402002	6427448	18A	403059	6440681
9B	401980	6427546	18B	403023	6440600
9C	401996	6427642	18C	403045	6440503

2.1.2 Habitat Assessments

Survey Design

The survey design was based on the known ecology of the New Holland Mouse throughout its distribution and previous observations of the types of habitat in which the species had been recorded from within the study area (see Ecobiological 2010 and Kerle 2011). This anecdotal evidence suggested that, in the study area at least, the New Holland Mouse preferred areas with a diverse and dense ground cover. Therefore, the main aim of the survey was to compare the habitat components of sites where the New Holland Mouse was trapped, with the sites where it was not trapped. In this regard, the habitat components likely to be important were identified as:

- the diversity of plant species;
- the density of structural layers;
- the density of the vegetation in the lower layers;
- the frequency and density of plant species, and
- topography and other factors (See Appendix D).

Detailed habitat assessments were undertaken by AMBS ecologists Belinda Pellow, James Bevan, Mark Semeniuk, Gina Barnett and Fiona Powell. Habitat assessments were undertaken at locations where surveys targeting the New Holland Mouse had been undertaken by AMBS (current survey), Ecobiological (2010) and Kerle (2011). A total of 43 sites were assessed, which included locations where the species had been previously recorded, and where it had not. Surveys were undertaken as follows:

- 15 surveys were undertaken at the Elliott trap locations where New Holland Mice had been captured. These sites were referred to as Present/Precise (Pres-Prec);
- 8 surveys were undertaken at the midpoint of transects where New Holland Mice had been trapped previously. These sites were referred to as Present/Imprecise (Pres-Imp); and
- 20 surveys were undertaken at the midpoint of transects where New Holland Mice had not been recorded. These sites were referred to as Absent/Imprecise (Abs-Imp).

At each site, all vascular plant species rooted in, or overhanging, a 20m x 20m quadrat were identified and recorded. Species were identified either in the field or from specimens collected and taken to the laboratory. A cover/abundance estimate was assigned to each species based on a Braun-Blanquet scale adapted from Poore (1955) (Table 4). Vegetation structure was described by estimating the height and cover of each recognisable horizontal stratum of trees, shrubs and ground vegetation. The type and severity of disturbance at each site was noted including fire history, grazing and weeds. Additional variables based on the Biometric index (Gibbons *et al.* 2005) were used to assess habitat features such as tree hollows, length of fallen logs, leaf litter and relative abundance of weeds. Details of location (elevation), physiography (slope and aspect) and soil features (colour, drainage, runoff, texture and depth) were also recorded. The location of all survey plots was recorded using a GPS (global positioning system). Other site specific information which was observed during the survey and thought to contribute to the understanding of habitat was also recorded.

Table 4: Cover/Abundance Scores adapted from Braun-Blanquet scale (Poore 1955)

Score	Percentage Cover	Estimated Percentage Cover Assigned for Analysis
1	one / few individuals & <5% cover	1
2	uncommon & <5% cover	2
3	common & <5% cover	3
4	very abundant & <5% cover	4
5	5 – 20% cover	12.5
6	20 – 50% cover	35
7	50 – 75% cover	62.5
8	75 – 100% cover	87.5

To provide information on the density of the ground layer, a density measure was made in each survey plot. The density of the vegetation at a height of 0.5 m or less was estimated and expressed as a percentage. The density score was determined by observing the distribution of the vegetation density from all strata below 0.5 m across the plot vertically and estimating the thickness of the layer horizontally.

Sampling methods followed established flora survey techniques that are used widely in NSW to describe species composition and vegetation structure (Keith & Bedward 1999, Tozer 2003) and habitat quality (Gibbons et al. 2005) of native vegetation. Use of these widely applied methods allows for a comparison with other existing data from previous surveys undertaken in the area if necessary.

Data Analysis

Data for the three site categories (Prec-Pres, Imp-Pres and Abs-Imp) were exported from the vegetation database and analysed using Primer 5 (Clark & Gorley 1994) to allow multivariate statistical analyses. An analysis of similarity (ANOSIM) was undertaken in this way. Univariate analyses (T-test, Z-test or Mann-Whitney U-test) were used to investigate relationships between specific variables. To identify the preferred habitat for the New Holland Mouse, data from the Precise/Present and the Absent/Imprecise groups were analysed. Data from the Imprecise/Present group were excluded from most analyses to provide a direct comparison only between sites where the species had either definitely been recorded or definitely not recorded.

In addition, we investigated the factors affecting the distribution of the New Holland Mouse using Generalised Additive Models (GAMs) based on presence and absence of the species. To increase model robustness we only included one random presence where multiple records were observed in close proximity, and discarded the nearby records that were probably spatially autocorrelated. This reduced the dataset to 9 presences, and 22 absences.

We subdivided the data into nine subsets, each with one presence and a random set of absences. These were used for nine-fold cross-validation, where each model was produced with eight of the nine subsets at a time, and then validated with the subset that was not used for model production. The overall validation was calculated as the average Area Under the Receiver Operator Characteristic Curve (AUC of ROC) of the nine models. As we have only a small number of records to produce models, and many predictors that could potentially explain the distribution of the species, there was a danger that we could overfit to the training data. The cross validation reduced this likelihood, as models were evaluated using data that was withheld from model production.

We started by producing univariate models using predictors such as grazing intensity, aspect, temperature and humidity, ground cover density, species richness of vegetation, legume cover, evidence of fire, and percent cover of *Imperata cylindrical* var. *major*.

2.2 Threatened Bird Surveys

For diurnal birds, standardised bird surveys were undertaken from 1 to 7 April 2011, during the first targeted trapping survey for the New Holland Mouse. At each of the 12 sites where Elliott trapping was done during this period, 20-minute searches for diurnal birds were undertaken within 3 hours of dawn. Other locations throughout the study area were surveyed during the late afternoon using the same standardised technique (Appendix A).

For nocturnal birds, call-playback was conducted at four sites (i.e. CP1 to CP4) over a various number of nights at each site (Table 5). This targeted the Bush Stone-curlew *Burhinus grallarius*, Powerful Owl *Ninox strenua*, Masked Owl *Tyto novaehollandiae*, Barking Owl *Ninox connivens*, Sooty Owl *Tyto tenebricosa* and Grass Owl *Tyto capensis*.

Table 5: Survey effort for call-playback targeting threatened nocturnal birds.

		Number of nights call-playback undertaken			
		Site			
Common name	Scientific name	CP1	CP2	CP3	CP4
Bush Stone-curlew	<i>Burhinus grallarius</i>	1	5	5	–
Powerful Owl	<i>Ninox strenua</i>	1	5	5	–
Masked Owl	<i>Tyto novaehollandiae</i>	1	7	7	–
Barking Owl	<i>Ninox connivens</i>	1	5	5	–
Sooty Owl	<i>Tyto tenebricosa</i>	–	5	5	–
Grass Owl	<i>Tyto capensis</i>	–	–	–	4

2.3 Other

Opportunistic observations of other vertebrate fauna species were recorded during both survey periods. Locations of survey sites are shown in Appendix A.

3 Results

3.1 General

A total of 110 vertebrate fauna species were recorded during the surveys comprising four species of frog, two species of reptiles, 92 species of birds and 12 species of mammals (Appendix B). Six species recorded during the surveys are listed as threatened under the TSC Act or EPBC Act (Table 6) and the locations of where they were recorded are shown in Figures 2, 3 and 4. Details of the threatened species that were recorded are presented in following sections of this report.

Table 6: Threatened fauna species recorded during the surveys (V = vulnerable).

Common name	Scientific name	TSC Act	EPBC Act
New Holland Mouse	<i>Pseudomys novahollandiae</i>	–	V
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	V	–
Glossy Black-cockatoo	<i>Calyptorhynchus banksia</i>	V	–
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	–
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	V	–
Little Eagle	<i>Hieraaetus morphnoides</i>	V	–

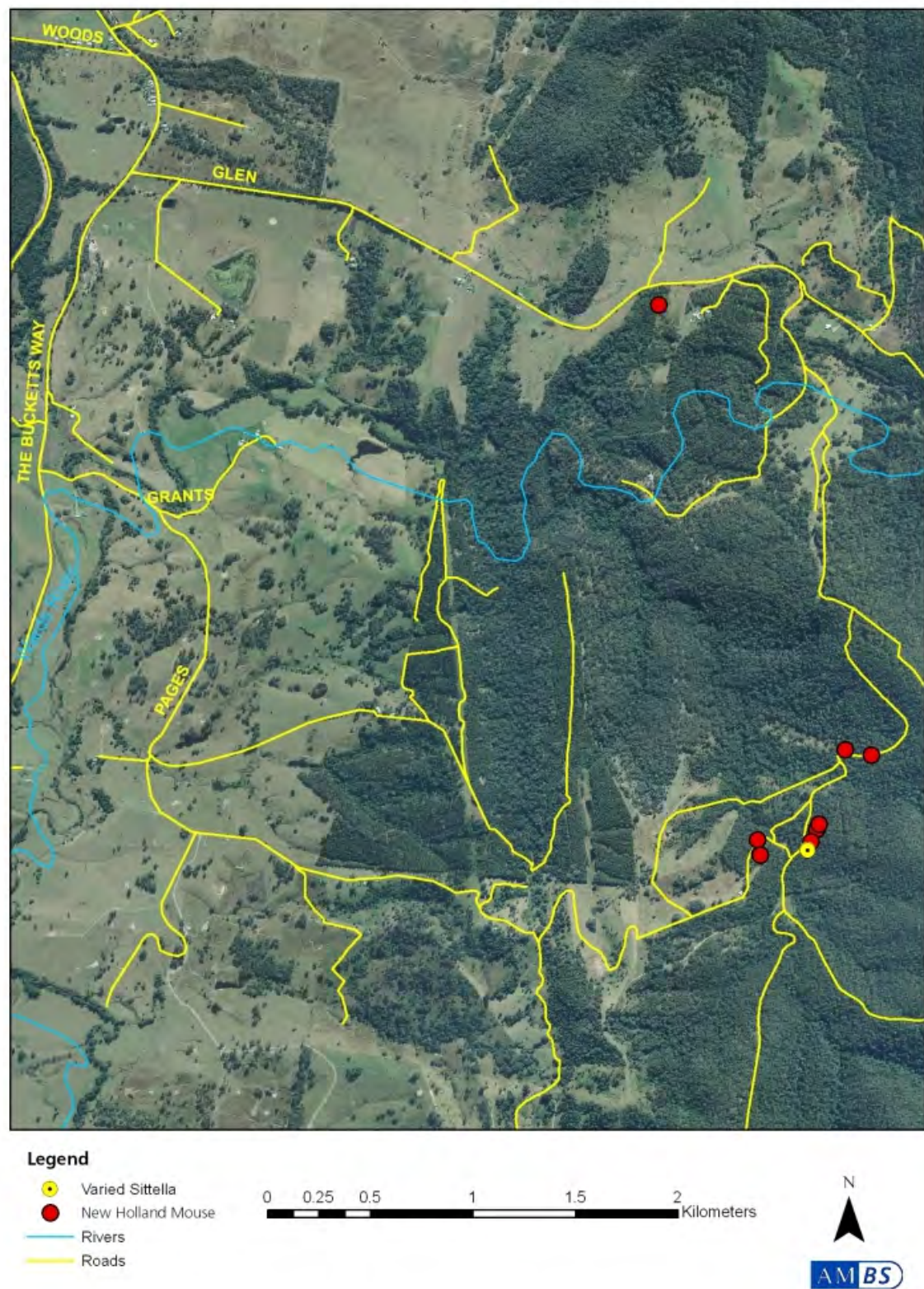


Figure 2: Threatened species locations (northern study area).



Figure 3: Threatened species locations (central study area).



Figure 4: Threatened species locations (southern study area).

3.2 New Holland Mouse Surveys

3.2.1 Targeted Trapping

Seven different species of mammal were recorded during the trapping surveys (Table 7). One reptile, a juvenile Land Mullet (*Bellatorias major*), was recorded in an Elliott trap at Site 3.

Table 7: Mammals recorded during the targeted trapping surveys.

Site	Brown Antechinus <i>Antechinus stuartii</i>	Swamp Rat <i>Rattus lutreolus</i>	New Holland Mouse <i>Pseudomys novaehollandiae</i>	Bush Rat <i>Rattus fuscipes</i>	Brush-tailed Phascogale <i>Phascogale tapoatafa</i>	Black Rat* <i>Rattus rattus</i>	House Mouse* <i>Mus musculus</i>
1	3M, 4F		2F (2R)			2F (1R)	
2	3M, 5F (5R)		1M, 1F (1R)			1F (1R)	
3	1F (1R)	1F					2M
4	2M, 1F (2R)					1M, 3F, 1U (3R)	1U
5	6M, 3F (6R)	2M, 4F (3R)				1M, 1F (3R)	
6	2M, 2F (4R)						1U
7	9M, 5F (3R)					1F, 1U (1R)	
8	2M (2R)					1U	
9		1M					
10	3M, 2F, 1U (3R)					2M, 1F (4R)	
11	8M, 9F, 1U (13R)				1F	2M, 1F, 1U (2R)	
12	11M, 7F, 1U (11R)	1M, 1U				2M	
13	10M, 3F (10R)	1M, 3F (2R)		1F			
14	3M, 2F (4R)	1M, 2F					1F (1R)
15	1M, 5F (3R)					1M	
16							
17	1M (1R)		2M				2M
18	1M	1F	1M				2M, 2F

* denotes introduced species.

New Holland Mouse

The New Holland Mouse was recorded at four of the 18 survey sites (Sites 1, 2, 17 and 18). One male and one female were recorded at Site 2, with the female being recaptured once. At Site 1, one individual was captured on three occasions, while the other was captured only once. The two individuals captured at Site 17 and the individual at Site 18 were only captured once. All individuals appeared to be in good physical condition. There was no evidence of breeding. Coordinates of capture locations and dates of capture are presented in Table 8.

Table 8: New Holland Mouse capture locations during the current survey.

Date Captured	Site	Easting	Northing	Record No.
01/04/2011	2	403463	6437973	NHM7
02/04/2011	2	403453	6438044	NHM8
02/04/2011	1	403705	6438123	NHM9
03/04/2011	1	403696	6438098	NHM10
04/04/2011	1	403672	6438039	NHM11
04/04/2011	2	403464	6437970	NHM12
04/04/2011	1	403705	6438123	NHM9
18/05/2011	17	403918	6438460	NHMa
20/05/2011	17	403811	6438486	NHMb
20/05/2011	18	403019	6440643	NHMc

The habitat type at three of these four sites was classified as grassy open forest or woodland (Plates 1, 2 and 3) with a ground cover dominated by native grasses and a sparse shrub layer. The fourth site (Plate 4) was quite different from the other three sites; being grassland adjacent to tall closed shrubland.

Site 1 (Plate 1): Two individual New Holland Mice recorded. The dominant tree here was *Eucalyptus globoidea* (White Stringybark), with fewer *Eucalyptus carnea* (Thick-leaved Mahogany), *Eucalyptus siderophloia* (Grey Ironbark) and *Eucalyptus propinqua* (Small-fruited Grey Gum). The understory was diverse and contained a variety of Acacias, including *Acacia implexa* (Hickory Wattle), *Acacia floribunda* (White Sally) and *Acacia maidenii* (Maidens Wattle). Other common shrubs included *Persoonia linariis* (Narrow-leaved Geebung), *Breynia oblongifolia* (Coffee Bush), *Rubus parvifolius* (Native Raspberry), *Billardiera scandens* (Appleberry), *Podolobium ilicifolium* (Prickly Shaggy Pea). The ground cover was relatively dense, being dominated by *Imperata cylindrica* (Blady Grass) and *Themeda australis* (Kangaroo Grass) with fewer *Pratia purpurascens* (Whiteroot) and *Poa labillardierei* var. *labillardierei* (Tussock). Other common species included *Desmodium rhytidophyllum*, *Dichondra repens* (Kidney Weed), *Hibbertia scandens* (Climbing Guinea Flower) and *Lissanthe strigosa* (Peach Heath).

**Plate 1: April survey, Site 1.**

Site 2 (Plate 2): Two individual New Holland Mice recorded. Dominant tree species were *Eucalyptus globoidea* (White Stringybark), *Eucalyptus siderophloia* (Grey Ironbark), and *Eucalyptus carnea* (Thick-leaved Mahogany). The understory was very sparse. Species recorded included *Billardiera scandens* (Appleberry), *Acacia maidenii* (Maidens Wattle), *Lissanthe strigosa* (Peach Heath), *Persoonia liniaris* (Narrow-leaved Geebung) and *Rubus parvifolius* (Native Raspberry). The ground cover was relatively dense, being dominated by *Imperata cylindrica* (Blady Grass), *Themeda australis* (Kangaroo Grass), with fewer *Pratia purpurascens* (Whiteroot). Other common species included *Dichondra repens* (Kidney Weed), *Cheilanthes sieberi*, *Glycine* sp., *Microlaena stipoides* var. *stipoides*, *Desmodium rhytidophyllum* and *Oplismenus aemulus*.



Plate 2: April Survey, Site 2.

Site 17 (Plate 3): Two individual New Holland Mice recorded. Dominant tree species were *Eucalyptus carnea* (Thick-leaved Mahogany), *Eucalyptus propinqua* (Small-fruited Grey Gum) and *Eucalyptus microcorys* (Tallowwood). *Corymbia maculata* (Spotted Gum) were occasional. The understory was relatively diverse, with common species including *Acacia maidenii* (Maiden's Wattle), *Acacia floribunda* (White Sally), *Podolobium ilicifolium* (Prickly Shaggy Pea), *Breynia oblongifolia* (Coffee Bush) *Glochidion ferdinandi* (Cheese Tree) and *Rubus parvifolius* (Native Raspberry). The ground cover was relatively dense, dominated by grasses *Imperata cylindrica* (Blady Grass), *Lomandra longifolia* (Spiny-headed Mat-rush), *Themeda australis* (Kangaroo Grass), *Entolasia stricta* (Wiry Panic) and *Pratia purpurascens* (Whiteroot).



Plate 3: May survey, Site 17.

Site 18 (Plate 4): One individual New Holland Mice recorded. This individual was captured in grassland immediately adjacent to a tall closed shrubland. The ground cover was very dense, dominated by grasses *Imperata cylindrica* (Blady Grass), *Andropogon virginicus* (Whiskey Grass) and *Themeda australis* (Kangaroo Grass). *Acacia floribunda* (White Sally Wattle) was abundant in the adjacent shrubland. The tallest stratum was comprised of regenerating *Angophora floribunda* (Rough-barked Apple) less than 10 m high. It appeared that the shrubland was regenerating from previous clearing.



Plate 4: May survey, Site 18.

Brush-tailed Phascogale *Phascogale tapoatafa*

One individual of this species was recorded from an Elliott trap on 7 April 2011 at Site 11, at coordinates 401232E, 6424134N (Zone 56, GDA 94). This is within an area referred to as the Duralie Offset Area. The female was in reasonable condition and there was no evidence of breeding.

Habitat in the area was classified as open grassy forest. Dominant tree species were *Eucalyptus globoidea* (White Stringybark), *Eucalyptus carnea* (Thick-leaved Mahogany) and *Corymbia maculata* (Spotted Gum). There was a diverse mid-story and understory with dominant species including *Allocasuarina littoralis* (Black She-oak) and *Exocarpos cupressiformis* (Native Cherry), *Dodonaea triquetra* (Large-leaved Hop Bush) and *Podolobium ilicifolium* (Prickly Shaggy Pea) and *Exocarpos cupressiformis*. Dominant ground cover species included *Imperata cylindrica* (Blady Grass), *Microlaena stipoides* var. *stipoides* (Weeping Grass) and *Entolasia stricta*.

3.2.2 Habitat Assessments

The habitat variables and flora species from all sites are included in Appendices C, D and E.

The ANOSIM and the multidimensional scaling (MDS) ordination (Figure 5) using data from all sites indicated that there was no significant difference between the three site categories (Prec-Pres, Imp-Pres and Abs-Imp) in relation to species composition (i.e. the difference between the three categories was not greater than the difference within the three categories). Three sites STR_T2, STR_STA01A18 and STR_STA02SEDGE were located at a greater distance from other sites within the ordination indicating that these sites were more different from all other sites. All lacked a tree and small tree layer and the fact that they were highly disturbed as a result of soil disturbance and/or livestock grazing is the most likely reason for this. The New Holland Mouse was not trapped at these sites.

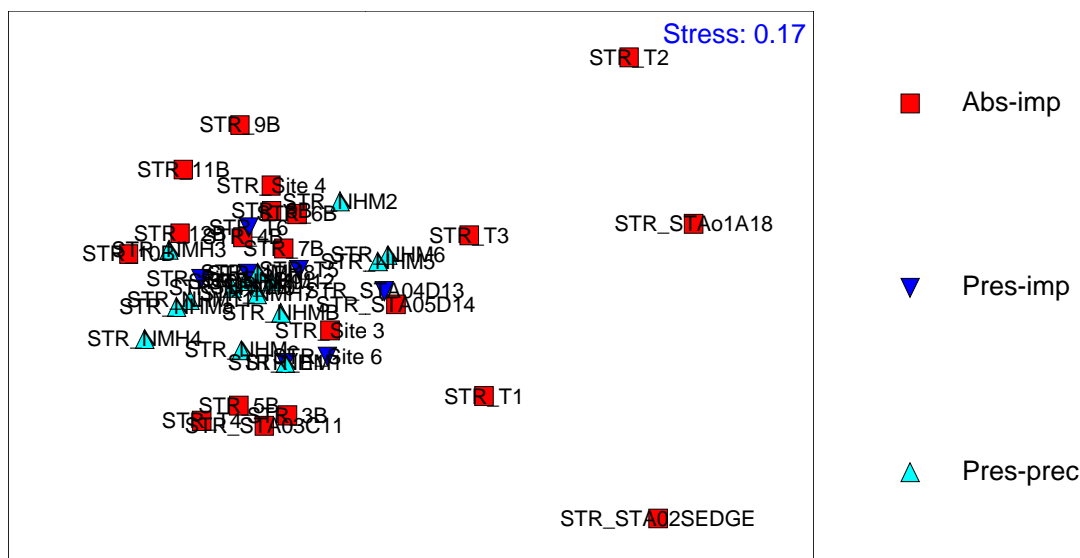


Figure 5: Ordination of three site categories in relation to species composition of sites.

Compared to sites where no New Holland Mice were recorded, sites where the species was recorded contained a higher percentage of native plants, sparser shrub cover, higher groundcover density and greater grass cover (Figure 6). All the sites where New Holland Mouse was recorded were either ungrazed or subject to only slight grazing pressure. Of the sites where the species was not recorded, six sites were classified as moderately or severely degraded by grazing.

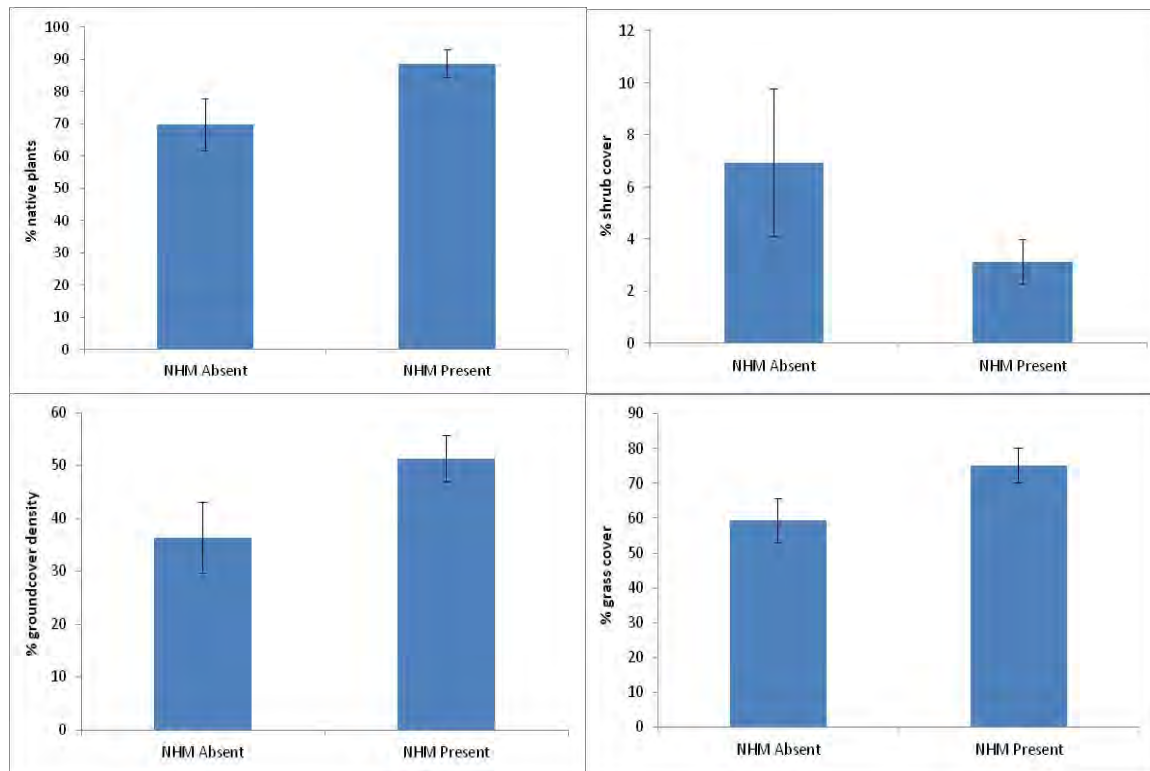


Figure 6: Differences between New Holland Mouse present vs absent sites for selected habitat variables.

There was no apparent difference in the diversity or abundance of leguminous plants between groups of sites, with the combined cover of these plant species being approximately 10% at both the present (Pres-prec) and absent (Abs-imp) sites (Figure 6). Similarly, there was no difference in time since disturbance from fire between the present and absent sites. Most survey sites appeared to have been burnt at least 10 years ago (87% for present sites, 77% for absent sites).

Groundcover density and the total proportion of native plants appear to be important habitat attributes for the New Holland Mouse (Figure 7). All locations where the New Holland Mouse was recorded had greater than 50% proportion of native plants and a ground cover density between 25% and 80%. Furthermore, at all the sites where the species was recorded there was at least a 50% cover of native plants, and at most sites there was at least a 70% cover of native plants.

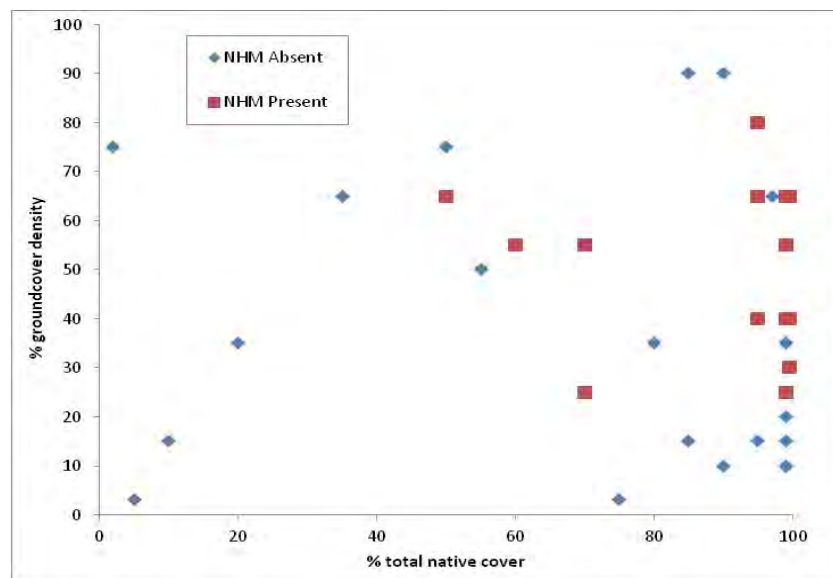


Figure 7: Groundcover density vs percentage native plant cover for NHM Absent and Present sites.

A high percentage cover of the grass species *Imperata cylindrica* var. *major* (Blady Grass) was found to be significantly related to sites in which the New Holland Mouse had been recorded (arcsin transformation, t-Stat = -2.94861, $p = 0.006$; Figure 8).

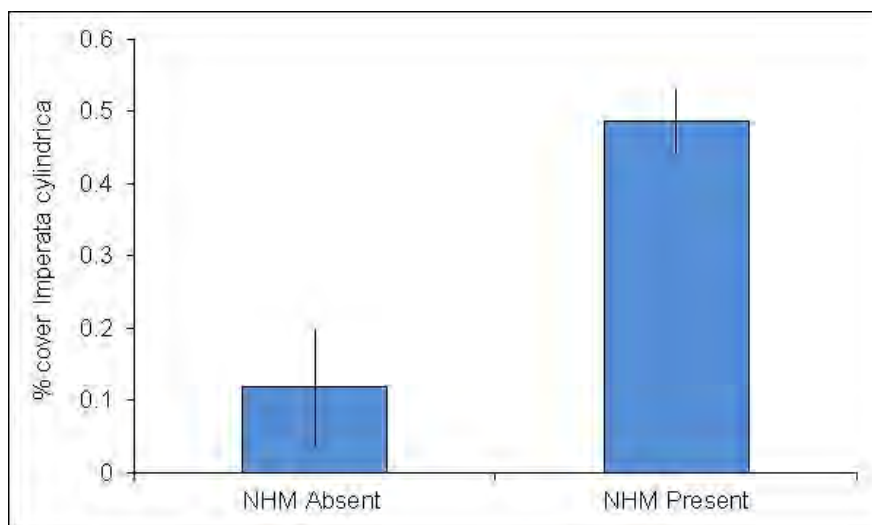


Figure 8: Percent cover of *Imperata cylindrica* for NHM Absent vs Present sites.

The aspect of the site may also have had some bearing on the presence of the New Holland Mouse (Figure 9). The species was recorded more often at sites which had a northerly or westerly aspect compared to sites that did not (Z-test, $z=4.52$, $p<0.001$). Only one site which recorded the species had a southerly or easterly aspect. No difference was found between sites for the degree of slope.

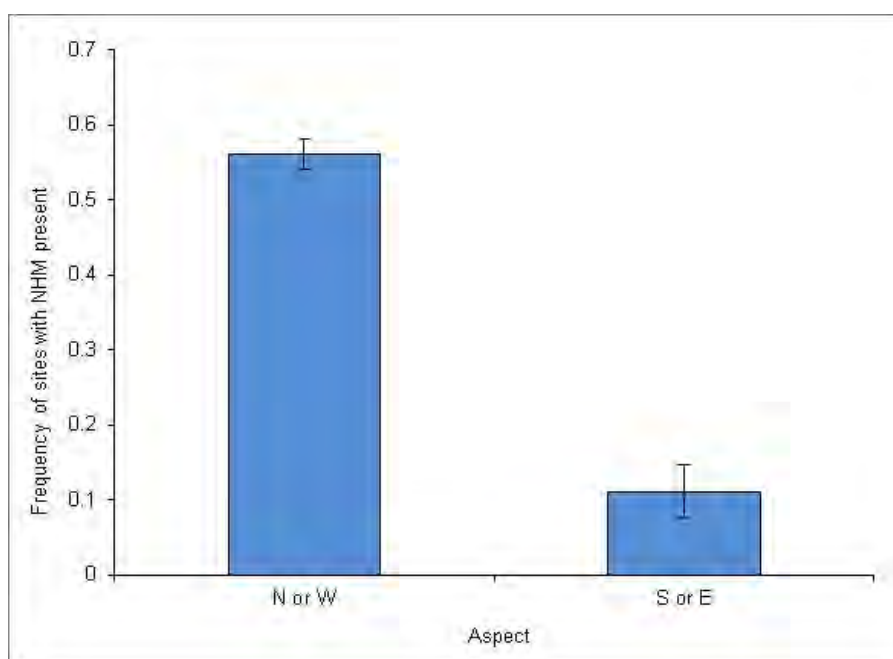


Figure 9: Frequency of sites where the New Holland Mouse was recorded in relation to aspect.

The results from the GAMs were similar to the results described above for comparisons of specific habitat variables. The factors that could best explain the distribution of the species were grazing intensity, percentage cover of *Imperata cylindrical var. major*, $\cos(\text{aspect} - 315^\circ)$ and the density of ground cover, each of which had an AUC of more than 0.8.

We investigated the possibility of multivariate models, but AUCs tended to decrease as we added extra predictors, which is probably because the low sample size was insufficient to develop multivariate models, and including too many predictors led to over-fitted and inaccurate models. We therefore tentatively draw conclusions based only on the univariate models.

The models suggested that the New Holland Mouse preferred ungrazed or lightly grazed areas, sites that have high cover of *Imperata cylindrical var. major*, sites that face northwest, or a vegetation density below 0.5 m of 50-60%.

3.3 Threatened Bird Surveys

Four threatened bird species were recorded. No threatened species were recorded during the nocturnal call-playback surveys. Descriptions of threatened species sightings are below.

Glossy Black-cockatoo *Calyptorhynchus banksii*

This species was recorded at several locations throughout the study area (Table 9). The species was opportunistically recorded on 4 April 2011, while on the 5 and 6 April 2011 the species was recorded during the standardised afternoon bird surveys. On each occasion individuals were observed flying overhead the canopy, with no foraging behaviour observed.

Table 9: Glossy Black-cockatoo locations during the current surveys.

Date	Number	Easting	Northing
04/04/2011	4	402121	6423475
05/04/2011	3	401639	6423146
06/04/2011	7	401787	6430263

Varied Sittella *Daphoenositta chrysoptera*

This species was opportunistically recorded on 7 April 2011 near site 8, at coordinates 401519E, 6430034N (Zone 56, GDA 94). At least ten individuals were present foraging in Stringybark forest dominated by *Eucalyptus globoidea* (White Stringybark) and *Eucalyptus carnea* (Thick-leaved Mahogany).

The species was also recorded on 20 May 2011 near site 1, at coordinates 403661E, 6437995N (Zone 56, GDA 94). At least four individuals were present foraging in Stringybark/Ironbark forest dominated by *Eucalyptus globoidea* (White Stringybark), *Eucalyptus carnea* (Thick-leaved Mahogany) and Grey Ironbark (*Eucalyptus siderophloia*).

Grey-crowned Babbler *Pomatostomus temporalis*

Eight individuals of the species were recorded opportunistically on 2nd April, at coordinates 400967E, 6429522N (Zone 56, GDA 94). They were found in roadside vegetation on farmland towards the south of the study area.

Little Eagle *Hieraaetus morphnoides*

One individual of the species was recorded opportunistically on 19 May 2011, at coordinates 400107E, 6435448N (Zone 56, GDA 94). The individual was observed flying high overhead.

4 Discussion

4.1 Ecology of the New Holland Mouse

The New Holland Mouse has a distribution which includes Tasmania, Victoria, New South Wales and south-eastern Queensland, mostly in coastal areas (Kemper and Wilson 2008). The species has been recorded in heathlands, woodlands, open forest, shrubland, grassland and paperbark swamps on sandy, loamy or rocky soils (Wilson and Laidlaw 2003; Kemper and Wilson 2008). They are nocturnal, constructing burrows for daytime refuge and tend to occupy home ranges of 0.5-1.5 ha (males and females) (Kemper and Wilson 2008). The breeding season is late winter to early spring, with abundances reaching their highest in autumn and lowest in spring (Kemper and Wilson 2008).

In Victoria the New Holland Mouse appears to be an omnivore with an opportunistic feeding strategy. Wilson and Bradtke (1999) found the species consumed considerable amounts of dicotyledon leaf (27%), fungi (19%), invertebrate (17%) and seed (14%). Similar results were reported by Norton (1987). Cockburn (1980) but obtained a higher proportion of seeds in the diet. In NSW, Thomson (1980) found seed accounted for 76% of the diet. This was influenced by season, with almost 100% seed consumed during late spring and summer, compared with 49% during late winter to early spring (Thomson 1980).

Most research on the species has been undertaken on coastal populations, for which very specific habitat preferences have been described. In general, coastal populations appear to prefer heathlands or woodlands with a heathy understorey, sandy substrates, sparse ground litter, high floristic diversity and an abundance of leguminous shrubs (Kemper 1991; Lock and Wilson 1999; Kemper and Wilson 2008). The species shows a preference for flat areas with north easterly aspect, which is possibly related to suitability of habitat for burrowing (Kemper and Wilson 2008). Wilson and Laidlaw (2003) found the New Holland Mouse could occupy a variety of different habitats and suggested the species is not restricted to heathlands with a high diversity of sclerophyllous shrubs.

Presence of the species has been related to vegetation structure, in particular vegetation density at 20-30cm and 60-70cm, and the total cover of vegetation (Wilson *et al.* 2005), although other authors have also reported low dense vegetation less than 1 m (Kemper 1991), 50 cm (Fox and Fox 1978), or 20 cm (Lock and Wilson 1999) to be important.

Populations have been shown to recolonise regenerating burnt areas after 1-2 years, and rehabilitated sand mined areas after 4-5 years. Populations tend to increase as vegetation regenerates after fire, clearing and sandmining, reaching maximum densities after two to six years (Kemper 1990; Fox and Fox 1978, 1984; Fox and McKay 1981, Fox 1982; Twigg *et al.* 1989; Wilson 1991).

Little research has been undertaken on inland populations. Van Dyck and Lawrie (1997) formally described the first record for the New Holland Mouse from Queensland, in habitat which differed markedly from known published records. The species was recorded approximately 100 km from the coast at an altitude of 560m, in tall open forest lacking a dense shrub layer and in an advanced seral stage. Van Dyck and Lawrie (1997) also subsequently reviewed other accounts of the New Holland Mouse from NSW, for which the habitat type also contrasted markedly with known information for the species:

- Carai Plateau: six individuals were trapped by Sally Townley in September 1993, at an altitude of 900m, with habitat consisting of *Eucalyptus laevopinea* open forest with an understorey dominated by *Lomandra* sp;
- Chaelundi State Forest: Reed (1993) caught one individual in an area described as 'grass-covered alluvium with a *Eucalyptus tereticornis* overstorey';
- Chaelundi State Forest: Townley (1993) caught several individuals at an altitude of 840 m, in forest with a variety of *Eucalyptus* species, and an understorey of shrubs, grasses, and small herbs; and
- Oxley Wild Rivers National Park: Townley (date unknown) trapped over 20 individuals throughout a variety of different habitats between altitudes of 400 and 1000 m. Habitats were open forest, dominated by a variety of different *Eucalyptus* species, with either grassy understoreys or dense heath layers.

Van Dyck and Lawrie (1997) concluded that the records confirmed the regular occurrence of the species at high altitudes and within tall open-forests, some of which have grassy understoreys rather than heath. However, they cautioned the proximity of the grassy understorey to heath (or other forms of dense understorey) should be examined before attributing grass as preferred habitat for the species.

In the Gloucester Valley, Ecobiological (2010) recorded the New Holland Mouse in areas dominated by Blady Grass (*Imperata cylindrica*), Bracken Fern (*Pteridium* sp.) and native grasses. The areas were subject to low grazing pressure, contained high plant species diversity and a lack of exotic plant cover. In contrast, Kerle (2011) has a low trapping success rate in areas containing Blady Grass and Bracken, instead recorded the New Holland Mouse at the edge of eucalypt woodland dominated by White Stringybark (*Eucalyptus globoidea*) and Grey Ironbark (*E. siderophloia*). The areas where the species was captured were subject to low grazing pressure, contained a dense groundcover and a very low proportion of exotic plants.

4.2 Habitat in the Study Area

The results of this study suggests habitat for the New Holland Mouse in the study area consists of areas with a high proportion of native plant species, low weed density, groundcover density between 50-60% and greater grass cover. Sites where the species was recorded were subject to nil or only slight grazing pressure, had a high percentage cover of *Imperata cylindrica* var. *major* (Blady Grass) and a northerly or westerly aspect.

These results are similar to the habitat types described by Ecobiological (2010) and Kerle (2011) in the study area. Their results suggested the species prefers areas with low grazing pressure, few exotic species and dense groundcover. However, Kerle (2011) reported a very low trapping rate in areas containing Blady Grass, whereas our results suggest Blady Grass is an important habitat feature for the New Holland Mouse. Ecobiological (2010) reported high plant diversity at sites containing the species; however, our results did not find any difference between present and absent sites with regard to native plant diversity.

Research on coastal populations has suggested the New Holland Mouse prefers areas in early succession phase, following disturbance due to fire or clearing (see Section 4.4.1). Our results did not find any relationship between presence of the species and fire history, with visual estimations suggesting most sites within of the study area were burnt approximately 10 years ago.

It is possible there is a relationship between the presence of the New Holland Mouse, the density of the groundcover and proportion of native plant species. All locations where the New Holland Mouse was recorded had greater than 50% proportion of native plants and a ground cover density between 25% and 80%. There were sites in which the New Holland Mouse was not recorded which had greater than 90% native plant species, but the groundcover density was either less than 25% or greater than 80%. We speculate that the species prefers habitat within a groundcover density 'range'. If the proportion of native plant species is suitable, the groundcover density could be too sparse (e.g. less than 25%) or too dense (e.g. greater than 90%). Groundcover which is too sparse may not provide adequate shelter, whereas groundcover which is too dense may limit the availability of leaf litter and/or suppress shrub growth, thus limiting the availability of foraging resources.

Our data has found a greater proportion of sites where the New Holland Mouse has been recorded to occur in areas with a northerly or westerly aspect. This differs from previous research findings which suggested the species prefers areas with a north-easterly aspect (Kemper and Wilson 2008). It is unclear at this stage if our results reflect a genuine preference of the species for these aspects or if they are due to our sampling mostly at sites with northerly or westerly aspects, compared to only 26% (n=9) of our sites that were on southerly or easterly aspects.

Given the large number of predictors and the low sample size of presences, we considered there is a chance that the factors identified above as important habitat for the New Holland Mouse could occur by chance alone. However, they are our best estimate of important habitat factors given the data at hand. Further research is needed before concluding that these factors are important for the New Holland Mouse throughout the region.

Based on the current survey, known habitat for the species exists in areas south of Glen Road (Figure 2). Based on the results from Kerle (2011) and Ecobiological (2010), habitat for the species is also likely to exist in areas to the north-east and south-east of the Stratford Coal Mine, and to the south-east of the Duralie Coal Mine. However, there were also many locations throughout the Gloucester Valley where targeted trapping was undertaken but the New Holland Mouse was not recorded. Kerle (2011) recorded the species at one out of five sites, Ecobiological (2010) recorded the species at two out of six sites, while the current survey recorded the species at four out of 18 sites. It is likely the New Holland Mouse has a patchy distribution throughout the Gloucester Valley.

5 Conclusion

Fauna surveys were undertaken in the Gloucester Valley, between the Stratford Coal Mine and the Duralie Coal Mine. The surveys consisted of targeted trapping and habitat assessment for the New Holland Mouse, targeted threatened bird surveys, and recording of opportunistic vertebrate fauna sightings.

A total of 110 vertebrate fauna species were recorded during the surveys. Six species recorded were listed as threatened under the TSC Act or EPBC Act:

- New Holland Mouse (*Pseudomys novahollandiae*);
- Brush-tailed Phascogale (*Phascogale tapoatafa*);
- Glossy Black-cockatoo (*Calyptorhynchus banksia*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- Grey-crowned Babbler (*Pomatostomus temporalis*); and
- Little Eagle (*Hieraaetus morphnoides*).

The targeted surveys for the New Holland Mouse recorded the species at four sites. The habitat type at three of these four sites was classified as grassy open forest or woodland, with a ground cover dominated by native grasses and a sparse shrub layer. The fourth site was quite different from the other three sites; being grassland adjacent to tall closed shrubland.

Habitat assessments were conducted on a range of other sites in which the New Holland Mouse had and had not been recorded (n=43) previously. The results suggested that in the study area the species preferred areas with high proportions of native plants, low densities of weeds, groundcover densities (less than 0.5 m high) between 50-60%, greater grass cover, low grazing pressure and have a northerly or westerly aspect. *Imperata cylindrica* var. *major* (Blady Grass) was often at sites where the New Holland Mouse was recorded. There is a possible relationship between the presence of the New Holland Mouse, groundcover density and the total proportion of native plant species.

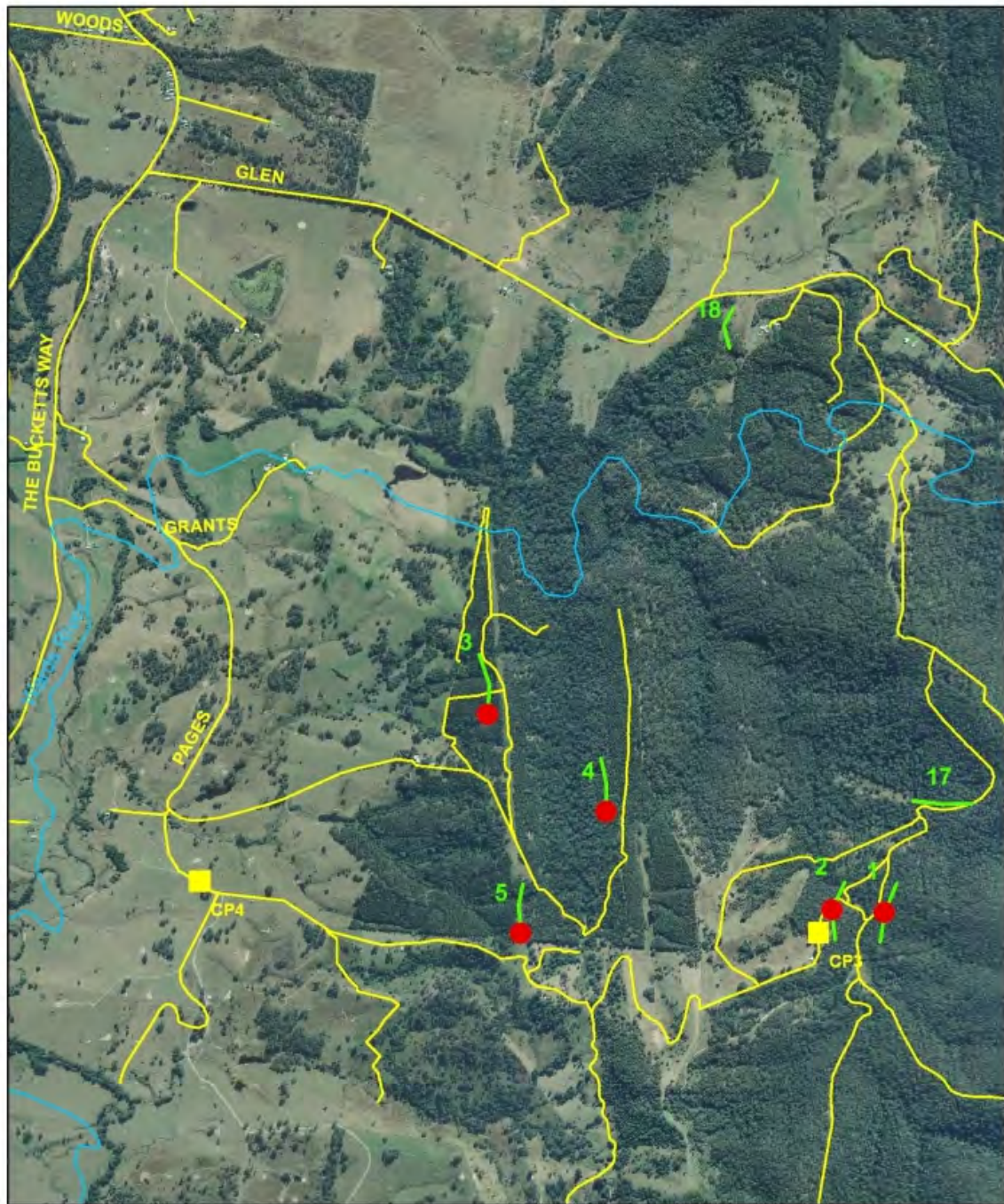
Based on the number of sites in which the New Holland Mouse has been recorded during the current and previous targeted trapping surveys, it is likely that the species has a patchy distribution throughout the Gloucester Valley.

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Appendix A: Fauna Survey Locations

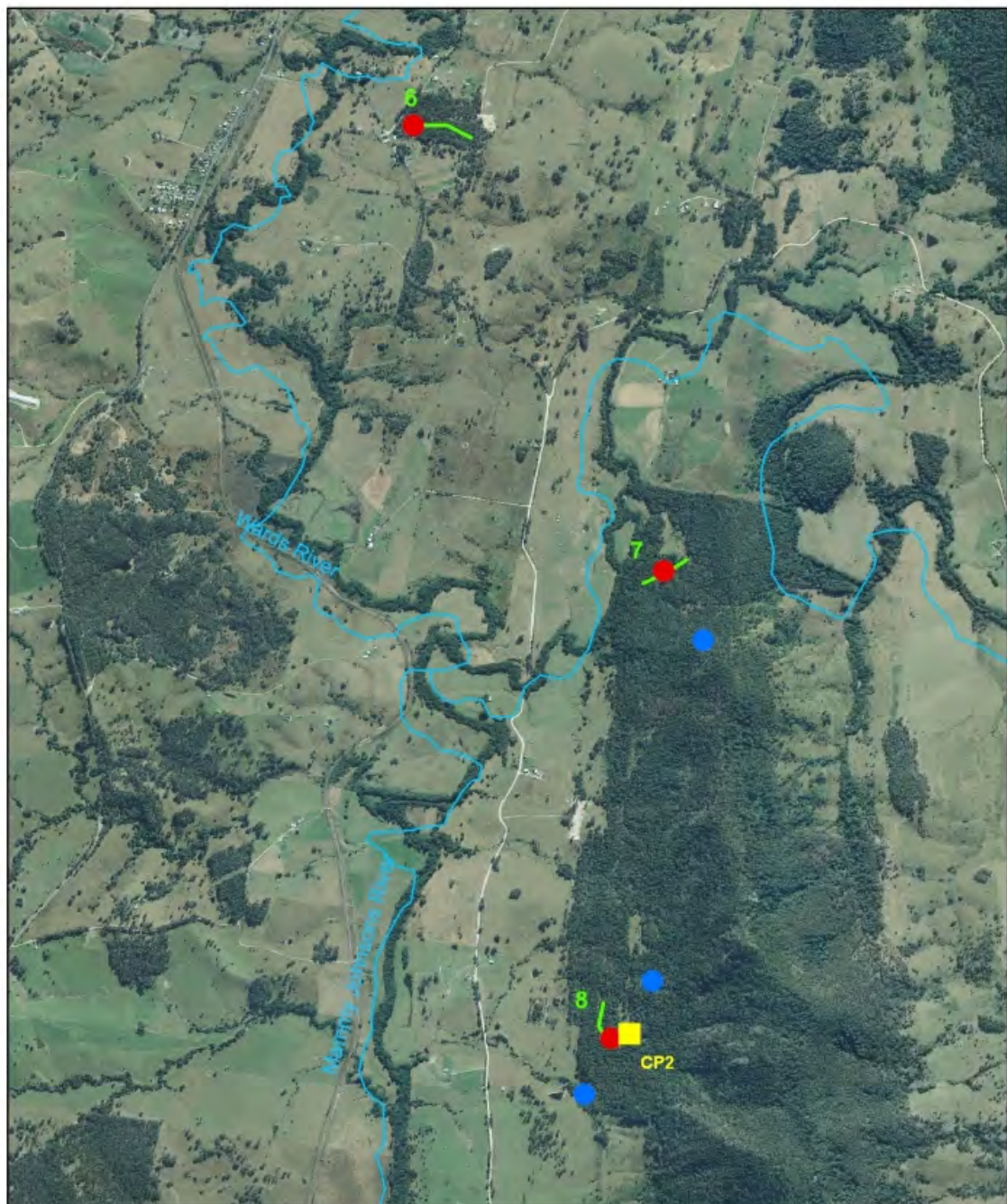


Legend

- Nocturnal call-playback
- Diurnal bird surveys (afternoon)
- Diurnal bird surveys (morning)
- Elliott trap lines
- Rivers
- Roads

0 0.25 0.5 1 1.5 2 Kilometers



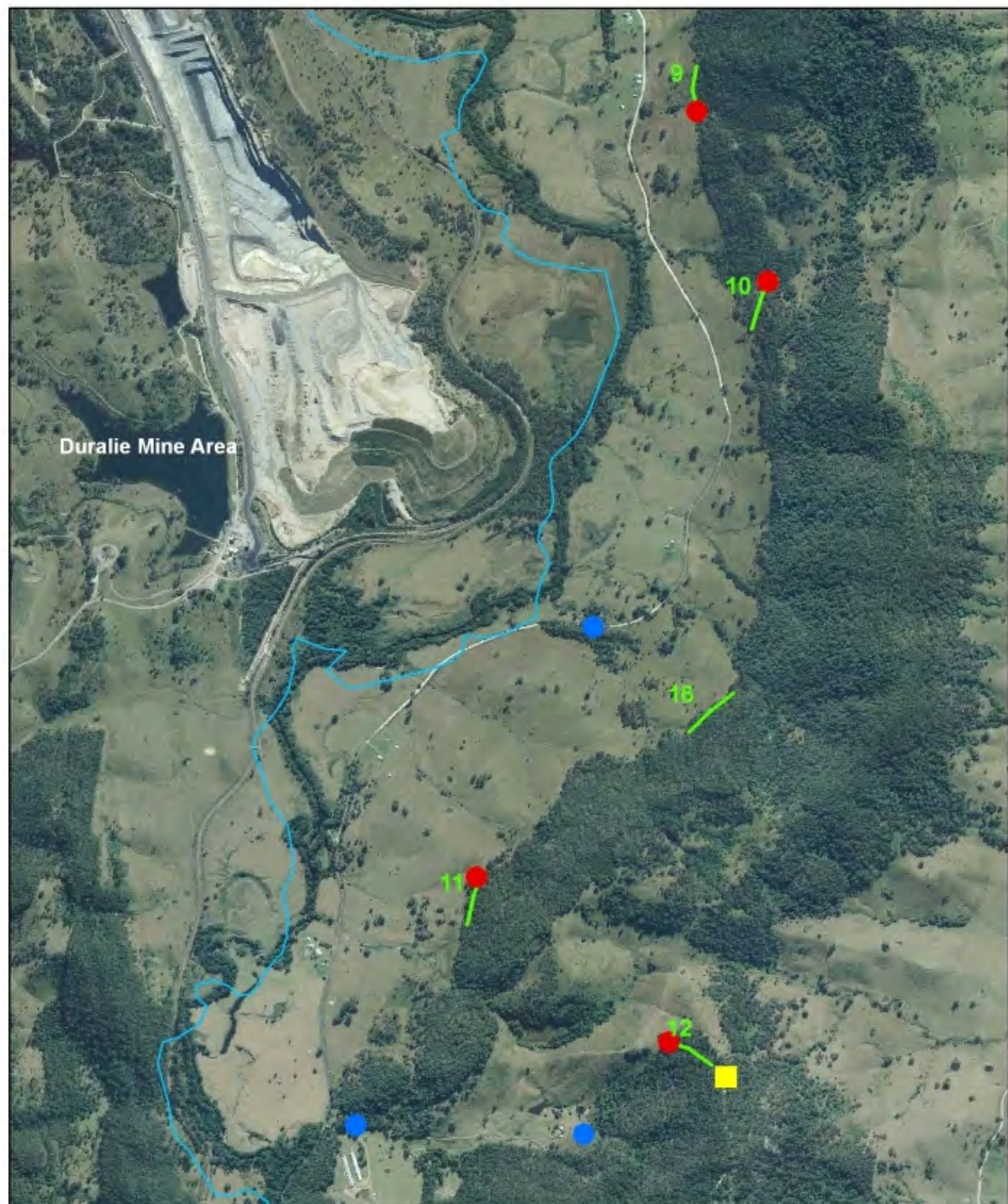


Legend

- Nocturnal call-playback
- Diurnal bird surveys (afternoon)
- Diurnal bird surveys (morning)
- Elliott trap lines
- Rivers

0 0.25 0.5 1 1.5 2 Kilometers





Legend

- Nocturnal call-playback
- Diurnal bird surveys (afternoon)
- Diurnal bird surveys (morning)
- Elliott trap lines
- Rivers

0 0.25 0.5 1 1.5 2 Kilometers





Legend

- Nocturnal call-playback
- Diurnal bird surveys (afternoon)
- Diurnal bird surveys (morning)
- Elliott trap lines
- Rivers

0 0.25 0.5 1 1.5 2 Kilometers



Appendix B: Fauna Species List

Vertebrate fauna species recorded in the study area during the current survey.

* denotes introduced species.

Class	Common Name	Scientific Name
Amphibia	Common Eastern Froglet	<i>Crinia signifera</i>
	Brown-striped Frog	<i>Limnodynastes peronii</i>
	Broad-palmed Frog	<i>Litoria latopalmata</i>
	Verreaux's Tree Frog	<i>Litoria v. verreauxii</i>
Reptilia	Land Mullet	<i>Bellatorias major</i>
	Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>
Aves	White-headed Pigeon	<i>Columba leucomela</i>
	Bar-shouldered Dove	<i>Geopelia humeralis</i>
	Wonga Pigeon	<i>Leucosarcia melanoleuca</i>
	Brown Cuckoo-Dove	<i>Macropygia amboinensis</i>
	Common Bronzewing	<i>Phaps chalcoptera</i>
	Crested Pigeon	<i>Ocyphaps lophotes</i>
	White-throated Nightjar	<i>Eurostopodus mystacalis</i>
	Australian Owllet-nightjar	<i>Aegotheles cristatus</i>
	Australian Pelican	<i>Pelecanus conspicillatus</i>
	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>
	Little Eagle	<i>Hieraaetus morphnoides</i>
	Wedge-tailed Eagle	<i>Aquila audax</i>
	Australian Hobby	<i>Falco longipennis</i>
	Australian Kestrel	<i>Falco cenchroides</i>
	Brown Falcon	<i>Falco berigora</i>
	Black Swan	<i>Cygnus atratus</i>
	Eurasian Coot	<i>Fulica atra</i>
	Dusky Moorhen	<i>Gallinula tenebrosa</i>
	Australian Wood Duck	<i>Chenonetta jubata</i>
	Pacific Black Duck	<i>Anas superciliosa</i>
	Buff-banded Rail	<i>Gallirallus philippensis</i>
	Purple Swampphen	<i>Porphyrio porphyrio</i>
	White-faced Heron	<i>Egretta novaehollandiae</i>
	Masked Lapwing	<i>Vanellus miles</i>
	Painted Button-quail	<i>Turnix varius</i>
	Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>
	Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>
	Galah	<i>Eolophus roseicapillus</i>
	Australian King-Parrot	<i>Alisterus scapularis</i>
	Crimson Rosella	<i>Platycercus elegans</i>
	Eastern Rosella	<i>Platycercus eximius</i>
	Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>
	Horsfield's Bronze-Cuckoo	<i>Chalcites basalis</i>
	Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>
	Pheasant Coucal	<i>Centropus phasianinus</i>
	Southern Boobook	<i>Ninox boobook</i>
	Laughing Kookaburra	<i>Dacelo novaeguineae</i>
	Noisy Pitta	<i>Pitta versicolour</i>
	White-throated Treecreeper	<i>Cormobates leucophaea</i>
	Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>
	Superb Fairy-wren	<i>Malurus cyaneus</i>
	Variegated Fairy-wren	<i>Malurus lamberti</i>
	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>
	Striated Thornbill	<i>Acanthiza lineata</i>

Class	Common Name	Scientific Name
	Yellow Thornbill	<i>Acanthiza nana</i>
	Brown Thornbill	<i>Acanthiza pusilla</i>
	Buff-rumped Thornbill	<i>Acanthiza reguloides</i>
	White-throated Gerygone	<i>Gerygone albogularis</i>
	Brown Gerygone	<i>Gerygone mouki</i>
	Yellow-throated Scrubwren	<i>Sericornis citreogularis</i>
	White-browed Scrubwren	<i>Sericornis frontalis</i>
	Spotted Pardalote	<i>Pardalotus punctatus</i>
	Striated Pardalote	<i>Pardalotus striatus</i>
	Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>
	Red Wattlebird	<i>Anthochaera carunculata</i>
	Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>
	Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>
	White-eared Honeyeater	<i>Lichenostomus leucotis</i>
	Noisy Miner	<i>Manorina melanocephala</i>
	Bell Miner	<i>Manorina melanophrys</i>
	Lewin's Honeyeater	<i>Meliphaga lewinii</i>
	Grey-crowned Babbler	<i>Pomatostomus temporalis</i>
	White-winged Chough	<i>Corcorax melanorhamphos</i>
	Australian Logrunner	<i>Orthonyx temminckii</i>
	Eastern Whipbird	<i>Psophodes olivaceus</i>
	Varied Sittella	<i>Daphoenositta chrysoptera</i>
	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
	Grey Shrike-thrush	<i>Colluricincla harmonica</i>
	Golden Whistler	<i>Pachycephala pectoralis</i>
	Rufous Whistler	<i>Pachycephala rufiventris</i>
	Olive-backed Oriole	<i>Oriolus sagittatus</i>
	Pied Butcherbird	<i>Cracticus nigrogularis</i>
	Australian Magpie	<i>Cracticus tibicen</i>
	Grey Butcherbird	<i>Cracticus torquatus</i>
	Pied Currawong	<i>Strepera graculina</i>
	Spangled Drongo	<i>Dicrurus bracteatus</i>
	Grey Fantail	<i>Rhipidura albiscapa</i>
	Willie Wagtail	<i>Rhipidura leucophrys</i>
	Rufous Fantail	<i>Rhipidura rufifrons</i>
	Australian Raven	<i>Corvus coronoides</i>
	Magpie-lark	<i>Grallina cyanoleuca</i>
	Jacky Winter	<i>Microeca fascinans</i>
	Eastern Yellow Robin	<i>Eopsaltria australis</i>
	Rose Robin	<i>Petroica rosea</i>
	Tawny Grassbird	<i>Megalurus timoriensis</i>
	Silvereye	<i>Zosterops lateralis</i>
	Welcome Swallow	<i>Hirundo neoxena</i>
	Mistletoebird	<i>Dicaeum hirundinaceum</i>
	Red-browed Finch	<i>Neochmia temporalis</i>
	Double-barred Finch	<i>Taeniopygia bichenovii</i>
	Australian Pipit	<i>Anthus australis</i>
	Common Myna *	<i>Acridotheres tristis</i>
Mammalia	Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>
	Brown Antechinus	<i>Antechinus stuartii</i>
	New Holland Mouse	<i>Pseudomys novaehollandiae</i>
	Bush Rat	<i>Rattus fuscipes</i>
	Swamp Rat	<i>Rattus lutreolus</i>
	Black Rat *	<i>Rattus rattus</i>
	House Mouse *	<i>Mus musculus</i>

Class	Common Name	Scientific Name
	Red-necked Wallaby	<i>Macropus rufogriseus</i>
	Eastern Grey Kangaroo	<i>Macropus giganteus</i>
	Swamp Wallaby	<i>Wallabia bicolor</i>
	Sugar Glider	<i>Petaurus breviceps</i>
	Fox *	<i>Vulpes vulpes</i>

Appendix C: Plant Species Recorded

SCIENTIFIC NAME	SITE NUMBER																																														
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6		
<i>Acacia falcata</i>	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	
<i>Acacia floribunda</i>	0	0	0	1	0	0	1	0	0	0	0	0	8	1	0	0	4	5	0	0	0	0	2	0	0	0	0	3	1	5	0	0	1	6	0	0	1	0	0	0	0	0	0	0	0	1	
<i>Acacia implexa</i>	5	5	0	0	4	0	0	0	3	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	4	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0		
<i>Acacia irrorata</i>	1	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	8	0	0		
<i>Acacia longifolia</i> subsp. <i>longifolia</i>	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0		
<i>Acacia longissima</i>	0	1	1	0	0	2	1	0	1	0	0	2	0	1	0	1	1	1	0	0	0	1	2	0	0	1	1	1	0	0	2	0	1	2	0	0	3	0	0	0	0	0	0	0	0	1	
<i>Acacia maidenii</i>	6	5	5	5	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	2	3	5	0	1	1	4	0	0	0	0	0	0	0	0	0	0	0	0	5	0	1
<i>Acacia ulicifolia</i>	0	0	0	3	0	3	3	3	3	0	2	1	0	1	0	1	0	0	3	3	3	1	1	1	1	0	0	0	3	0	0	0	0	0	1	0	0	0	1	0	3	3	0	3	2		
<i>Acianthus fornicatus</i>	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Adiantum aethiopicum</i>	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0		
<i>Ageratina adenophora</i> *	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Ajuga australis</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Allocasuarina littoralis</i>	0	0	0	0	0	0	0	1	6	0	3	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Allocasuarina torulosa</i>	0	0	0	0	0	0	0	0	0	2	0	5	0	0	0	5	1	0	0	0	0	5	7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	6	
<i>Alternanthera denticulata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0			
<i>Amyema congener</i> subsp. <i>congener</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
<i>Anagallis arvensis</i> *	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	
<i>Andropogon virginicus</i> *	0	0	0	1	0	1	0	0	3	0	0	2	0	2	0	1	1	4	1	1	4	1	0	5	4	0	2	0	0	0	0	0	0	3	6	3	0	3	6	0	7	0	0	1	5	0	
<i>Angophora floribunda</i>	0	1	0	0	0	0	0	4	0	5	0	0	0	0	2	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	1	0	0	5	0	0	1	0	0	0	0	0	0	0	0	5	
<i>Araujia sericifera</i> *	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		
<i>Aristida ramosa</i>	0	0	3	0	1	0	0	0	0	0	2	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0		
<i>Aristida vagans</i>	0	2	3	0	0	2	2	4	0	2	2	3	0	0	2	3	0	0	2	2	2	2	0	5	4	2	2	2	0	0	2	0	0	0	0	0	0	2	4	0	0	0	0	0	2	4	
<i>Arthropodium</i> spp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Aster subulatus</i> *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	0			
<i>Austrodanthonia monticola</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Austrostipa</i> spp.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Axonopus fissifolius</i> *	1	2	3	0	1	1	0	0	0	0	0	0	35	2	2	0	0	4	0	0	3	0	0	6	5	1	1	0	0	0	0	0	3	4	5	6	0	5	3	8	0	8	2	3	0		
<i>Backhousia myrtifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Bidens pilosa</i> *	0	1	2	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	2	0	0		
<i>Billardiera scandens</i>	3	2	0	1	0	1	1	3	2	2	3	0	0	0	0	0	3	0	0	0	1	0	1	0	0	3	3	3	3	3	3	2	0	2	0	0	1	0	0	0	0	0	0	0	1	2	
<i>Boronia parviflora</i>	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Bothriochloa macra</i>	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	2	0	0	0				
<i>Botrychium australe</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0><				

SCIENTIFIC NAME	SITE NUMBER																																															
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6			
<i>microcarpa</i>																																																
<i>Briza maxima</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
<i>Breynia oblongifolia</i>	3	2	2	2	2	1	3	2	0	3	2	0	1	2	0	0	2	2	3	3	0	3	2	1	0	2	2	2	5	5	2	2	1	2	0	0	0	0	0	0	0	0	0	0	0	1	3	1
<i>Brunoniella australis</i>	1	0	0	1	0	2	3	0	0	0	0	0	1	2	2	1	1	0	3	3	0	0	2	1	1	0	2	1	1	0	1	0	0	1	0	0	0	1	2	0	0	0	0	0	1	0		
<i>Brunoniella pumilio</i>	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Bursaria spinosa</i>	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0		
<i>Caesia parviflora</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Callistemon acuminatus</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Callistemon salignus</i>	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Calotis dentex</i>	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Capillipedium spicigerum</i>	0	0	0	0	3	0	0	0	4	2	0	0	2	5	0	0	0	0	0	4	3	2	1	0	0	0	0	0	0	0	0	0	0	3	2	0	0	1	0	0	0	0	0	0	6	2		
<i>Cardamine paucijuga</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Carex appressa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0		
<i>Carex breviculmis</i>	1	0	0	0	0	1	0	0	0	0	0	0	7	2	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	
<i>Carex spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Cassytha pubescens</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Cayratia clematidea</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Centella asiatica</i>	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	3	0	0	2	0	2	3	3	3	2	1	0	3	0	0	2	3	3	2	4	3	0	0	3	2	0	3	0			
<i>Cheilanthes sieberi</i>	2	3	0	3	0	3	0	2	3	0	0	3	0	3	2	2	2	2	2	2	2	1	4	4	4	3	2	2	2	2	3	2	4	2	0	0	0	1	0	0	0	1	0	0	0	0	3	
<i>Chiloglottis diphylla</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Chloris divaricata</i> var. <i>divaricata</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Chloris gayana</i> *	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	0	0		
<i>Chrysocephalum apiculatum</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Cirsium vulgare</i> *	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	3	0	0			
<i>Cissus antarctica</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Cissus hypoglauca</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Clematicissus opaca</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1			
<i>Clematis aristata</i>	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Clematis glycinoides</i>	0	0	2	0	3	1	1	0	0	0	1	0	2	0	2	1	3	1	2	2	0	0	1	0																								

SCIENTIFIC NAME	SITE NUMBER																																													
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6	
<i>Cyperus gracilis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	2	0	0	0		
<i>Cyperus polystachyos</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0		
<i>Cyperus</i> spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Cyperus sesquiflorus</i> *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3	0	0	1	5	0	2	3	1	0		
<i>Cyperus trinervis</i>	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Daviesia ulicifolia</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	2	0	0
<i>Dawsonia</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dendrobium</i> spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Desmodium brachypodum</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Desmodium gunnii</i>	2	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	2	2	0	0	3	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0	0	0
<i>Desmodium rhytidophyllum</i>	3	3	0	4	0	2	3	3	0	1	0	4	0	2	2	2	4	0	0	0	2	3	0	0	0	3	4	3	3	3	2	3	0	0	0	0	2	0	0	0	0	0	0	2	4	2
<i>Desmodium varians</i>	2	2	2	0	0	1	2	1	0	1	0	3	3	2	0	2	3	0	2	2	0	2	0	2	1	3	3	2	0	1	2	2	3	0	0	0	2	1	0	0	0	0	0	0	2	1
<i>Dianella caerulea</i> var. <i>producta</i>	0	0	0	0	0	2	1	0	0	2	2	2	0	0	0	3	0	0	1	1	0	2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3
<i>Dianella caerulea</i>	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Dianella longifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Dianella revoluta</i>	1	0	0	0	0	0	0	1	0	1	2	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
<i>Dichelachne micrantha</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
<i>Dichondra repens</i>	3	3	4	3	3	1	2	2	0	0	0	3	5	3	4	0	2	2	2	2	0	0	4	2	3	3	3	3	3	4	3	3	1	3	0	2	4	2	1	3	0	2	3	2	3	
<i>Digitaria didactyla</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0		
<i>Digitaria diffusa</i>	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0
<i>Digitaria parviflora</i>	0	0	0	0	0	0	1	1	0	1	1	3	0	0	0	1	2	0	1	1	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Digitaria ramularis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dillwynia phyllicoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
<i>Diospyros australis</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dioscorea transversa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
<i>Dodonaea triquetra</i>	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Doodia aspera</i>	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
<i>Drosera auriculata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Duboisia myoporoides</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	2	3	0	0	0	3	2	2	2	0	0	1	0	0	0	0	2	2	3	3	2	3	1	3	4	3	3	1	2	2	2	2	2	1	0	0	3	2	1	1	0	1	0	3	3	
<i>Einadia nutans</i> subsp. <i>nutans</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0														

SCIENTIFIC NAME	SITE NUMBER																																															
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6			
<i>Epilobium spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0			
<i>Eragrostis brownii</i>	1	1	2	3	2	3	0	3	5	1	0	2	0	3	1	1	0	2	1	1	4	0	0	3	4	0	3	3	1	0	2	0	3	3	3	3	0	0	3	2	3	0	3	0	2	3	0	
<i>Eragrostis leptostachya</i>	1	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	2	3	2	0	0	0	0	1	0	1	2	3	0	0	0	0	2	0	2	0	0	0	0		
<i>Eremophila debilis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
<i>Eriochilus cucullatus</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Eucalyptus amplifolia subsp. amplifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0		
<i>Eucalyptus blakelyi</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Eucalyptus carnea</i>	5	0	0	0	0	7	0	5	0	0	5	5	0	0	6	6	5	0	6	6	0	5	0	0	0	5	4	5	0	0	5	6	3	0	0	0	0	0	0	4	0	0	4	4	0	0	0	
<i>Eucalyptus globoidea</i>	7	0	0	0	0	0	6	5	0	0	5	4	0	6	0	0	0	0	5	5	5	2	0	0	0	7	5	6	8	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	5	
<i>Eucalyptus spp.</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0		
<i>Eucalyptus microcorys</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Eucalyptus moluccana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0			
<i>Eucalyptus propinqua</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	0	0	0	0	0	5	0	0	0	0	0	5	1	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Eucalyptus siderophloia</i>	5	6	0	0	5	0	5	0	0	5	4	5	1	1	5	5	0	0	0	0	5	5	0	6	5	4	4	5	5	0	6	1	0	0	0	0	0	1	5	5	0	0	5	4	5	6		
<i>Eucalyptus tereticornis</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Euchiton involucratus</i>	1	0	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	1	1	0	2	1	0	3	0	0	1	1	1	0	2	1	0	0		
<i>Eustrephus latifolius</i>	1	0	0	0	0	0	0	1	0	4	0	4	0	0	1	0	0	0	0	0	0	4	2	0	0	0	1	0	0	4	0	1	0	1	0	0	3	0	0	0	0	0	3	3	1	0		
<i>Exocarpos cupressiformis</i>	2	2	0	0	0	0	2	1	4	2	5	0	0	0	1	0	0	0	0	0	2	3	1	0	0	0	1	1	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	
<i>Facelis retusa*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Fallopia convolvulus*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0		
<i>Fimbristylis dichotoma</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	3	0	0	1	0	1	1	0	0	0	2	0	0	2	0	0	3	2	0	4	0	1	1	2	0	0		
<i>Gahnia aspera</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Gahnia spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		
<i>Galium propinquum</i>	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		
<i>Geitonoplesium cymosum</i>	1	2	0	0	1	3	3	1	0	4	3	2	3	3	0	1	2	0	1	1	0	3	3	0	0	3	3	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	
<i>Geranium solanderi</i> var. <i>solanderi</i>	1	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	2	0	0	0	0	0	0	2	2	0	0	0	
<i>Glochidion ferdinandi</i>	3	1	0	0	0	0	0	3	0	6	3	3	0	0	0	2	2	1	0	0	0	3	5	0	0	0	0	2	1	3	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Glycine clandestina</i>	2	3	0	3	1	3	2	3	2	0	2	1	3	2	0	3	3	1	0	0	2	0	0	0	0	3	3	2	2	2	2	2	2	1	0	0	3	1	3	0	2	1	1	3				

SCIENTIFIC NAME	SITE NUMBER																																													
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6	
<i>Hibbertia dentata</i>	0	1	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
<i>Hibbertia diffusa</i>	1	0	0	2	1	0	0	2	0	0	3	0	0	3	0	3	2	1	1	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
<i>Hibbertia riparia</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Hibbertia scandens</i>	2	2	0	2	2	0	0	0	0	0	1	2	0	0	0	0	0	3	1	1	0	0	2	0	0	2	1	3	3	3	2	3	2	2	0	0	3	0	0	0	0	0	0	1	0	0
<i>Moraea spp.*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	
<i>Hybanthus stellarioides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Hydrocotyle hirta</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	0	0	0	
<i>Hydrocotyle laxiflora</i>	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0
<i>Hydrocotyle spp.</i>	2	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	1	0	0	0	0	0	2	4	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	
<i>Hydrocotyle tripartita</i>	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Hypericum gramineum</i>	0	1	0	2	0	1	0	1	0	0	0	0	2	3	1	2	0	0	0	0	0	0	0	2	3	0	1	2	0	0	0	0	0	0	0	0	0	3	0	3	1	3	0	0	1	
<i>Hypericum japonicum</i>	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Hypoxis hygrometrica</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
<i>Hypochaeris radicata*</i>	3	3	3	2	1	2	0	1	2	0	0	2	5	2	2	1	2	3	0	0	4	0	1	4	4	3	3	2	2	3	3	1	3	2	3	2	4	4	3	4	3	3	3	2	2	
<i>Imperata cylindrica var. major</i>	7	8	4	6	8	4	5	4	5	4	0	0	8	6	4	4	6	7	6	6	4	5	3	3	5	7	6	7	8	7	7	5	7	6	0	0	6	8	3	3	0	0	4	7	2	
<i>Jacksonia scoparia</i>	0	0	0	1	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	
<i>Juncus usitatus</i>	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	4	0	0	2	4	0	0	0	1	0		
<i>Juncus vaginatus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		
<i>Kennedia rubicunda</i>	0	0	0	3	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
<i>Lagenophora gracilis</i>	2	3	0	0	0	3	3	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	2	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lantana camara*</i>	0	2	0	0	3	0	5	0	0	2	1	3	6	2	0	1	0	4	1	1	0	1	5	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0	0	
<i>Laxmannia gracilis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0		
<i>Leontodon taraxacoides subsp. taraxacoides*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0		
<i>Lepidosperma laterale</i>	0	0	0	0	0	2	1	2	0	2	1	0	0	0	0	1	0	0	0	0	2	1	1	0	0	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Leptospermum petersonii</i>	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Leptospermum polygalifolium</i>	0	0	0	0	0	0	0	1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
<i>Lespedeza juncea subsp. sericea</i>	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	
<i>Leucopogon juniperinus</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Libertia spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
<i>Ligustrum sinense*</i>	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	3	1	2		
<i>Lissanthe strigosa</i>	3	2	0	0	0	0	3	3	1	0	3	0	0	0	4	0	2	2	0	0	0	0	1	0	0	2	3	2	3	3	2	1	2	2	0	0	0	0	1	0	0	2	0	0	1	
<i>Lolium rigidum</i>	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0																															

SCIENTIFIC NAME	SITE NUMBER																																															
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6			
<i>Lomandra multiflora</i> subsp. <i>Multiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Lophostemon confertus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Lotus uliginosus</i> *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	
<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	
<i>Luzula flaccida</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Lythrum hyssopifolia</i> *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	
<i>Maytenus silvestris</i>	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	1	1	2	0	0	0	1	2	0	0	2	2	2	0	1	1	0	2	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0
<i>Medicago</i> spp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Melaleuca decora</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Melaleuca nodosa</i>	0	0	0	0	0	6	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
<i>Melaleuca quinquenervia</i>	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Melicope micrococca</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Mentha satureioides</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Microlaena stipoides</i> var. <i>stipoides</i>	3	0	2	3	0	3	0	5	4	0	4	0	6	0	6	2	0	5	2	2	0	0	5	1	2	3	3	2	0	0	0	0	2	4	0	0	5	2	3	1	0	3	0	1	6	0	0	
<i>Mitrasacme alsinoides</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Modiola caroliniana</i> *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
<i>Monotoca scoparia</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Myoporum acuminatum</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Myrsine variabilis</i>	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Notelaea longifolia</i>	1	0	0	0	0	1	2	2	0	1	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
<i>Opercularia aspera</i>	2	2	0	2	0	2	0	0	1	1	1	0	0	0	1	3	1	0	2	2	2	0	2	1	3	2	2	1	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
<i>Opercularia diphylla</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Opercularia hispida</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	
<i>Ophioglossum lusitanicum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
<i>Oplismenus aemulus</i>	0	2	3	0	3	1	2	0	0	2	1	3	3	2	4	0	0	1	3	3	0	0	3	0	0	4	4	2	3	4	2	3	2	1	0	0	4	0	2	0	0	0	4	3	1	0	0	
<i>Oplismenus imbecillis</i>	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Oxalis chnoodes</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2									

SCIENTIFIC NAME	SITE NUMBER																																														
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6		
<i>Pellaea falcata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0		
<i>Pennisetum clandestinum</i> *	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	5	0	0	3	0			
<i>Persicaria decipiens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0		
<i>Persoonia linearis</i>	2	2	0	3	0	0	2	2	3	2	3	2	0	1	0	3	2	0	0	0	0	2	0	0	0	2	3	3	3	5	2	2	0	0	0	0	0	0	0	0	0	0	0	1	4		
<i>Persicaria strigosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0		
<i>Phyllanthus gunnii</i>	0	0	0	1	0	0	0	0	0	3	2	1	0	0	0	2	3	0	0	0	0	2	2	0	0	0	2	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Phyllanthus hirtellus</i>	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	
<i>Phytolacca octandra</i> *	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Pimelea linifolia</i>	0	0	0	0	0	1	0	2	2	0	0	0	0	0	1	0	0	2	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	
<i>Pittosporum multiflorum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Pittosporum revolutum</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
<i>Pittosporum undulatum</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Plantago lanceolata</i> *	0	2	2	0	0	0	0	0	0	0	0	0	3	3	0	0	1	4	0	0	0	1	0	0	2	2	0	0	0	2	0	0	1	3	2	2	3	2	2	3	2	2	0	2	0	0	
<i>Plectranthus parviflorus</i>	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Poa sieberiana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Poa labillardierei</i> var. <i>labillardierei</i>	1	2	0	0	0	5	2	2	0	0	0	2	0	0	0	0	2	1	0	0	0	0	1	0	1	3	2	3	3	2	1	3	2	0	0	0	0	0	0	3	0	0	0	3	3	0	
<i>Podolobium ilicifolium</i>	5	3	0	4	0	0	1	3	5	3	4	4	0	0	0	4	3	0	0	0	0	5	0	0	0	0	1	2	3	5	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	4	
<i>Polymeria calycina</i>	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	1	4	0	0	0	2	1
<i>Polyscias elegans</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Polyscias sambucifolia</i>	2	0	0	1	0	1	2	0	1	0	1	0	0	0	0	0	1	1	0	0	0	2	1	0	0	1	3	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Pomaderris intermedia</i>	1	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pomax umbellata</i>	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Poranthera microphylla</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
<i>Pratia purpurascens</i>	3	4	3	3	0	4	3	3	0	2	3	4	5	3	4	3	3	3	2	2	3	4	5	4	4	4	3	3	4	4	3	3	3	1	0	3	3	4	2	5	0	3	3	3	4		
<i>Pseuderanthemum variable</i>	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	1	0	0		
<i>Pteridium esculentum</i>	2	0	3	4	2	0	0	2	5	5	0	3	0	0	0	0	0	2	6	6	0	2	0	0	0	0	1	0	0	5	0	1	0	2	0	0	6	1	0	0	0	0	0	4	4	2	
<i>Pterostylis longifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Pterostylis</i> spp.	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Pultenaea retusa</i>	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	

SCIENTIFIC NAME	SITE NUMBER																																														
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6		
<i>Rubus parvifolius</i>	2	0	2	2	3	0	0	0	2	3	1	1	0	2	0	0	2	0	1	1	0	2	3	1	0	2	3	2	4	5	0	3	1	2	0	0	2	0	0	0	0	0	3	3	1		
<i>Rumex brownii</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0			
<i>Sannantha pluriflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
<i>Schoenus apogon</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	
<i>Senecio madagascariensis*</i>	0	0	0	0	2	0	0	1	1	0	1	0	2	2	1	0	2	2	0	0	3	0	0	1	3	2	0	0	1	0	1	0	3	4	3	3	4	3	1	3	2	3	1	3	0	0	
<i>Senecio pinnatifolius</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
<i>Paspalidium distans</i>	2	2	0	1	0	2	3	0	0	0	0	3	0	0	0	3	0	0	0	0	2	0	1	3	3	1	2	1	2	0	1	0	0	0	0	1	0	0	2	3	0	0	2	0	2	0	0
<i>Setaria gracilis*</i>	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Setaria pumila*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5	0	8	0	0		
<i>Sida rhombifolia*</i>	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	2	2	1	0	0	0		
<i>Sigesbeckia orientalis subsp. orientalis</i>	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	4	2	0	0		
<i>Smilax australis</i>	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Smilax glyciphylla</i>	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Solanum americanum</i>	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Solanum mauritianum*</i>	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	3	0	0		
<i>Solanum nigrum*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	0	0	0	3	0	0			
<i>Solanum prinophyllum</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	
<i>Sonchus oleraceus*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	
<i>Sporobolus africanus*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Sporobolus creber</i>	0	1	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	2	2	0	1	2	3	0	3	0	0	0	0	
<i>Sporobolus fertilis*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
<i>Sporobolus sessilis*</i>	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Stackhousia spp.</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Stenotaphrum secundatum*</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0		
<i>Stephania japonica</i>	1	1	3	0	0	0	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Syncarpia glomulifera</i>	0	0	0	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Taraxacum officinale*</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	
<i>Themeda australis</i>	5	5	5	5	6	5	6	6	7	5	0	0	0	7	5	5	5	4	2	2	7	6	4	6	7	4	5	6	5	5	5	4	3	5	0	0	4	4	0	5	0	1	0	5	7	0	0
<i>Trachymene spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
<i>Trachymene incisa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0		

SCIENTIFIC NAME	SITE NUMBER																																													
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B	E1	NHM 1	NHM 2	NMH 3	NMH 4	NHM 5	NHM 6	NMH 7	NMH 8	NHM 9	NHM 10	NHM11	NHM 12	NHM a	NHM b	NHM c	STA01 A18	STA02 SEDGE	STA03 C11	STA04 D13	STA05 D14	T1	T2	T3	T4	T5	T6	
<i>Veronica plebeia</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	1	2	0	
<i>Viola betonicifolia</i>	0	0	0	3	1	0	0	2	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	1	0	0	0	2	0	0	
<i>Vittadinia muelleri</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Wahlenbergia spp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Wahlenbergia gracilis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Xanthorrhoea macronema</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Xanthosia pilosa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		

Appendix D: Habitat Variables

Site	NHM record	Site Type	Total % Cover Weeds	Total % Cover Natives	Density Score (%)	% Cover at <0.5m – Shrub	% Cover at <0.5m – Grass	% Cover at <0.5m – Herb	% Cover at <0.5m – Fern	Notes	% Cover Imperata cylindrica	Slope	Altitude (m)	Soil	Soil Depth	Soil Texture	Aspect	Years since fire	Grazing	Logs (m)	No. Hollow trees
STR_1B	Yes	Pres-imp	0.5	99	60	10	85	5	0.5		3	Moderate slope to north west		Brown	Deep	CLAY LOAM	NW	<10	Slight	5	0
STR_2B	Yes	Pres-imp	0.5	99.5	50	0.5	75	1	0.5		62.5	Slope to north east	186	Grey	Deep	SANDY LOAM	NE	10+	Nil	4	3
STR_3B	No	Abs-imp	15	85	15	0	40	5	5	Logged and planted with <i>Corymbia maculata</i>	4	Slope to the NNW	190	Grey	Deep	SANDY LOAM	NW	10+	Nil	0	0
STR_4B	No	Abs-imp	0.5	99	35	1	46	4	1	Logged and planted with <i>Corymbia maculata</i>	35	Steep slope to north west. <i>Corymbia maculata</i> plantation	160	Grey	Deep	CLAY	NW	10+	Nil	0	0
STR_5B	No	Abs-imp	15	85	90	0	99	1	0.5		87.5	Steep slope to north east	185	Brown	Deep	CLAY LOAM	NE	10+	Nil	12	0
STR_6B	No	Abs-imp	0.5	99	10	0.5	65	5	0.5		4	Moderate slope tp south west	102	White	Deep	CLAY	SW	<10	Nil	22	2
STR_7B	No	Abs-imp	10	90	10	1	60	0.5	0.5		12.5	Moderate slope to north	117	Grey	Deep	SAND	N	10+	Nil	23	0
STR_8B	No	Abs-imp	0.5	99	10	2	35	4	2		4	Moderate slope to south east	122	Brown	Deep	CLAY LOAM	SE	10+	Slight	15	1
STR_9B	No	Abs-imp	10	90	90	40	50	5	4		12.5	Steep slope to south-west		Brown	Deep	CLAY LOAM	SW	0	Nil	0	0
STR_10B	No	Abs-imp	0.5	99	20	40	10	0.5	5	Whole site covered in rocks which provides ground cover/shelter	4	Steep slope to west	120	Brown	Deep	CLAY LOAM	W	10+	Nil	2	0
STR_11B	No	Abs-imp	0.5	99	35	10	55	10	0.5		0	Steep slope to the west		Brown	Deep	CLAY LOAM	W	10+	Nil	20	0
STR_12B	No	Abs-imp	3	97	65	1	70	10	1		0	Steep slope to west	230		Deep	SAND	W	5+	Nil	10	0
STR_Site 1	No	Abs-imp	20	80	35	3	70	25	0		87	Gentle to north	67	Brown	Deep	CLAY	N	No evidence	Moderate	4	0
STR_Site 2	No	Abs-imp	5	95	15	3	95	0.5	0		35	Steep to east	104	Brown	Deep	CLAY LOAM	E	No evidence	Nil	0	0

Site	NHM record	Site Type	Total % Cover Weeds	Total % Cover Natives	Density Score (%)	% Cover at <0.5m – Shrub	% Cover at <0.5m – Grass	% Cover at <0.5m – Herb	% Cover at <0.5m – Fern	Notes	% Cover Imperata cylindrica	Slope	Altitude (m)	Soil	Soil Depth	Soil Texture	Aspect	Years since fire	Grazing	Logs (m)	No. Hollow trees
STR_Site 3	No	Abs-imp	1	99	15	5	85	1	<1		4	Gentle slope to east	92	Brown	Deep	CLAY LOAM	E	10+	Moderate	3	1
STR_Site 4	No	Abs-imp	<1	99	10	25	30	5	<1		4	Steep slope to the west	118	Brown	Deep	CLAY LOAM	W	10+	Nil	1	0
STR_Site 5	Yes	Pres-imp	0	100	85	2	90	7	1	Deep build up of debris	35	Steep slope to the north-west	211	Brown	Deep	CLAY LOAM	NW	10+	Nil	10	0
STR_Site 6	Yes	Pres-imp	10	90	35	2	90	5	<1		62.5	Steep slope to west	198	Brown	Deep	CLAY LOAM	W	10+	Slight	2	0
STR_E1	Yes	Pres-imp	5	95	65	0.5	30	4	1	Deep accumulation of litter and other plant debris	35	Flat	190	Brown	Deep	CLAY LOAM	F	10	Nil	5	0
STR_NHM1	Yes	Pres-prec	5	95	65	0.5	30	4	1	Deep accumulation of litter and other plant debris	62.5	Almost flat with northerly aspect	190	Brown	Deep	CLAY LOAM	N	10	Nil	5	0
STR_NHM2	Yes	Pres-prec	5	95	40	1	90	5	0.5		87.5	Moderate slope to north west		Black	Deep	CLAY LOAM	NW	<5	Nil	0	0
STR_NMH3	Yes	Pres-prec	0.5	99.5	40	1	55	5	5	Whole site covered in rocks which provides ground cover/shelter	12.5	moderate westerly slope	119	Brown	Deep	SANDY LOAM	W	10+	Nil	5	0
STR_NMH4	Yes	Pres-prec	30	70	25	10	45	5	4		62.5	steep slope to south-west	128	Brown	Deep	CLAY LOAM	SW	10+	Nil	7	0
STR_NHM5	Yes	Pres-prec	30	70	55	5	65	10	4		62.5	Moderate slope to the north west	152	Brown	Deep	CLAY LOAM	NW	10+	Slight	0	0
STR_NHM6	Yes	Pres-prec	50	50	65	5	90	20	1		62.5	Moderate slope to north west	153	Brown	Deep	CLAY LOAM	NW	10+	Nil	0	0
STR_NMH7	Yes	Pres-prec	1	99	65	0.5	85	5	0.5		35	gentle slope to north	188	Brown	Deep	CLAY LOAM	N	10+	Slight	2	1
STR_NMH8	Yes	Pres-prec	1	99	25	2	85	9	1		12.5	Moderate slope to north	72	Brown	Deep	CLAY LOAM	N	10	Slight	2	0
STR_NHM9	Yes	Pres-prec	0.5	99	65	3	85	4	0.5		4	Steep slope to the west	187	Brown	Deep	CLAY LOAM	W	<10	Slight	3	0
STR_NHM10	Yes	Pres-prec	0.5	99.5	65	1	95	0.5	0.5		87.5	Westerly slope	187	Brown	Deep	SAND	W	<10	Nil	17	0
STR_NHM11	Yes	Pres-prec	0.5	99.5	30	10	70	5	1		35	Slope to the SW	188	Brown	Deep	SANDY LOAM	SW	<10	Nil	7	0
STR_NHM12	Yes	Pres-prec	1	99	40	0.5	85	5	0.5		35	Gentle slope to north	195	Brown	Deep	CLAY LOAM	N	10+	Slight	2	0

Site	NHM record	Site Type	Total % Cover Weeds	Total % Cover Natives	Density Score (%)	% Cover at <0.5m – Shrub	% Cover at <0.5m – Grass	% Cover at <0.5m – Herb	% Cover at <0.5m – Fern	Notes	% Cover Imperata cylindrica	Slope	Altitude (m)	Soil	Soil Depth	Soil Texture	Aspect	Years since fire	Grazing	Logs (m)	No. Hollow trees
STR_NHMa	Yes	Pres-prec	1	99	55	5	85	5	<1	Dense layer of debris, logs, sticks and dead grasses	3	Steep slope to NorthWest	224	Brown	Deep	CLAY LOAM	NW	10+	Nil	20	1
STR_NHMb	Yes	Pres-prec	5	95	80	2	95	4	<1		12.5	Moderate slope to north	190	Brown	Deep	CLAY LOAM	N	10+	Nil	0	0
STR_NHMc	Yes	Pres-prec	40	60	55	0	65	3	<1	50% of site=90% Density; 50% of site=20% Density	62.5	Steep slope to west	194	Brown	Deep	CLAY LOAM	W	10+	Slight	0	0
STR_STA01A18	No	Abs-imp	80	20	35	1	80	5	0	Recent road works may have impacted on this site	0	Steep upper slope north facing. Road works have impacted on this location	180	Grey	Deep	CLAY	N	No evidence	Moderate	0	0
STR_STA02SE DGE	No	Abs-imp	45	55	50	0	50	45	0		0	Gentle slope to north east	166	Black	Shallow	CLAY	NE	10+	Severe	0	0
STR_STA03C11	No	Abs-imp	50	50	75	5	5	20	70		35	Slope to south east	157	Brown	Deep	CLAY LOAM	SE	<10	Nil	5	0
STR_STA04D13	Yes	Pres-imp	20	80	80	1	99	2	0.5		87.5	Moderate slope to north west	155	Grey	Deep	CLAY	N	10+	Slight	0	0
STR_STA05D14	No	Abs-imp	25	75	3	1	40	5	0		3	Slight slope to south west	147	Brown	Deep	CLAY	SW	10+	Severe	10	1
STR_T1	No	Abs-imp	98	2	75	0	100	10	0		3	Gentle slope to south east	151	Brown	Deep	CLAY	SE	10+	Severe	0	0
STR_T2	No	Abs-imp	90	10	15	5	90	5	0	Regeneration site from seed. Bund adjacent to mine dump.	0	Steep slope to south east, man made bund,	140	Grey	Deep	CLAY	SE	0	Nil	0	0
STR_T3	No	Abs-imp	95	5	3	0.5	95	1	0	Heavily grazed by horses	0	Flat	144	Grey	Deep	CLAY	F	10+	Severe	0	0
STR_T4	No	Abs-imp	65	35	65	0.5	80	5	4		4	Very steep slope to west	152	Brown	Deep	CLAY LOAM	SW	5+	Nil	0	1
STR_T5	Yes	Pres-imp	25	75	50	3	65	10	1		62.5	Moderate slope to north west		Grey	Deep	CLAY	NW	<5	Nil	0	0
STR_T6	Yes	Pres-imp	0.5	99	35	1	65	4	1		2	Steep slope to WSW	114	Brown	Deep	CLAY LOAM	WSW	10+	Nil	6	0

Appendix E: Plant Species Frequencies

List of species and frequency of occurrence across all survey sites. * = Introduced Species

FAMILY	SCIENTIFIC NAME	COMMON NAME	Number of Sites Recorded
Fabaceae	<i>Acacia falcata</i>		6
Fabaceae	<i>Acacia floribunda</i>	White Sally Wattle	14
Fabaceae	<i>Acacia implexa</i>	Hickory Wattle	12
Fabaceae	<i>Acacia irrorata</i>	Green Wattle	8
Fabaceae	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sydney Golden Wattle	4
Fabaceae	<i>Acacia longissima</i>	Long-leaf Wattle	20
Fabaceae	<i>Acacia maidenii</i>	Maiden's Wattle	15
Fabaceae	<i>Acacia ulicifolia</i>	Prickly Moses	23
Orchidaceae	<i>Acianthus fornicatus</i>	Pixie Caps	6
Adiantaceae	<i>Adiantum aethiopicum</i>	Common Maidenhair	5
Asteraceae	<i>Ageratina adenophora</i> *	Crofton Weed	1
Lamiaceae	<i>Ajuga australis</i>	Austral Bugle	1
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black she-oak	5
Casuarinaceae	<i>Allocasuarina torulosa</i>	Forest Oak	8
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed	1
Loranthaceae	<i>Amyema congener</i> subsp. <i>congener</i>		2
Primulaceae	<i>Anagallis arvensis</i> *	Scarlet/Blue Pimpernel	4
Poaceae	<i>Andropogon virginicus</i> *	Whisky Grass	23
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	10
Asclepiadaceae	<i>Araujia sericifera</i> *	Moth Vine	3
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	8
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass	24
Anthericaceae	<i>Arthropodium</i> spp.		1
Asteraceae	<i>Aster subulatus</i> *	Wild Aster	6
Poaceae	<i>Austrodanthonia monticola</i> (unconfirmed)		1
Poaceae	<i>Austrostipa</i> spp.		1
Poaceae	<i>Axonopus fissifolius</i> *	Narrow-leafed Carpet Grass	24
Myrtaceae	<i>Backhousia myrtifolia</i>	Grey Myrtle	4
Asteraceae	<i>Bidens pilosa</i> *	Cobblers Pegs	10
Pittosporaceae	<i>Billardiera scandens</i>	Appleberry	23
Rutaceae	<i>Boronia parviflora</i>	Swamp Boronia	2
Poaceae	<i>Bothriochloa macra</i>	Red Grass	5
Ophioglossaceae	<i>Botrychium australe</i>	Parsley Fern	4
Sterculiaceae	<i>Brachychiton populneus</i>	Kurrajong	1
Asteraceae	<i>Brachyscome microcarpa</i>	Forest Daisy	3
Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush	31
Poaceae	<i>Briza maxima</i>	Quaking Grass	1
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet	23
Acanthaceae	<i>Brunoniella pumilio</i>	Dwarf Blue Trumpet	4
Pittosporaceae	<i>Bursaria spinosa</i>	Blackthorn	5
Anthericaceae	<i>Caesia parviflora</i>	Pale Grass-lily	1
Myrtaceae	<i>Callistemon acuminatus</i>	Tapering-leaved Bottlebrush	1
Myrtaceae	<i>Callistemon salignus</i>	Willow Bottlebrush	1
Asteraceae	<i>Calotis dentex</i>		5
Poaceae	<i>Capillipedium spicigerum</i>	Scented-top Grass	14
Brassicaceae	<i>Cardamine paucijuga</i>		1
Cyperaceae	<i>Carex appressa</i>	Tall Sedge	3
Cyperaceae	<i>Carex breviculmis</i>		9

FAMILY	SCIENTIFIC NAME	COMMON NAME	Number of Sites Recorded
Cyperaceae	<i>Carex</i> spp.		2
Lauraceae	<i>Cassytha pubescens</i>		1
Vitaceae	<i>Cayratia clematidea</i>	Grape	3
Apiaceae	<i>Centella asiatica</i>	Pennywort	21
Adiantaceae	<i>Cheilanthes sieberi</i>		31
Orchidaceae	<i>Chiloglottis diphylla</i>		1
Poaceae	<i>Chloris divaricata</i> var. <i>divaricata</i>	Slender Chloris	1
Poaceae	<i>Chloris gayana</i> *	Rhodes Grass	3
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Yellow But	1
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle	8
Vitaceae	<i>Cissus antarctica</i>	Water Vine	4
Vitaceae	<i>Cissus hypoglauca</i>	Water Vine	4
Vitaceae	<i>Clematicissus opaca</i>	Small-leaved Water Vine	5
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard	8
Ranunculaceae	<i>Clematis glycinoides</i>	Headache Vine	17
Verbenaceae	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum, Downy Chance Tree	12
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew	2
Asteraceae	<i>Conyza bonariensis</i> *	Flaxleaf Fleabane	21
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum	9
Asteraceae	<i>Crassocephalum crepidioides</i>	Thickhead	2
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	24
Poaceae	<i>Cynodon dactylon</i> (possibly introduced)	Couch	5
Cyperaceae	<i>Cyperus aggregatus</i> *		1
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	3
Cyperaceae	<i>Cyperus polystachyos</i>		2
Cyperaceae	<i>Cyperus sesquiflorus</i> *		1
Cyperaceae	<i>Cyperus</i> spp.		8
Cyperaceae	<i>Cyperus trinervis</i>		1
Fabaceae	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	8
Polytrichaceae	<i>Dawsonia</i> sp.	Moss	2
Orchidaceae	<i>Dendrobium</i> spp.		1
Fabaceae	<i>Desmodium brachypodum</i>	Large Tick-trefoil	1
Fabaceae	<i>Desmodium gunnii</i>	Slender tick trefoil	13
Fabaceae	<i>Desmodium rhytidophyllum</i>		25
Fabaceae	<i>Desmodium varians</i>	Slender Tick-trefoil	28
Phormiaceae	<i>Dianella caerulea</i>	Blue Flax-lily	14
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>		8
Phormiaceae	<i>Dianella longifolia</i>	Blue Flax-lily	2
Phormiaceae	<i>Dianella revoluta</i>	Blue Flax-lily	8
Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass	5
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	37
Poaceae	<i>Digitaria didactyla</i>	Queensland Blue Couch	1
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	6
Poaceae	<i>Digitaria parviflora</i>	Small-flowered Finger Grass	12
Poaceae	<i>Digitaria ramularis</i>		2
Fabaceae	<i>Dillwynia phyllicoides</i>		1
Dioscoreaceae	<i>Dioscorea transversa</i>	Native Yam	1
Ebenaceae	<i>Diospyros australis</i>	Black Plum	3
Sapindaceae	<i>Dodonaea triquetra</i>	Large-leaf Hop-bush	1
Blechnaceae	<i>Doodia aspera</i>	Prickly Rasp Fern	5
Droseraceae	<i>Drosera auriculata</i>		1
Solanaceae	<i>Duboisia myoporoides</i>	Corkwood	1

FAMILY	SCIENTIFIC NAME	COMMON NAME	Number of Sites Recorded
Poaceae	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass	32
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>nutans</i>	Climbing Saltbush	1
Elaeocarpaceae	<i>Elaeocarpus obovatus</i>	Hard Quandong	1
Poaceae	<i>Entolasia marginata</i>	Bordered Panic	10
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	28
Poaceae	<i>Entolasia whiteana</i>		2
Asteraceae	<i>Epaltes australis</i>	Spreading Nut-heads	1
Onagraceae	<i>Epilobium</i> spp.		1
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	32
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	15
Myoporaceae	<i>Eremophila debilis</i>	Amulla	1
Orchidaceae	<i>Eriochilus cucullatus</i>	Parson's Bands	2
Myrtaceae	<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i>	Cabbage Gum	3
Myrtaceae	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum	1
Myrtaceae	<i>Eucalyptus carnea</i>	Thick-leaved Mahogany	20
Myrtaceae	<i>Eucalyptus globoidea</i>	White Stringybark	19
Myrtaceae	<i>Eucalyptus microcorys</i>	Tallowwood	1
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box	7
Myrtaceae	<i>Eucalyptus propinqua</i>	Small-fruited Grey Gum	26
Myrtaceae	<i>Eucalyptus siderophloia</i>	Grey Ironbark	5
Myrtaceae	<i>Eucalyptus</i> spp.		2
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum	2
Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed	18
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry	15
Santalaceae	<i>Exocarpos cupressiformis</i>	Native Cherry	16
Asteraceae	<i>Facelis retusa</i> *		2
Polygonaceae	<i>Fallopia convolvulus</i> *	Black Bindweed	1
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge	17
Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge	2
Cyperaceae	<i>Gahnia</i> spp.		1
Rubiaceae	<i>Galium propinquum</i>	Maori Bedstraw	6
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily	25
Geraniaceae	<i>Geranium solanderi</i> var. <i>solanderi</i>	Native Geranium	11
Euphorbiaceae	<i>Glochidion ferdinandi</i>	Cheese Tree	19
Fabaceae	<i>Glycine clandestina</i>		33
Fabaceae	<i>Glycine microphylla</i>	Small-leaf Glycine	19
Fabaceae	<i>Glycine tabacina</i>	Glycine	20
Asclepiadaceae	<i>Gomphocarpus fruticosus</i> *	Narrow-leaved Cotton Bush	5
Haloragaceae	<i>Gonocarpus teucrioides</i>	Raspwort	20
Goodeniaceae	<i>Goodenia heterophylla</i>		4
Goodeniaceae	<i>Goodenia paniculata</i>	Branched Goodenia	5
Sapindaceae	<i>Guioa semiglauca</i>	Guioa	2
Fabaceae	<i>Hardenbergia violacea</i>	False Sarsaparilla	10
Dilleniaceae	<i>Hibbertia aspera</i>	Rough Guinea Flower	9
Dilleniaceae	<i>Hibbertia dentata</i>	Twining Guinea Flower	7
Dilleniaceae	<i>Hibbertia diffusa</i>	Wedge Guinea Flower	15
Dilleniaceae	<i>Hibbertia riparia</i>	Erect Guinea-flower	1
Dilleniaceae	<i>Hibbertia scandens</i>	Climbing Guinea Flower	21
Violaceae	<i>Hybanthus stellarioides</i>		3
Apiaceae	<i>Hydrocotyle hirta</i>	Hairy Pennywort	4
Apiaceae	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort	7
Apiaceae	<i>Hydrocotyle</i> spp.		10
Apiaceae	<i>Hydrocotyle tripartita</i>	Pennywort	3

FAMILY	SCIENTIFIC NAME	COMMON NAME	Number of Sites Recorded
Clusiaceae	<i>Hypericum gramineum</i>	Small St. John's Wort	17
Clusiaceae	<i>Hypericum japonicum</i>		1
Asteraceae	<i>Hypochaeris radicata</i> *	Catsear	3
Hypoxidaceae	<i>Hypoxis hygrometrica</i>	Golden Weather-grass	37
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass	39
Fabaceae	<i>Jacksonia scoparia</i>	Dogwood	9
Juncaceae	<i>Juncus usitatus</i>		7
Juncaceae	<i>Juncus vaginatus</i>		1
Fabaceae	<i>Kennedia rubicunda</i>	Dusky Coral Pea	5
Asteraceae	<i>Lagenophora gracilis</i>	Slender Lagenophora	12
Verbenaceae	<i>Lantana camara</i> *	Lantana	17
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily	2
Asteraceae	<i>Leontodon taraxacoides</i> subsp. <i>taraxacoides</i> *	Lesser Hawkbit	1
Cyperaceae	<i>Lepidosperma laterale</i>		12
Myrtaceae	<i>Leptospermum petersonii</i>	Lemon-scented Teatree	1
Myrtaceae	<i>Leptospermum polygalifolium</i>	Tantoon	3
Fabaceae	<i>Lespedeza juncea</i> subsp. <i>sericea</i>		3
Ericaceae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath	2
Iridaceae	<i>Libertia</i> spp.		1
Oleaceae	<i>Ligustrum sinense</i> *	Small Leaved Privet	12
Epacridaceae	<i>Lissanthe strigosa</i>	Peach Heath	22
	<i>Lolium rigidum</i>	Wimmera Ryegrass	1
Lomandraceae	<i>Lomandra confertifolia</i> subsp. <i>pallida</i>		1
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt-rush	3
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>		26
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	30
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush	1
Myrtaceae	<i>Lophostemon confertus</i>	Brush Box	1
Fabaceae	<i>Lotus uliginosus</i> *	Birds-foot Trefoil	1
Onagraceae	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Water Primrose	1
Juncaceae	<i>Luzula flaccida</i>		1
Lythraceae	<i>Lythrum hyssopifolia</i>	Hyssop Loosestrife	1
Celastraceae	<i>Maytenus silvestris</i>	Narrow-leaved Orangebark	16
Fabaceae	<i>Medicago</i> spp.		1
Myrtaceae	<i>Melaleuca decora</i>		1
Myrtaceae	<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark	3
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	1
Rutaceae	<i>Melicope micrococca</i>	Hairy-leaved Doughwood	1
Lamiaceae	<i>Mentha satureioides</i>	Native Pennyroyal	1
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>		28
Loganiaceae	<i>Mitrasacme alsinoides</i>		1
Malvaceae	<i>Modiola caroliniana</i> *	Red-flowered Mallow	1
Epacridaceae	<i>Monotoca scoparia</i>		1
Iridaceae	<i>Moraea</i> spp.*		2
Myoporaceae	<i>Myoporum acuminatum</i>	Boobialla	1
Myrsinaceae	<i>Myrsine variabilis</i>		4
Oleaceae	<i>Notelaea longifolia</i>	Large Mock-olive	10
Rubiaceae	<i>Opercularia aspera</i>	Coarse Stinkweed	22
Rubiaceae	<i>Opercularia diphylla</i>		1

FAMILY	SCIENTIFIC NAME	COMMON NAME	Number of Sites Recorded
Rubiaceae	<i>Opercularia hispida</i>	Hairy Stinkweed	1
Ophioglossaceae	<i>Ophioglossum lusitanicum</i>	Adders Tongue	1
Poaceae	<i>Oplismenus aemulus</i>	Australian Basket Grass	29
Poaceae	<i>Oplismenus imbecillis</i>	Creeping Beard Grass	2
Oxalidaceae	<i>Oxalis chnoodes</i>		5
Oxalidaceae	<i>Oxalis exilis</i>		2
Oxalidaceae	<i>Oxalis perennans</i>		9
Oxalidaceae	<i>Oxalis radicata</i>		4
Oxalidaceae	<i>Oxalis</i> spp.		7
Asteraceae	<i>Ozothamnus diosmifolius</i>	White Dogwood	16
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	20
Poaceae	<i>Panicum effusum</i>	Hairy Panic	1
Poaceae	<i>Panicum simile</i>	Two-colour Panic	27
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod	4
Poaceae	<i>Paspalidium distans</i>		21
Poaceae	<i>Paspalum dilatatum</i> *	Paspalum	12
Adiantaceae	<i>Pellaea falcata</i>	Sickle Fern	2
Poaceae	<i>Pennisetum clandestinum</i> *	Kikuyu Grass	6
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed	1
Polygonaceae	<i>Persicaria strigosa</i>	Spotted Knotweed	21
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung	2
Euphorbiaceae	<i>Phyllanthus gunnii</i>	Scrubby Spurge	12
Euphorbiaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge	4
Phytolaccaceae	<i>Phytolacca octandra</i> *	Inkweed	3
Thymelaeaceae	<i>Pimelea linifolia</i>	Slender Rice Flower	11
Pittosporaceae	<i>Pittosporum multiflorum</i>	Orange Thorn	1
Pittosporaceae	<i>Pittosporum revolutum</i>	Rough Fruit Pittosporum	9
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum	2
Plantaginaceae	<i>Plantago lanceolata</i> *	Lamb's Tongues	21
Lamiaceae	<i>Plectranthus parviflorus</i>	Cocksbur Flower	3
Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>	Tussock	21
Poaceae	<i>Poa sieberiana</i>		2
Fabaceae	<i>Podolobium ilicifolium</i>	Prickly Shaggy Pea	19
Convolvulaceae	<i>Polymeria calycina</i>		11
Araliaceae	<i>Polyscias elegans</i>	Celery Wood	1
Araliaceae	<i>Polyscias sambucifolia</i>	Elderberry Panax	15
Rhamnaceae	<i>Pomaderris intermedia</i>		6
Rubiaceae	<i>Pomax umbellata</i>		5
Euphorbiaceae	<i>Poranthera microphylla</i>		3
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot	41
Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower	6
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Common Bracken	21
Orchidaceae	<i>Pterostylis longifolia</i>	Tall Greenhood	1
Orchidaceae	<i>Pterostylis</i> spp.		1
Fabaceae	<i>Pultenaea retusa</i>	Notched Bush-pea	4
Fabaceae	<i>Pultenaea villosa</i>	Hairy Bush-pea	7
Ranunculaceae	<i>Ranunculus plebeius</i>	Forest Buttercup	3
Ranunculaceae	<i>Ranunculus repens</i> *	Creeping Buttercup	1
Ranunculaceae	<i>Ranunculus</i> spp.		1
Myrtaceae	<i>Rhodamnia rubescens</i>	Scrub Turpentine	1
Rubiaceae	<i>Richardia humistrata</i> *		1
Rubiaceae	<i>Richardia stellaris</i> *		2
Rosaceae	<i>Rubus fruticosus</i> sp. agg.*	Blackberry complex	7
Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry	27
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	1

FAMILY	SCIENTIFIC NAME	COMMON NAME	Number of Sites Recorded
Myrtaceae	<i>Sannantha pluriflora</i>		1
Cyperaceae	<i>Schoenus apogon</i>	Fluke Bogrush	4
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed	27
Asteraceae	<i>Senecio pinnatifolius</i>	Variable Groundsel	1
Poaceae	<i>Setaria parviflora</i> *	Slender Pigeon Grass	3
Poaceae	<i>Setaria pumila</i> *	Pale Pigeon Grass	4
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne	6
Asteraceae	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	Indian Weed	5
Smilacaceae	<i>Smilax australis</i>	Lawyer Vine	3
Smilacaceae	<i>Smilax glycyphylla</i>	Sweet Sarsparilla	3
Solanaceae	<i>Solanum americanum</i>	Glossy Nightshade	1
Solanaceae	<i>Solanum mauritianum</i> *	Wild Tobacco Bush	8
Solanaceae	<i>Solanum nigrum</i> *	Black-berry Nightshade	5
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade	8
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sowthistle	2
Poaceae	<i>Sporobolus africanus</i> *	Parramatta Grass	3
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass	12
Poaceae	<i>Sporobolus fertilis</i> *	Giant Parramatta Grass	1
Poaceae	<i>Sporobolus sessilis</i> *		3
Stackhousiaceae	<i>Stackhousia</i> spp.		1
Poaceae	<i>Stenotaphrum secundatum</i> *	Buffalo Grass	1
Menispermaceae	<i>Stephania japonica</i>	Snake Vine	8
Myrtaceae	<i>Syncarpia glomulifera</i>	Turpentine	5
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion	6
Poaceae	<i>Themeda australis</i>	Kangaroo Grass	37
Apiaceae	<i>Trachymene incisa</i>		1
Apiaceae	<i>Trachymene</i> spp.		1
Ulmaceae	<i>Trema tomentosa</i> var. <i>aspera</i>	Native Peach	6
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Autumn-lily	1
Fabaceae	<i>Trifolium repens</i> *	White Clover	1
Fabaceae	<i>Trifolium</i> spp.*		3
Uvulariaceae	<i>Tripladenia cunninghamii</i>		1
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop	31
Asteraceae	<i>Vernonia cinerea</i>		14
Scrophulariaceae	<i>Veronica plebeia</i>	Trailing Speedwell	11
Violaceae	<i>Viola betonicifolia</i>	Native Violet	9
Asteraceae	<i>Vittadinia muelleri</i>		1
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling or Australian Bluebell	1
Campanulaceae	<i>Wahlenbergia</i> spp.		6
Xanthorrhoeaceae	<i>Xanthorrhoea macronema</i>		1
Apiaceae	<i>Xanthosia pilosa</i>	Woolly Xanthosia	1

Attachment I-B: Stratford Coal Mine New Holland Mouse (*Pseudomys novaehollandiae*) Targeted Survey Programme (Dr Anne Kerle)

**STRATFORD COAL MINE
NEW HOLLAND MOUSE (*Pseudomys
novaehollandiae*) TARGETED SURVEY
PROGRAMME**



JUNE 2011

**Dr Anne Kerle
Consulting Ecologist**

This report has been prepared by Dr Anne Kerle for:

GLOUCESTER COAL LIMITED

June 2011

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(Scientific licence (NPW Act 1974) S10014)

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EXECUTIVE SUMMARY

Anne Kerle was commissioned by Gloucester Coal Limited to undertake a targeted survey for the New Holland Mouse (*Pseudomys novaehollandiae*) in the Gloucester Valley, New South Wales (NSW). The New Holland Mouse was listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on the 11 August 2010. This species is not currently listed as threatened under the NSW *Threatened Species Conservation Act, 1995*.

This report documents targeted surveys for the New Holland Mouse in the wider area within and surrounding the Stratford Coal Mine. Five target areas were selected to target potential habitat for the New Holland Mouse. Elliot traps were used to capture the mouse.

During the targeted surveys, two New Holland Mice were recorded. The New Holland Mice were located at the edge of a eucalypt woodland dominated by White Stringybark (*Eucalyptus globoidea*) and Grey Ironbark (*E. siderophloia*). The areas where the species was captured were subject to low grazing pressure, contained a dense groundcover and a very low proportion of exotic plants.

1 INTRODUCTION

1.1 SCOPE

Anne Kerle was commissioned by Gloucester Coal Limited to undertake a targeted survey for the New Holland Mouse (*Pseudomys novaehollandiae*) in the Gloucester Valley, New South Wales (NSW).

The objective of the targeted survey programme is to investigate the occurrence of the New Holland Mouse and its habitat at various sites in the Gloucester Valley. This report outlines the methods and results of this targeted survey.

1.2 BACKGROUND OF THE NEW HOLLAND MOUSE

The New Holland Mouse (*Pseudomys novaehollandiae*) is a small native rodent restricted to a mostly coastal distribution from central Queensland to the mid-south coast of NSW, coastal eastern Victoria and north-eastern Tasmania. This distribution is fragmented and patchy with 6 to 8 metapopulations being described in 2006 (Commonwealth Department of Sustainability, Environment, Water, Population and Communities [SEWPaC], 2010). While this distribution is mostly coastal the species is now known from sites further inland. It is listed as Vulnerable under Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This species is not listed as threatened under the NSW *Threatened Species Conservation Act, 1995*.

Broadly, the habitat preferred by the New Holland Mouse is described as open heathlands, open woodlands with a heathland understorey and vegetated sand dunes which are at least two years post fire in age (Kemper and Wilson, 2008; SEWPaC, 2010). Research has indicated that the habitat of this species is defined by floristically rich vegetation with a high cover at ground level and at least a 50% total vegetation cover (Braithwaite and Gullan, 1978; Fox and Fox, 1978). Both the floristic composition and the structural attributes are critical in defining preferred New Holland Mouse habitat (Braithwaite and Gullan, 1978). Key attributes include a wide variety of heath plants, vegetation cover below 50 centimetres (cm), a soft substrate, an early stage of regeneration and high total vegetation cover (Fox and Fox, 1978).

The New Holland Mouse prefers habitat of an early to mid-post disturbance seral stage (SEWPaC, 2010). However, the age of this vegetation appears to vary with the type of disturbance and the history of disturbance. Recolonisation of burnt areas can occur after one or two years while this may take four to five years in rehabilitated sand-mined areas (Fox and Fox, 1978; Kemper and Wilson, 2008). Post-fire recolonisation is slower in Tasmania where it takes some 7 to 10 years (Lazenby *et al.*, 2008). A similar post-disturbance response by these mice is found in early to mid-seral post-clearing regrowth vegetation (Braithwaite and Gullan, 1978).

The New Holland Mouse is a seasonal breeder with some evidence of opportunistic breeding. The breeding season lasts about five months being mostly from August to early January and occasionally extending into March in NSW (Fox *et al.*, 1993, Kemper and Wilson, 2008). Two litters can be produced in a season (Pye, 1991). The breeding season has been recorded continuing for at least 10 months when climatic conditions included above average rainfall in the period September to March. The extended breeding response to these wet conditions is most likely to be due to the abundance or quality of food produced by those conditions (Fox *et al.*, 1993).

Marked seasonal fluctuations in population size have been recorded and generally abundance tends to be highest in autumn and lowest in early spring (Kemper, 1977). This is likely to be a response to seasonal changes in resource availability and the timing of the recruitment of weaned young. Population densities can be high (17 to 24 animals per hectare) under favourable conditions, but such populations can become extinct with deteriorating conditions and concurrent changes in habitat. Three or four years of above average rainfall can produce high population densities but densities will rapidly decline with below average rainfall and drought conditions (Kemper and Wilson, 2008).

The New Holland Mouse is a species with a patchy distribution of disjunct populations and specific habitat requirements. The survival of populations requires the presence of a habitat mosaic with a variety of post-disturbance ages which provides for dispersal of individuals from areas with vegetation that is becoming unsuitable for their requirements to patches that have reached an optimum suitability and resource availability. Extensive local movements of individuals have been recorded and there is some suggestion that there is a juvenile dispersal mechanism between habitat patches (Fox and Fox, 1978; Wilson, 1991). Under appropriate conditions, however, this species has the reproductive capacity to enable rapid colonisation of suitable habitat.

The New Holland Mouse has been recorded in the eastern section of the Stratford Coal Mine, south of the Stratford Coal Mine and once, 17 km south, in the Duralie Coal Mine offset area (Ecobiological, in prep a, in prep b). Database searches conducted using the National Parks and Wildlife Service Atlas of NSW Wildlife returned a total of seven records of the New Holland Mouse in the Gloucester Local Government Area. Records were located at the Barrington Tops National Park, the Mernot, Woko and Barrington Tops State Forests and Stroud Road (NSW Office of Environment and Heritage, 2011).

2 METHODS

2.1 TIMING AND WEATHER CONDITIONS

The survey was carried out from 31 January to 4 February 2011. Temperatures during the survey were very hot. Maximum and minimum temperatures recorded for the Commonwealth Bureau of Meteorology (BoM) weather station at Paterson (Tocal AWS) (site number: 061250), the closest and most applicable weather station to the study area, are shown in Table 2.1. The maximum temperature during the survey period was on 3 February (41.3 degrees Celsius [$^{\circ}\text{C}$]), while the minimum temperature was recorded on 31 January (16.2 $^{\circ}\text{C}$) (Table 2.1). There was no rainfall recorded during the survey period.

Table 2.1
Weather Conditions Recorded at Paterson (Tocal AWS) Weather Station
During the Survey

Date	Temperature ($^{\circ}\text{C}$)	
	Maximum	Minimum
Monday 31 January 2011	40.1	16.2
Tuesday 1 February 2011	41.9	19.3
Wednesday 2 February 2011	39.7	23.0
Thursday 3 February 2011	41.3	25.6
Friday 4 February 2011	-	23.0

Source: BoM (2011).

2.2 TARGET AREAS AND SAMPLING SITES

Target Areas

Five target areas were selected prior to the commencement of the survey by David Goldney (Cenwest Environmental Services). These are described in detail in Table 2.2.

Table 2.2
Target Area Locations

Target Area 1 (STA1)	East of Avon North Open Pit and east of Target Area 4.
Target Area 2 (STA2)	South-east of the Stratford East Open Pit and north of Glen Road.
Target Area 3 (STA3)	South of Stratford East Open Pit and Glen Road. The Target Area includes remnant forest/rainforest intergrade at the top of a gully, a deep gully partially cleared around a dam and below a disused dairy and with remnant rainforest further downstream and the western bank cleared and now vegetated by bracken fern and blade grass.
Target Area 4 (STA4)	East of Avon North Open Pit and west of Target Area 1.
Target Area 5 (STA5)	South of Stratford South Open Pit on the northern side of Glen Road.

Detailed descriptions of the target areas are provided in Appendix 1.

Sampling Sites

Twenty-four sampling sites were selected across the five target areas (Figure 2.1). The date and time of sampling, co-ordinates and altitude of sampling sites is shown in Table 2.3.

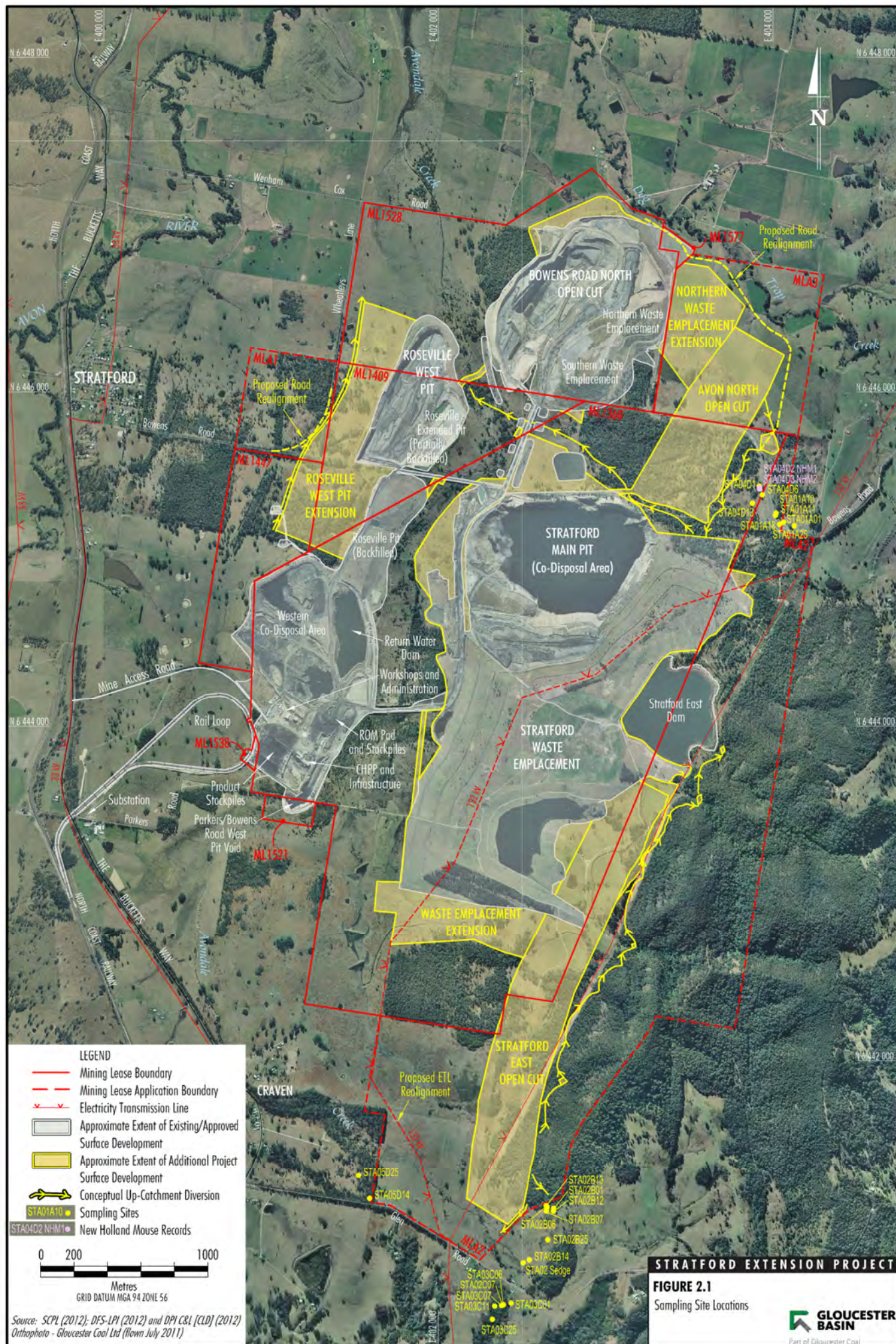


Table 2.3
Sampling Site Locations

Sampling Site	Date and Time of Sampling	Easting	Northing	Altitude
Target Area 1 (STA1)				
STA01A01	2/02/2011	404063	6445221	179 metres (m)
STA01A10	2/02/2011 10:05	404019	6445275	169 m
STA01A11	2/02/2011 10:07	404015	6445261	169 m
STA01A18	2/02/2011 10:13	404040	6445208	175 m
STA01A25	2/02/2011 10:17	404129	6445281	174 m
Target Area 2 (STA2)				
STA02 Sedge	3/02/2011 9:40	402507	6440797	168 m
STA02B06	1/02/2011 17:49	402649	6441127	220 m
STA02B01	3/02/2011 9:03	402689	6441121	227 m
STA02B12	3/02/2011 9:00	402687	6441104	225 m
STA02B13	3/02/2011 8:48	402642	6441136	210 m
STA02B14	3/02/2011 9:34	402543	6440815	174 m
STA02B25	3/02/2011 9:21	402654	6440934	202 m
STA02B07	3/02/2011 8:51	402645	6441105	214 m
STA02C07	3/02/2011 10:32	402378	6440539	145 m
Target Area 3 (STA3)				
STA03C01	3/02/2011 10:22	402434	6440554	162 m
STA03C07	3/02/2011	402379	6440539	-
STA03C11	3/02/2011 10:38	402336	6440536	156 m
STA03C25	3/02/2011 10:45	402324	6440457	147 m
STA03C06	3/02/2011 10:26	402389	6440544	147 m
Target Area 4 (STA4)				
STA04D01	1/02/2011 9:10	403917	6445437	156 m
STA04D13	2/02/2011 10:53	403876	6445334	159 m
STA04D02 NHM1	2/02/2011 10:46	403921	6445427	157 m
STA04D03 NHM2	3/02/2011 10:48	403920	6445419	158 m
STA04D06	2/02/2011 10:50	403936	6445384	161 m
Target Area 5 (STA5)				
STA05D14	2/02/2011 17:36	401590	6441180	180 m
STA05D25	2/02/2011 17:40	401522	6441316	168m

Notes:

- All co-ordinates are in Zone 56, WGS 84.
- See Figure 2.1 for site locations.
- The last three digits represent trap box no (A-D) followed by trap number (1-25), e.g. STA01A10 = Stratford Target Area 1, Box A, Trap No 10.
- The two trap locations where the New Holland Mouse were caught are identified by the letters NHM.

STA1

The trap line traversed grassland/bracken fern community from a timber windrow to a creek (bearing 340⁰) and then returned from the creek towards a road in a parallel line (Bearing 90⁰). The last few traps were located through a patch of mixed aged open Broad-leaved White Mahogany and Broad-leaved Ironbark forest.

STA2

The trap line initially began in sedgeland at a watercourse at the bottom of a hill with traps extending uphill through bracken and grassland about half way to remnant vegetation at the top of the ridge. Traps located within sedgeland along the creek were removed after one night and replaced in two parallel lines at the top of the ridge, seven within the remnant woodland and six in the adjacent grassland.

STA3

The trapline ran from the top on the eastern side of a gully in the forest/rainforest intergrade, and crossed the gully to the top of the western bank on a bearing of 230⁰. It then followed the creekline on a bearing of 210⁰ through bracken dominated groundcover. Three traps were placed within the intergrade forest; all others were in the bracken dominated vegetation.

STA4

The trapline contained 13 traps and ran from the edge of remnant woodland and through grassland.

STA5

The trapline contained 12 traps and were placed in eucalypt woodland at the edge of a cleared grazed grassland.

2.2.1 Survey Techniques

As described by SEWPac (2010), the New Holland Mouse is:

*...similar in size and appearance to the introduced house mouse (*Mus domesticus*), although it can be distinguished by its slightly larger ears and eyes, the absence of a notch on the upper incisors and the absence of a distinctive 'mousy' odour.*

While identification of the New Holland Mouse can be difficult, it was readily distinguished from the House Mouse by the general appearance of the animals (ear size, colouring and a delicate appearance) in addition to the more readily discernable absence of notching of the upper incisors and absence of odour. Because of the similarity between the New Holland Mouse and the House Mouse, the potential presence of the New Holland Mouse was investigated by a trapping programme.

A total of 25 small Elliot traps (Type A) were placed in trapping transects within STA1, STA 2 and STA 3, 13 were placed in trapping transects within STA 4 and 12 were placed in trapping transects within STA 5. These traps have been proven to be effective in capturing this species in previous studies, especially if the treadle is lightly set. The layout of the traps was designed to cover the range of habitats within each of the selected sites. Traps were spaced approximately 15 m apart along the trapline and traps were left over four consecutive nights (100 trap nights (each) at STA 1, STA 2 and STA3, 52 trap nights at STA 4 and 48 trap nights for STA 5, equating to 400 trap nights for the programme).

All traps were set on 31 January, however, due to fading light traps at STA2 located in sedgeland, 13 traps from the sedgeland were relocated to remnant vegetation at the top of a hill with six set in grassland parallel to the forest edge and seven set within forest on 1 February.

The traps were baited with a mixture of peanut butter and rolled oats, which has been used in previous surveys for this species (Fox and Gullick, 1989). Each trap contained grass nesting material for temperature regulation and were covered by a plastic bag to keep animals dry in the event of rainfall and protect any captured species from ants. Traps were opened within two hours of dark (6.00 pm to 8.00 pm) and checked and closed within two hours of daylight (6.30 am to 8.00 am).

Any captured animals were weighed, measured, sexed and breeding status assessed. Animals were marked with a permanent marker on the ear in order to distinguish recaptures.

In addition to the targeted species, all species trapped or observed at each site, including signs (such as scats, markings on trees, etc.), were recorded.

2.3 HABITAT ASSESSMENT

A habitat assessment of the main habitats within each Target Area was carried out along each transect. The following attributes were recorded:

- Vegetation description
- Dominant plant species and species diversity for ground, mid and upper strata plants.
- Groundcover (i.e. percentage of grass, herbs, litter, bare soil, rocks, logs, cryptogams).
- Shrub and tree projected foliage cover at <2 m, 2 to 4 m, 4 to 6 m and >6 m.
- The presence of weeds and vertebrate pests.
- Evidence of disturbance and fire.
- Evidence of grazing by stock.
- The presence of rocks and water.
- Evidence of fauna.
- Conservation values.
- Soil type.
- Number of tree hollows.
- Locality description.
- Tree condition.

3 RESULTS

3.1 TRAPPING RESULTS

The results of the trapping programme are shown below in Table 3.1. Eight species of small mammal were captured during the survey and the overall trap success was 9.25%.

Table 3.1
Trapping Results for Each of the Target Areas

Scientific Name	Common Name	STA1	STA2	STA3	STA4	STA5	TOTAL
<i>Pseudomys novaehollandiae</i>	New Holland Mouse				2 (F)		2
<i>Mus musculus</i> *	House Mouse		1				1
<i>Rattus fuscipes</i>	Bush Rat		2 (M)				2
<i>Rattus lutreolus</i>	Swamp Rat	5 (M)	3 (2 F, 1M)	3 (2F, 1M)			11
<i>Rattus rattus</i> *	Black Rat			3			3
<i>Antechinus flavipes</i>	Yellow-footed Antechinus	1 (M)	2 (F)	2 (1M, 1F)		1 (M)	6
<i>Antechinus stuartii</i>	Brown Antechinus	2 (M)		4 (M)			5
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale					2 (1M, F)	2
Total Trapped (including recaptures)		9	11	12	2	3	37
Trap Success		9%	11%	12%	3.8%	6.25%	9.25%

Note: The number of each species trapped is indicated and the sex ratio is indicated in brackets (F: female, M: male).

* Introduced species.

Species trapped included three dasyurids, three native rodents and two introduced rodents. The introduced rodents were uncommon with only one House Mouse (*Mus musculus*) trapped in sedgeland at the bottom of Target Area STA2, prior to the relocation of those traps, and three Black Rats (*Rattus rattus*) recorded below a dairy and dam at Target Area 3. The most frequently caught species was the Swamp Rat (*Rattus lutreolus*) (11 individuals) captured at three Target Areas (1, 2 and 3). Swamp Rats were also recaptured the most, with one immature male caught in the same trap on each night in Target Area 2. Target Areas 2 and 3 had the most diverse fauna assemblages (four individual species recorded at each Target Area) and the highest trapping success (11 and 12%, respectively) (Table 3.1).

Habitats where each non-target native species was captured were:

- **Bush Rat:** mature remnant ridge forest (veg plot 2/3).
- **Swamp Rat:** dense bracken and bladey grass (veg plots 1/2, 2/1, 3/2).
- **Yellow-footed Antechinus:** In forested water course (veg plot 1/3), mature remnant ridge forest (veg plot 2/3), in bracken (veg plot 3/2).
- **Brown Antechinus:** In remnant woodland (veg plots 1/1, 1/3), adjacent to remnant rainforest gully in bracken (veg plot 3/2).
- **Brush-tailed Phascogale:** Grazed remnant open forest with some logs on the ground (veg plot 5/1).

Two New Holland Mice were captured on the third and fourth days of trapping at Target Area 4 at sites STA04D2 and STA04D3 (see Table 2.3 for co-ordinates). The two individuals captured were immature females. These traps were at the edge of a eucalypt woodland dominated by White Stringybark (*Eucalyptus globoidea*) and Grey Ironbark (*E. siderophloia*). The traps ran across the boundary between woodland and closed grassland that dominated the remainder of the Target Area. The ground layer was well vegetated with a high native grass cover and other ground cover and 20% litter cover (Plates 1a and 1b). The groundcover was not dominated by bracken or bladey grass. Some scattered shrub growth was present (5%) and the canopy cover was 15%. There was no recent evidence of fire or grazing and a very low proportion of exotic plants and the soils were loam.



Plates 1a and 1b
Groundcover in the Vicinity of the Traps where the New Holland Mice were Trapped

The sex, approximate age, weight, body measurements and habitat that the New Holland Mice were recorded in are provided in Table 3.2.

Table 3.2
Biological Data for Trapped New Holland Mice

Mouse No.	Date	Sex	Age	Weight (g)	Head (mm)	HB (mm)	Tail (mm)	Ear (mm)	Hind foot	Habitat
1 D2	3/2/11	F	Imm	12	25	70	80	13	21	Forest edge
2 D3	4/2/11	F	Imm	11	25	60	80	13.5	21	Grassland /forest

3.2 HABITAT ANALYSIS

The results of the habitat analyses conducted for the dominant vegetation types within each Target Area are provided in detail in Appendix 1.

The structural attributes of each of the vegetation plots are summarised in Table 3.1. Many of these attributes reflect the selection criteria of dense ground cover dominated by Bladey Grass (*Imperata cylindrica*) and Bracken Fern (*Pteridium* sp) used when the sites were selected. The majority of traps were placed in this habitat type in response to the results of the trapping by Ecobiological (in prep a), in which New Holland Mouse was found in sites dominated by Bladey Grass, Bracken Fern and native grasses.

Table 3.3
Habitat Attributes of Vegetation Plots within the Target Survey Areas

	Target Area 1			Target Area 2			Target Area 3		Target Area 4		Target Area 5
Attribute	Plot 1/1	Plot 1/2	Plot 1/3	Plot 2/1	Plot 2/2	Plot 2/3	Plot 3/1	Plot 3/2	Plot 4/1	Plot 4/2	Plot 5/1
Plant Community	Mixed aged open forest	Closed grassland	Mixed aged open forest	Grassy herbland	Grassy herbland	Mature Eucalyptus forest	Remnant forest	Bracken grass land	Eucalyptus woodland	Closed grass land	Mixed aged open forest
% Overstorey cover	35	N	25	N	<5%	25	30	N	15	N	10
% Midstorey cover	15	N	5	5	<5	20	25	<1%	5	<5	5
% Grass cover	50	95	50	70	45	30	45	40	50	90	50
% groundcover (other)	30	5	5	20	45	25	20	60	15	5	<5
% Litter	15	-	35	-	<5	25	10	<5	20	-	30
% Bare ground	5	<1	10	5	<5	10	5	Y	15	5	10
% logs	N	N	N	N	N	<5%	<5	N	<5	N	<5
%Rock	N	N	N	5	5	5	20	N	N	N	<5
% Exotic	40	30	20	20	10	<10	50	<10	<5	<10	<10
Regeneration	+	N	+	N	+	+	+	N	+	+	+
Tree Hollows	Few	N	Few	N	N	Yes	Yes	N	Yes	N	Y
Fire history	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Grazing (stock)	N	N	N	Y	Y	N	Y	Y	N	N	Y
Soil Type	Loam	Loam	Loam	Loam with cobbles	Loam with coarse gravels	Loam with coarse gravels	Skeletal	Loam	Loam	Loam	Loam

Notes:

- + regeneration occurring.
- Y = area grazed; N = area not grazed, logs absent, no hollows; NR = no recent evidence of fire.
- Plot 4/1 represents New Holland Mouse habitat.

4 CONCLUSION

During the targeted surveys, two juvenile female New Holland Mice were located at two survey sites within Target Area 4. The New Holland Mice were located at the edge of a eucalypt woodland dominated by White Stringybark (*Eucalyptus globoidea*) and Grey Ironbark (*E. siderophloia*). The areas where the species was captured were subject to low grazing pressure, contained a dense groundcover and a very low proportion of exotic plants.

The results of this stratified survey demonstrate that the Bladey grass / Bracken habitat selected does not appear to be the favoured habitat of the New Holland Mouse. This conclusion derives from the low success rate for trapping New Holland Mice (0.5%) and the negative results for this targeted species in the majority of the trappingsites. The overall trap success of 9.25% indicates that absence of the target species at other sites was not due to poor trapping technique or a lack of available traps. It is possible that the very favourable rainfall conditions over the last 12 months may have led to the build up of populations of this species with these individuals representing the summer cohort.

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APPENDIX 1

HABITAT ATTRIBUTES AND PHOTOGRAPHS OF SAMPLING SITES

A detailed description of the vegetation and habitat present within each of the target areas is provided below.

Target Area 1 (STA1)

This area is located to the east of the Avon North portion of the additional land disturbance area, east of the Wenham Cox Rd. The trap line (STA01A01 – STA0125) traversed the grassland/bracken fern community (Plot 1/2) from the timber windrow to the creek (bearing 340⁰) and then returned from the creek (Plot 1/3) towards the road in a parallel line (bearing 90⁰). The last few traps were located through a patch of mixed aged open Broad-leaved White Mahogany and Broad-leaved Ironbark forest (Plot 1/1).

AMG references (Zone 56):

Trap Number	Easting	Northing
STA01A01	404063	6445221
STA01A10	404019	6445275
STA01A11	404015	6445261
STA01A18	404040	6445208
STA01A25	404129	6445281



Plate 1
Target Area 1 (STA1)

Plot 1/1

Date: 2/2/11	Location: AMG Zone 56 404094E 6445195N; Altitude 174 m ; Trap nos A21-A25.
Locality description: Upper slope, near gate.	
Vegetation description: Mixed age open eucalypt forest; small semi isolated patch (20x20 m).	
Tree condition: Mostly <20 cm diameter breast height (dbh) but also 20-30 cm and 30-40 cm dbh; some small hollows in large trees, no dieback.	
Canopy projected foliage cover: 35% (>6 m).	Midstorey cover: 15%
Shrub and tree cover (pfc): <2 m - <5%; 2-4 m – 15%.	Soil: Loam.
Groundcover: 15% litter, 30% herb and fern, 50% grass cover, 5% bare ground.	
Percentage exotic flora species: 40%.	
Logs present: Nil. Rocks present: Nil. Tree hollow present: Few. Regeneration Occurring: Yes	
Fauna: Strong fox odour in this area; Red-necked Wallaby; Eastern Grey Kangaroo scats.	
Disturbance: Evidence of clearing in the surrounding area with windrow timber still present; no stock but history of grazing; no recent evidence of fire; herbaceous weeds present.	
Conservation value: Some conservation value but with significant levels of disturbance. It has the potential to regenerate or degrade depending on management.	



Plate 2
Plot 1/1

Plot 1/2

Date: 2/2/11	Location: AMG Zone 56 404063E, 6445221N; Altitude 179 m; Trap nos A1-A08; A13-A17.		
Locality description: Mid-slope grassland.			
Vegetation description: Grassland with some patches of dense bracken fern growth.			
Tree condition: NA.			
Canopy projected foliage cover: NA.		Midstorey cover: NA.	
Shrub and tree cover (pfc): NA.		Soil: Loam.	
Groundcover: 95% grass cover.			
Percentage exotic flora species: 30%.			
Logs present: Nil. Rocks present: Nil. Tree hollow present: Nil. Regeneration Occurring: No			
Fauna: Kangaroo and wallaby scats and tracks.			
Disturbance: Cleared, no current stock but evidence of past grazing. No recent evidence of fire.			
Conservation value: Highly degraded, restoration needed: potential to degrade or regenerate depending on management.			



Plate 3
Plot 1/2

Plot 1/3

Date: 2/2/11	Location: AMG Zone 56 404019E 6445275N; Altitude 169 m; Trap Nos A09-A12.		
Locality description: Lower slope, gully.			
Vegetation description: Mixed age open forest.			
Tree condition: Mixed age stand, no dieback.			
Canopy projected foliage cover: 25%.			Midstorey cover: 5%
Shrub and tree cover (pfc): <2 m – 5%, 2-4 m – 5%, 4-6 m – 10%.			Soil: Loam.
Groundcover: 50% grass, 5% herb and fern, 35% litter, 10% bare.			
Percentage exotic flora species: 20%.			
Logs present: Nil.		Rocks present: Nil.	Tree hollow present: Few.
Regeneration Occurring: Yes			
Fauna: Kangaroo and wallaby scats and tracks.			
Disturbance: No current stock but evidence of past grazing, no recent evidence of fire, herbaceous weeds common.			
Conservation value: Some disturbance, some resilience lost: cold be self sustaining with regeneration strategies.			



Plate 4
Plot 1/3

Target Area 2 (STA2)

This area is at the south-eastern extremity of the MLA, just east of the Stratford East additional land disturbance area, north of the Glen Road. The trap line initially began at the watercourse at the bottom of the hill with traps extending through bracken and grassland (Plot 2/1) about half way to the remnant vegetation at the top of the ridge. Traps from the sedges along the creek were removed after one night and replaced in two parallel lines at the top of the ridge, seven within the remnant woodland (Plot 2/3) and six in the adjacent grassland (Plot 2/2).

AMG references (Zone 56):

Trap Number	Easting	Northing
STA02 Sedge	402507	6440797
STA02B06	402649	6441127
STA02B01	402689	6441121
STA02B12	402687	6441104
STA02B13	402642	6441136
STA02B14	402543	6440815
STA02B25	402654	6440934
STA02B07	402645	6441105
STA02C07	402378	6440539

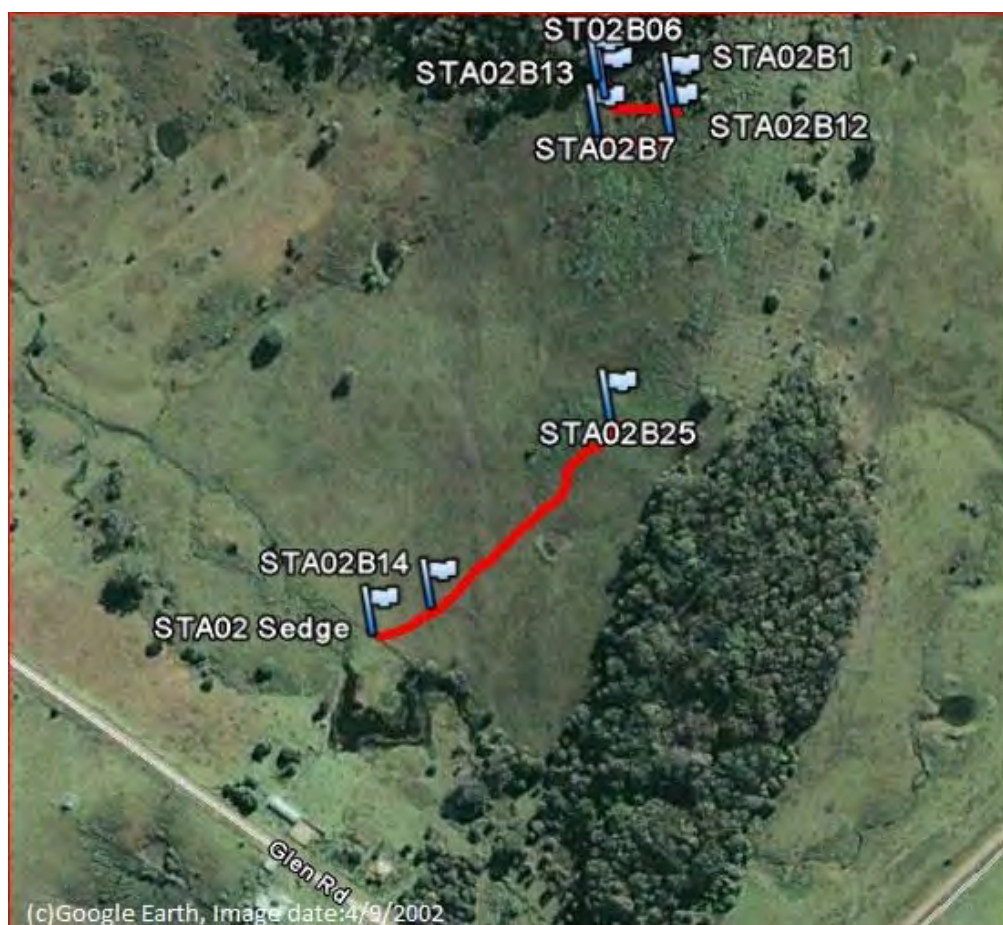


Plate 5
Target Area 2 (STA2)

Plot 2/1

Date: 3/2/11	Location: AMG Zone 56 402654E 6440934; Altitude 202 m.
Locality description: Mid-slope.	
Vegetation description: Grassy herbland with large patches of bracken fern including scattered <i>Acacias</i> , <i>Epacrids</i> , etc. within the fern patches.	
Tree condition: N/A - Upper storey cover comprised of tall shrubs and small trees	
Canopy projected foliage cover: NA	Midstorey cover: 15%
Shrub and tree cover (pfc): 5%.	Soil: Loam, some exposed cobbles, exposed rock.
Groundcover: 70% grass, 20% herb and fern, 5% bare .	
Percentage exotic flora species: 20%.	
Logs present: Nil. Rocks present: 5% rocks. Tree hollow present: Nil. Regeneration Occurring: No.	
Fauna: Nil.	
Disturbance: Cleared land, recent grazing but no stock present at the time of survey, no recent evidence of fire, herbs dominated by weed species.	
Conservation value: Degraded through clearing and grazing with significant resilience lost and no regeneration.	

**Plate 6a****Plot 2/1: Mid slope with bracken and bladey grass dominant.****Plot 6b****Plot 2/1: Mid slope with bracken and bladey grass dominant.**

Plot 2/2

Date: 3/2/11	Location: AMG Zone 56 402645E, 6441105E; Altitude 214 m.
Locality description: Cleared upper slope / ridge top adjacent to uncleared forest.	
Vegetation description: Grassy herbland with widely scattered regenerating trees and shrubs.	
Tree condition: Mostly small regrowth <20 cm dbh, <4 m in height.	
Canopy projected foliage cover: 5% cover.	Midstorey cover: 15%
Shrub and tree cover (pfc): <2 m - <5% cover.	Soil: Loam with abundant coarse gravels.
Groundcover: 45% grass, 45% herb and fern, <5% bare, < 5% litter, moss.	
Percentage exotic flora species: 10%.	
Logs present: Nil. Rocks present: 5%. Tree hollow present: Nil. Regeneration Occurring: Yes	
Fauna: Fox scats, macropod sign.	
Disturbance: Cleared land beside remnant forest, recent grazing but no stock present at the time of survey, no recent evidence of fire, herbs dominated by weed species.	
Conservation value: Degraded through clearing and grazing with significant resilience lost and no regeneration.	



Plate 7
Plot 2/2

Plot 2/3

Date: 3/2/11	Location: AMG Zone 56 402689E 6441121N; Altitude 225 m.		
Locality description: Upper slope/edge of ridge top remnant eucalypt forest.			
Vegetation description: Mature Eucalypt open forest.			
Tree condition: Mixed aged open forest; no dieback			
Canopy projected foliage cover: 25%.		Midstorey cover: 20%	
Shrub and tree cover (pfc): <2 m – 20%, 2-4 m – 20%, 4-6 m – 25%.		Soil: Loam with abundant coarse fragments (gravels).	
Groundcover: 30% grass, 25% herb and fern, 25% litter, 10% bare.			
Percentage exotic flora species: <10%.			
Logs present: 5%.	Rocks present: 5%.	Tree hollow present: Yes.	Regeneration Occurring: Yes
Fauna: Some macropod tracks and scats.			
Disturbance: Past selective logging and firewood collection, past grazing but no stock currently, no recent evidence of fire, low proportion of introduced species.			
Conservation value: High quality self regenerating and sustaining remnant which is currently little disturbed.			



Plate 8
Edge between remnant forest (Plot 2/3) and cleared grassland (Plot 2/2)

Target Area 3 (STA3)

Located south of the Glen Road and outside the MLA this trap site begins at the top on the eastern side of the gully in the forest / rainforest intergrade (Plot 3/1) and crosses the gully to the top of the western bank on a bearing of 230° . It then follows the creekline on a bearing of 210° through bracken dominated groundcover (Plot 3/2).

AMG references (Zone 56):

Trap Number	Easting	Northing
STA03C01	402434	6440554
STA03C07	402379	6440539
STA03C11	402336	6440536
STA03C25	402324	6440457
STA03C06	402389	6440544



Plate 9
Target Area 3 (STA3)

Plot 3/1

Date: 3/2/11	Location: AMG Zone 56 402434E, 6440554N; Altitude 162 m.
Locality description: Edge of steeply sloping creekline /gully.	
Vegetation description: Narrow band of mature remnant forest which was originally the intergrade between eucalypt forest and a rainforest gully which is now partly cleared and dominated by bracken fern. Eucalypt forest is now cleared grazing land. Further downstream the gully rainforest remains and contains both indicative flora and fauna.	
Tree condition: dbh varies from <20 cm to 40 cm dbh, some mistletoe and dieback.	
Canopy projected foliage cover: 30%.	Midstorey cover: 25%
Shrub and tree cover (pfc): <2 m – 20%, 2-4 m – 20%, 4-6 m – 25%.	Soil: Rocks and rock outcrops, skeletal soil.
Groundcover: 45% grass, 20% herb and fern, 10% litter, 5% bare.	
Water: Dam in creekline.	
Percentage exotic flora species: <10%.	
Logs present: <5%. Rocks present: 20%. Tree hollow present: Yes. Regeneration Occurring: Yes	
Fauna: Nil.	
Disturbance: Cleared for grazing and currently lightly stocked with cattle moving between the undulating grazing land to the dam in the creek. No recent evidence of fire, 50% introduced herbaceous species, lantana and privet.	
Conservation value: Some conservation value with significant levels of disturbance. It has the potential to regenerate or degrade depending on management.	



Plate 10
Plot 3/1

Plot 3/2

Date: 3/2/11	Location: AMG Zone 56 402336E, 6440536N; Altitude 156 m.
Locality description: North-east facing slope adjacent to cleared rainforest gully; cleared grazing land.	
Vegetation description: Bracken grassland with occasional dead Acacias above remnant rainforest in gully.	
Tree condition: NA	
Canopy projected foliage cover: NA.	Midstorey cover: 15%
Shrub and tree cover (pfc): NA	Soil: Loam.
Groundcover: 60% bracken fern, 40% blade grass to 1.5 m, litter <5%. Ground under this predominantly bare.	
Water: Dam in creek with swampy creek line.	
Percentage exotic flora species: <10%.	
Logs present: Nil. Rocks present: Nil. Tree hollow present: Nil. Regeneration Occurring: No.	
Fauna: Macropods tracks and scats, bandicoot diggings, Lace monitor (<i>Varanus varius</i>).	
Disturbance: Cleared for grazing and currently lightly stocked with cattle moving between the undulating grazing land to the dam in the creek. No recent evidence of fire.	
Conservation value: Degraded with significant loss of resilience, no regeneration except for some scattered dead Acacias. Opportunity for regeneration limited.	



Plate 11
Plot 3/2

Target Area 4 (STA4)

This site was located east of the Avon North additional land disturbance area in the north-east of the MLA, west of Wenham Cox Road and Target Area 1. The trapline of 13 traps ran from the edge of the remnant woodland (Plot 4/1) and through grassland (Plot 4/2).

AMG references (Zone 56):

Trap Number	Easting	Northing
STA04D01	403917	6445437
STA04D13	403876	6445334
STA04D02	403921	6445427
STA04D03	403920	6445419
STA04D06	403936	6445384



Plate 12
Target Area 4 (STA4)

Plot 4/1

Date: 2/2/11	Location: AMG Zone 56 403916E, 6445437N; Altitude 156 m.		
Locality description: Mid slope Eucalypt woodland close to road and gate.			
Vegetation description: Mixed aged Eucalypt woodland with grassy understorey and scattered low shrubs.			
Tree condition: Mixed open woodland; no dieback			
Canopy projected foliage cover: 15%.		Midstorey cover: 5%	
Shrub and tree cover (pfc): <2 m – 20%, 2-4 m - <5%, 4-6 m - <5%, >6 m – 15%		Soil: Loam.	
Groundcover: 50% grass, 15% herb and rush, 20% litter, 15% bare ground.			
Percentage exotic flora species: <5%.			
Logs present: <5%.	Rocks present: Nil.	Tree hollow present: Yes.	Regeneration Occurring: Yes
Fauna: Macropod scats and tracks.			
Disturbance: This is a remnant patch adjacent to cleared land. Previously grazed but not currently, no recent evidence of fire, some herbaceous weeds and bracken fern absent.			
Conservation value: Self sustaining little disturbed remnant.			



Plate 13
Plot 4/1

Plot 4/2

Date: 2/2/11	Location: AMG Zone 56 403936E, 6445386E; Altitude 161 m.
Locality description: Mid slope cleared grassland adjacent to road.	
Vegetation description: Closed grassland with occasional shrub and a few remnant trees.	
Tree condition: NA	
Canopy projected foliage cover: NA.	Midstorey cover: <5%
Shrub and tree cover (pfc): NA	Soil: Loam, no rock or gravel evident.
Groundcover: 90% grass, 5% other groundcover, 5% bare ground.	
Percentage exotic flora species: <10%.	
Logs present: Nil. Rocks present: Nil. Tree hollow present: Nil. Regeneration Occurring: Yes	
Fauna: Macropod scats and tracks	
Disturbance: Cleared, no recent evidence of fire, no evidence of recent grazing.	
Conservation value: Highly degraded and requiring restoration which has already been commenced with some single species plantings.	


	
<p align="center">Plate 14a Plot 4/2</p>	<p align="center">Plate 14b Plot 4/2</p>



Plate 15a
New Holland Mouse trapped at STA04 (Plot 4/1)



Plate 15b
New Holland Mouse trapped at STA04 (Plot 4/1)

Target Area 5 (STA5)

Target Area 5 is located at the south-western extremity of the MLA, on the northern side of the Glen Road. Due to the presence of cattle the site was located just to the east of TA5 as indicated on the map. The 12 traps in this trap line were placed in the eucalypt woodland at the edge of the cleared grazed grassland (Plot 5/1).

AMG references (Zone 56):

Trap Number	Easting	Northing
STA05D14	401590	6441180
STA05D25	401522	6441316



Plate 16
Target Area 5 (STA5)

Plot 5/1

Date: 2/2/11	Location: AMG Zone 56 401522E, 6441180N ; Altitude 180 m.
Locality description: Woodland north of Glen Rd adjacent to cleared paddock and wooded healthy road reserve.	
Vegetation description: Mixed age Eucalypt woodland.	
Tree condition: No dieback	
Canopy projected foliage cover: 10%.	Midstorey cover: 5%
Shrub and tree cover (pfc): <2 m – 5%, 2-4 m – 5%, 4-6 m 10%, >6 m – 10%.	Soil: Loam.
Groundcover: 50% grass, 30% litter, 10% bare, <5% herbs/forb/ferns.	
Percentage exotic flora species: <10%.	
Logs present: <5%. Rocks present: <5%. Tree hollow present: Yes. Regeneration Occurring: Yes	
Fauna: Some macropod tracks and scats.	
Disturbance: Rotational grazing with cattle recently removed so grass biomass low. No recent evidence of fire. General absence of exotic species.	
Conservation value: Some conservation value but with significant levels of disturbance but with the potential to regenerate with appropriate management.	



Plate 17
Plot 5/1



Plate 18
Brush-tailed Phascogale trapped at STA05

Attachment I-C: Stratford Coal Mine New Holland Targeted Survey Programme (Ecobiological)



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Stratford Coal Mine

New Holland Mouse Targeted Survey Programme

Stratford Coal Mine

New Holland Mouse Targeted Survey Programme

Report prepared for Gloucester Coal Limited

July 2011

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.

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Executive Summary

EcoBiological was commissioned by Gloucester Coal Limited to undertake a targeted survey for the New Holland Mouse (*Pseudomys novaehollandiae*) in the Gloucester Valley, New South Wales (NSW). The New Holland Mouse was listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on the 11 August 2010, but is not currently listed as a threatened species under the NSW *Threatened Species Conservation Act 1995*.

EcoBiological recorded the New Holland Mouse at the Stratford Coal Mine (Mining Lease 1360) during general fauna surveys carried out in February 2010. The species had not been previously recorded at the locality, despite many previous surveys. At the time, the closest records of the New Holland Mouse were located approximately 17 kilometres (km) south, in the Duralie Coal Mine offset area, where it was recorded by EcoBiological in February 2009. There is also a record of the species in the Department of Environment, Climate Change and Water database from 1996 near Stroud Road, approximately 21 km south.

This report documents further targeted surveys for the New Holland Mouse in the wider area around the Stratford Coal Mine, as well as one site within the Duralie Coal Mine offset area. Six survey locations were selected to target potential habitat for the New Holland Mouse. Elliot traps were used to capture the mouse.

During the targeted surveys, four New Holland Mice were recorded at a single site (Site 5) at the Stratford Coal Mine, and a single mouse was recorded within the Duralie Coal Mine offset area, where the species had previously been located. The New Holland Mouse was found in areas dominated by Bladey Grass (*Imperata cylindrica*), Bracken Fern (*Pteridium* sp.) and native grasses. The areas were subject to low grazing pressure, contained high plant species diversity and a lack of exotic plant cover.



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1. Introduction

1.1. Scope

EcoBiological was commissioned by Gloucester Coal Limited to undertake a targeted survey for the New Holland Mouse (*Pseudomys novaehollandiae*) in the Gloucester Valley, New South Wales (NSW) (Figure 1).

The objective of the targeted survey program is to investigate the occurrence of the New Holland Mouse and its habitat at various sites in the Gloucester Valley, NSW. This report outlines the methods and results of this targeted survey.

1.2. Background on New Holland Mouse

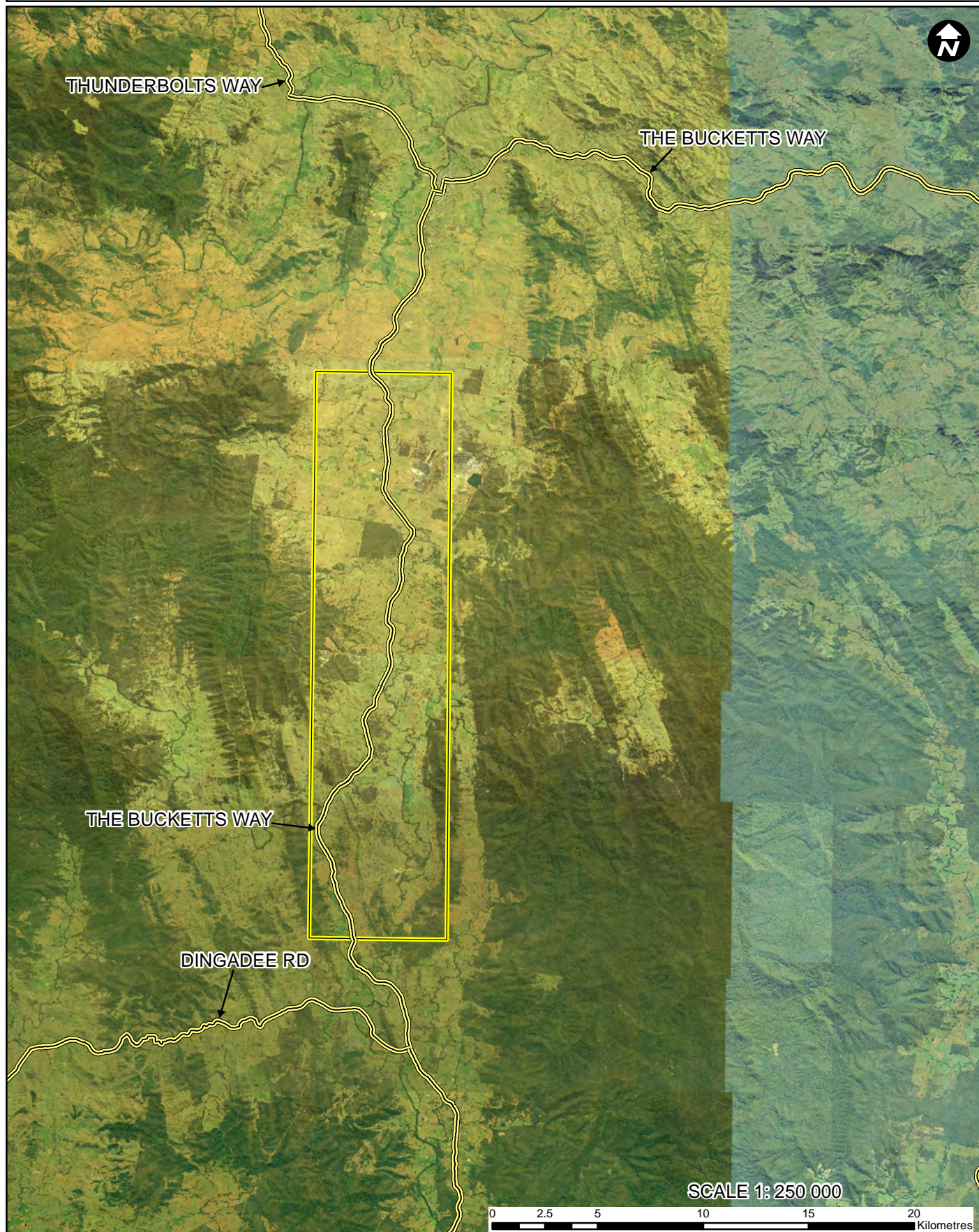
Pseudomys novaehollandiae, Family Muridae, also known as the New Holland Mouse, is a small, burrowing native rodent.

The New Holland Mouse has a fragmented distribution across the east coast of Australia, in Tasmania, Victoria, New South Wales and Queensland. The New Holland Mouse is known east of the Gloucester Valley along the coast and west to the Great Dividing Range.

The New Holland Mouse is listed as 'Vulnerable' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as the species' geographic distribution is precarious for its survival and the estimated total number of mature individuals is limited and is likely to continue to decline (TSSC, 2009). The species is not listed as threatened under the NSW *Threatened Species Conservation Act 1995*.

In other states, the species is listed as 'Endangered' under the Tasmanian *Threatened Species Protection Act 1995*, listed as 'Endangered' under the Victorian *Flora and Fauna Guarantee Act 1988* and listed as Least Concern under the Queensland *Nature Conservation Act 1992*.

Figure 1 - Location Overview



Legend / Notes

 Study Area



Map Projection:

NSW Lambert's Conformal Conic

Data Sources:

OpenStreetMap - 2010
NearMap - 2010
ecobiological - 2010

Project Ref: 245-746

Plot Date: 22/7/11

Revision: Glenn 001 V2



The Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee states:

*'The New Holland Mouse is similar in size and appearance to the introduced house mouse (*Mus musculus*), although it can be distinguished by its slightly larger ears and eyes, the absence of a notch on the upper incisors and the absence of a distinctive 'mousy' odour. The species is grey-brown in colour and its dusky-brown tail is darker on the dorsal side. The species has a head-body length of approximately 65-90 mm, a tail length of approximately 80-105 mm and a hind foot length of approximately 20-22 mm (Menkhorst and Knight, 2001).*

Specimens of the New Holland Mouse from Tasmania are larger in weight than specimens from NSW and Victoria, however head-body length and skull measurements are similar between the Tasmanian and mainland forms of the species (Hocking 1980, Lazenby, 1999).

Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes (Keith and Calaby, 1968; Posamentier and Recher, 1974; Fox and Fox, 1978; Hocking, 1980; Fox and McKay, 1981; Norton, 1987; Pye, 1991; Wilson, 1991; Lazenby et al., 2008).

The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals (Kemper, 1980; Lazenby et al., 2008). The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha (Lazenby et al., 2008; Lazenby, 1999). The species peaks in abundance during early to mid stages of vegetation succession typically induced by fire (Posamentier and Recher, 1974; Braithwaite and Gullan, 1978; Fox and Fox, 1978; Fox and McKay, 1981).'

EcoBiological recorded the New Holland Mouse at the Stratford Coal Mine (Mining Lease 1360) during general fauna surveys in February 2010. The species had not been previously recorded at the locality, despite many previous surveys. At the time, the closest records of the New Holland Mouse were approximately 17 kilometres (km) south, in the Duralie Coal Mine offset area, where the species was recorded by EcoBiological in February 2009.

A database search was undertaken using the National Parks and Wildlife Service (NPWS) Atlas of NSW Wildlife records of the New Holland Mouse across NSW. Seven records of the New Holland Mouse were evident in the Gloucester Local Government Area and lower Gloucester Valley (Table 1).



Table 1: Known closest locations of the New Holland Mouse to Stratford Coal Mine prior to this study (Atlas of NSW Wildlife, 2011)

Easting	Northing	Location	Last Date	Source
151.614	-31.681	Mernot State Forest	23/05/2008	SFR
151.74	-31.7346	Woko National Park	4/07/1976	NPWS
151.665	-31.9511	Barrington Tops State Forest	19/07/2001	SFR
151.675	-32.0592	Barrington Tops National Park	3/06/1976	NPWS
151.59	-32.0853	Barrington Tops National Park	8/06/1976	NPWS
151.451	-32.0758	Barrington Tops National Park	8/06/1976	NPWS
151.93	-32.3297	Stroud Road	31/10/1996	NPWS
151.9612	-32.2925	Duralie Offset Lands	11/04/2009	ecobiological (2009)
151.9800	-32.1324	Stratford Mine Lease	7/02/2010	ecobiological (2010)

Key: SFR: State Forest Records; NPWS: Record from previous surveys conducted by the NSW National Parks and Wildlife Service; ecobiological (2010): Flora and Fauna Survey Report: Stratford Coal Mine, Gloucester, New South Wales, December 2010; ecobiological (2009) Flora and Fauna Survey Report: Duralie Coal Mine, Gloucester, New South Wales, October 2009.



2. Methods

2.1. Sampling Sites

Six survey sites were selected across the investigation area (Figures 2 and 3). These sites were surveyed between the 27 September and the 1 October 2010 for four trap nights.

Sites 1 to 5 were located around the Stratford Coal Mine Site and Site 6 is located south of Stratford along Buckley's Range, north-east of Duralie Mine.

Table 2: Sampling site locations (A = start of transect; B = end of transect)

Site (transect)	Northing	Easting
T1A	-32.151917	151.936448
T1B	-32.150148	151.934591
T2A	-32.11864	151.974919
T2B	-32.120664	151.97365
T3A	-32.120044	151.952746
T3B	-32.118741	151.950849
T4A	-32.165389	151.959106
T4B	-32.164061	151.959161
T5A	-32.157887	151.965452
T5B	-32.160674	151.964915
T6A	-32.292499	151.961158
T6B	-32.294154	151.961978

Sites 1 and 3 were located in relatively flat grazed lands that were still subject to cattle grazing, though with some fern and bladey grass understorey cover. Site 4 was located at the top of a gully also in a paddock that was subject to grazing. Site 5 was located within re-vegetating habitat at the base of the Buckley's Range. This site had been previously burnt, though had no obvious signs of cattle grazing.

Site 2 was located within a re-vegetated waste emplacement to the west of the Bowens Road North Mine. This survey location was selected since the New Holland Mouse is known to peak in abundance during early to mid-stages of vegetation succession (Posamentier and Recher 1974; Braithwaite and Gullen 1978; Fox and Fox 1978; Fox and McKay 1981).



Site 6 was located approximately 20 km south of Stratford Mine, within the proposed Duralie Offset Area. This site is included since the New Holland Mouse was previously recorded in this location. Though adjacent to a paddock grazed by cattle, this site showed no obvious signs of cattle grazing being at the base of the rocky upslope country.

Photographs of the study sites are shown in Appendix 1. Detailed habitat assessments were undertaken at each site (see Section 2.3).

2.2. Survey Techniques

As described in Department of Environment, Water, Heritage and Arts (2010):

'the New Holland Mouse is similar in size and appearance to the introduced house mouse (Mus domesticus), although it can be distinguished by its slightly larger ears and eyes, the absence of a notch on the upper incisors and the absence of a distinctive 'mousy' odour.'

The New Holland Mouse can also be distinguished by the morphology of the soles of its feet, presence of a distinctive "pink" that is slightly darker on the dorsal side and paler on the ventral side. Females also have two pairs of abdominal nipples compared to six to eight in House Mice which also occur on the chest.'

Because of the similarity between the New Holland Mouse and the House Mice, the potential presence of the New Holland Mouse was investigated by a trapping programme.

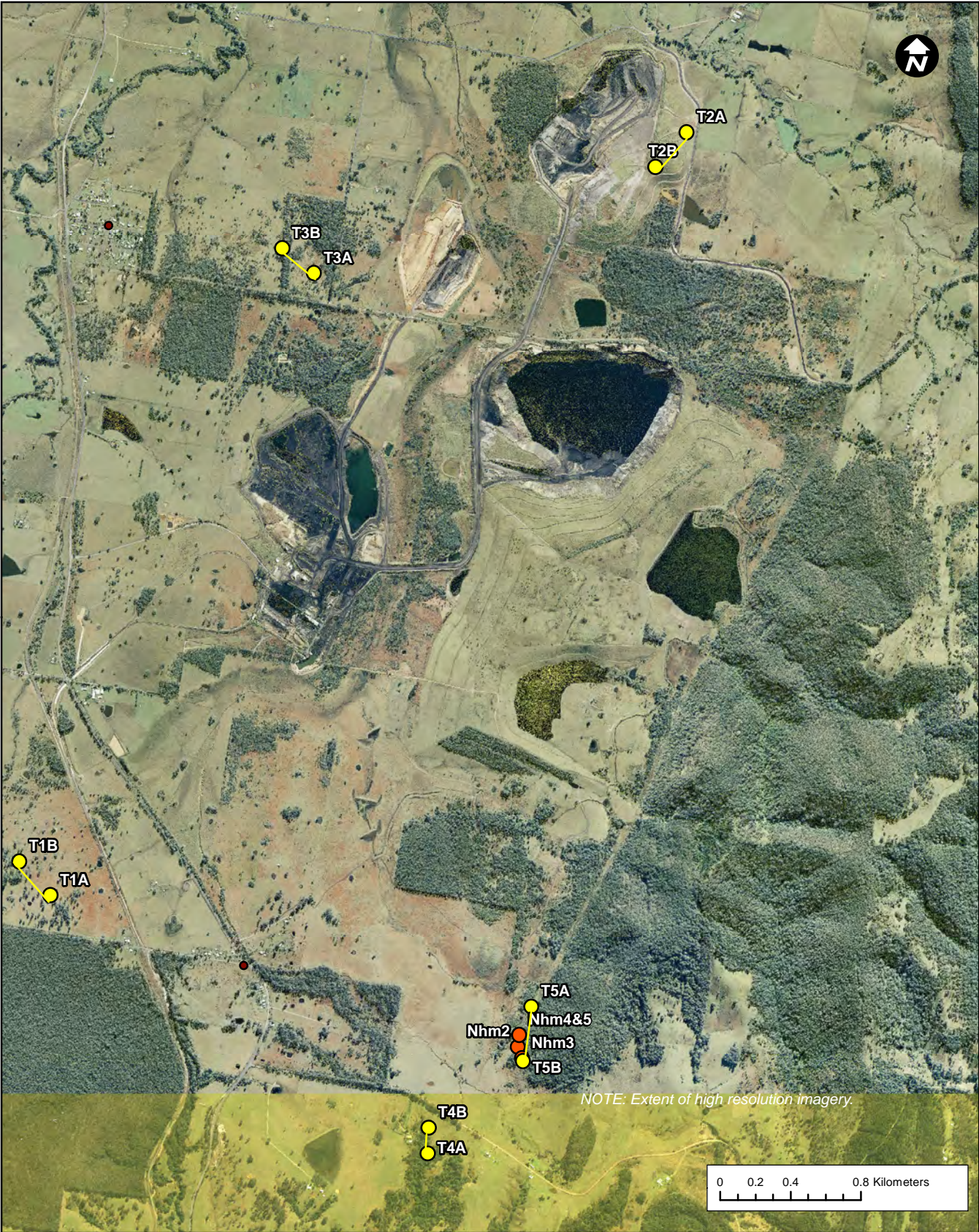
Twenty-five small Elliot traps (type A) were placed in trapping transects at each site (Sites 1 to 6). Traps were left over four consecutive nights (100 trap nights per site, equating to 600 trap nights for the programme).

The traps were baited with a mixture of peanut butter and rolled oats (Fox and Gullick, 1989) and parrot mix (Lazenby, et al. 2008). Each trap was provided with enough nesting material to keep captured animals warm, and partially covered with a stout plastic bag to keep animals dry in the event of rainfall. Any captured animals were weighed, measured and sexed and in the case of females, a determination made as to their breeding status.

Recaptured animals were recognised by the body dimensions, sex, and by the injuries to their tails which were distinctive.

A list of any fauna observed using the above methods were recorded at each site.

Figure 2 - Sampling Site Locations



Legend

- New Holland Mouse Records
- Sampling Sites



Map Projection:
NSW Lamberts Conformal Conic

Data Sources:
OpenStreetMap (10/2010)
BlueMarble (2004)
ecobiological (10/2010)

Project Ref: 245-746 Rev: 1

Plot Date: 13 OCT 2010 1400

Figure 3 - Sampling Site Locations (Duralie Offset Area)



Legend ● New Holland Mouse Records ● Sampling Sites	 survey & assessment		Map Projection: NSW Lamberts Conformal Conic
	Project Ref: 245-746 Rev: 1		Data Sources: OpenStreetMap (10/2010) BlueMarble (2004) ecobiological (10/2010)
	Plot Date: 12 OCT 2010 1736		



2.3. Habitat Assessment

At each sampling site, a habitat assessment was carried out at a 20x20m plot midway along each trapping line. The following attributes were recorded:

- Native plant diversity: The number of native plant species.
- Overstorey cover: estimate of projected foliage cover from the centre of the quadrat using Walker and Hopkins (1988) as a guide.
- Midstorey cover: estimate of projected foliage cover from the centre of the quadrat.
- Ground cover (grasses): estimate of ground cover from the centre of the quadrat.
- Ground cover (shrub): estimate of ground cover from the centre of the quadrat.
- Ground cover (other): estimate of ground cover from the centre of the quadrat.
- Exotic cover: estimate of projected foliage cover from the centre of the quadrat.
- Number of hollow trees: Tally of hollow-bearing trees in quadrat.
- Regeneration: presence/absence of overstorey regeneration; and
- Length of hollow logs: Tally of ground log length in metres.

In addition, the following habitat attributes were noted at each sampling site:

- Litter cover: estimate of ground cover from the centre of the quadrat.
- Evidence of recent fire: evidence of fire categorised into recent, intermediate and old fire events based on types and degree of fire signs.
- Evidence of recent grazing; presence and abundance of stock signs (droppings, stock presence, hoof marks); and
- Soil type: based on a categorisation into the dominant soil types, sand, loam, silt and clay.



3. Results

The results of the trapping program are shown below in Table 3. The most frequently caught species was the House Mouse (*Mus musculus*)¹ (11 individuals) with five individuals of the Bush Rat (*Rattus fuscipes*) and the New Holland Mouse. Two Black Rats (*Rattus rattus*) and one Yellow-footed Antechinus (*Antechinus flavipes*) were also caught.

Table 3: Number of individuals trapped at each sampling site (total captures in brackets)

Site No	Description	New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	Bush Rat (<i>Rattus fuscipes</i>)	Yellow-footed Antechinus (<i>Antechinus flavipes</i>)	House Mouse (<i>Mus musculus</i>) ^{1*}	Black Rat (<i>Rattus rattus</i>) [*]
1	Parkers Road West				2	
2	Mullock heap				8	1
3	Bowens Road					
4	Glenn Road Gully		5 (11)			1
5	Southern easement	4 (5)		1	1	
6	Duralie	1				
	Total	5	5	1	11	2

*Introduced species

¹All House Mice were euthanised upon capture according to the license conditions held by ecobiological.

The New Holland Mouse was recorded at two sites, #5 and #6. There were four individual New Holland Mice captured at Site 5 (Southern easement, 32.1607S; 151.9649E) with one female recaptured. One New Holland Mouse was caught at Site 6 (Duralie Offset Area, 32.2925S; 151.9612E). The approximate age, reproductive condition, snout-vent length and tail length of all New Holland Mice caught are shown in Table 4. Photographs of the caught New Holland Mice are shown in Appendix 2.

Table 4: Biological data for caught New Holland Mice

ID	Sex	Age	Weight (gms)	Snout Vent length (mm)	Tail length (mm)
New Holland Mouse (NHM1)	Male	Sub-adult	15	74.2	79
NHM2	Male	Adult	17.5	77.1	41.9*
NHM3	Female	Sub-adult	14.5	71.5	53.9*
NHM4	Male	Adult	18.1	77	80.9*
NHM5	Female	Adult	17.5	76.2	54.9*

*=tail damaged prior to capture

Three animals appeared to be of the same age cohort (NHM2, NHM4 and NHM5), with NHM1 and NHM3 being slightly smaller than the other animals caught.



The larger animals were assessed as being adult, while the younger animals have been assigned sub-adult status. None of the animals caught (either male or female) were in a reproductive state and it is likely that all animals were born during the previous summer though at different times. Tail lengths varied considerably as three animals were found to have shortened tails and damage. NHM5 had its tail bent at a 90 degrees angle with significant scarring. The tail damage was not a result of the trapping programme. None of the animals displayed any behaviour which was detrimental to their survival while being trapped. All were relatively calm while being handled and in the trap. The mice showed no apparent signs of distress when released.

3.1. Habitat Assessment Results

The New Holland Mouse was found in areas dominated by Bladey Grass (*Imperata cylindrica*), Bracken Fern (*Pteridium* sp.) (Site 5) and native grasses (Site 6). The areas were subject to low grazing pressure, contained high plant species diversity and a lack of exotic plant cover.

Table 5 reports the results of the habitat assessment undertaken at each of the sites. Also included is the site data collected from site T14, the location of a New Holland Mouse detected by **ecobiological** in February 2010. The methodology used to describe the habitat attributes was consistent across both survey periods. The three transects where New Holland Mice were detected is shaded in light grey.

Table 5: Habitat attributes for sampling sites

Attributes	1	2	3	4	5	6	T14
Northing (mid-point)	-32.1519	-32.1186	-32.1200	-32.1654	-32.1579	-32.2925	-32.1324
Easting (mid-point)	151.9364	151.9749	151.9527	151.9591	151.9655	151.9612	151.9800
Native plant diversity	12	7	10	15	28	21	27
% Overstorey cover	10	0	10	60	20	55	40
% Midstorey cover	10	60	0	80	10	15	10
% Groundcover (grasses)	80	0	72	36	42	64	86
% Groundcover (shrub)	7	0	5	16	15	5	0
% Groundcover (other)	5	10	12	25	68	10	4
% Exotic cover	10	82	14	42	7	0	4
Individual Hollows	0	0	0	1	0	0	0
Regeneration	present	present	absent	present	present	present	present
Length Hollow logs (m)	15	0	7.5	11	0	12	2.5
% Litter	12	5	8	13	21	44	20
Fire History	No sign	No sign	No sign	No sign	Recent cool Burn	Recent cool Burn	Recent cool Burn
Grazing	present	nil	present	present	nil	nil	nil
Soil	Clay /loam	Clay	Clay /loam	Clay /loam	loam	loam	loam



4. Conclusions

During the targeted surveys, four New Holland Mice were recorded at one of five surveyed sites at Stratford (Site 5 [Southern easement]) , and a single New Holland Mouse was recorded within the Duralie Coal Mine offset area where a New Holland Mouse had previously been recorded. The New Holland Mouse was found in areas dominated by Bladey Grass (*Imperata cylindrica*), Bracken Fern (*Pteridium* sp.) and native grasses. The areas where the species was captured were subject to low grazing pressure, contained high native plant species diversity and a lack of exotic plant cover.



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Appendix 1: Study Sites



Site 1: Parkers Road West



Site 2: Waste Emplacement



Site 3: Bowens Road



Site 4: Glenn Road



Site 5: Stratford Easement South



Site 6: Duralie Offset Area



Appendix 2: Pictures of Caught New Holland Mice



Plate 1: NHM1



Plate 2: NHM2



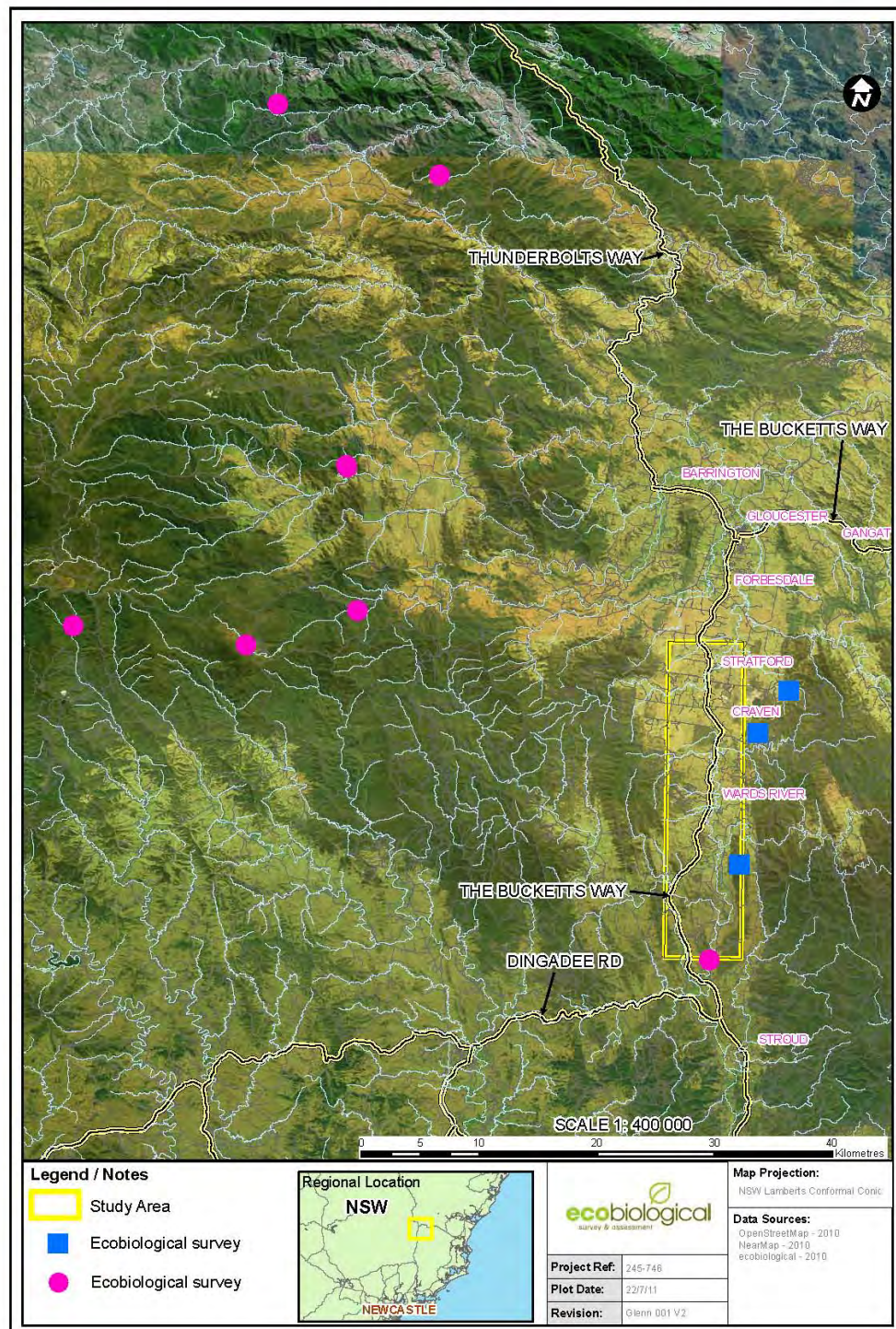
Plate 3: NHM3



Plate 4: NHM4 and NHM5



Appendix 3: Distribution of the New Holland Mouse





Appendix 4: Contributions and Qualifications of EcoBiological Staff

Name	Qualification	Title	Contribution
David Paull	B. Sc. (Masters)	Senior Ecologist	Fauna survey, animal handling, report preparation
Karen Bowland	B. Biol. Sc (Honours)	Ecologist	Fauna survey, animal handling
Luke Foster	B. Env Sc.	Ecologist	Fauna survey
Johnathan Nagy	Assoc. Dip. GIS	GIS Manager	GIS mapping
Adam Blundell	B.Env.Sc	Senior Environmental Scientist	Report review



Appendix 5: Licensing Matters Relating to the Survey

EcoBiological and employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act* 1974 (License Number: S12398, Expiry: 30 November 2010) 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.

Appendix J: Targeted surveys for arboreal mammals, EcoBiological (2011)



ecobiological

survey & assessment

Stratford Coal Mine

Arboreal Mammal Targeted Survey Programme

Stratford Coal Mine

Arboreal Mammal Targeted Survey Programme

Report prepared for Gloucester Coal Limited

July 2011

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.

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survey & assessment



Executive Summary

Ecobiological was commissioned by Gloucester Coal Limited to undertake a targeted survey for the Squirrel Glider (*Petaurus norfolcensis*) and the Brush-tailed Phascogale (*Phascogale tapoatafa*) in the Gloucester Valley, New South Wales (NSW). Both species are listed as 'Vulnerable' under the NSW *Threatened Species Conservation Act 1995*.

Ecobiological recorded both species during previous surveys of the Stratford Coal Mine (Mining Lease 1360) in 2007, 2009 and February 2010.

This report documents further targeted surveys for the Squirrel Glider and the Brush-tailed Phascogale in the wider area around the Stratford Coal Mine. Five survey locations were selected to target potential habitat for both species. A variety of detection techniques were employed including Elliott traps, pipe traps, movement sensitive cameras, nocturnal spotlight searches and call playback.

During the targeted surveys, one Squirrel Glider and one Brush-tailed Phascogale were recorded at (Site 1). A scat identified as belonging to the Brush-tailed Phascogale was also found at the same site. Neither species were recorded at Sites 2-5.

Site 1 is characterised as being a medium-sized remnant with poor external physical connectivity. It is a lowland eucalypt forest with a mixed tree association. At least five tree species are potentially used by both species at this site, namely; Cabbage Gum (*Eucalyptus amplifolia*), White Stringybark (*Eucalyptus globoidea*), Grey Gum (*Eucalyptus punctata*), Grey Ironbark (*Eucalyptus siderophloia*) and Spotted Gum (*Corymbia maculata*). This site also contains potential *Acacia* spp. and other sap-bearing tree feeding sites.

Site 2 is similar to Site 1 in terms of floristic composition and structure. It is likely that both target species are also present at Site 2 despite lack of detection during this survey. Both species are known from the area as indicated in NSW database records.

Site 3 – 5 may also provide habitat suitable for these species though all records of the Squirrel Glider from Stratford and Duralie Mine areas are from habitats similar to Sites 1 and 2. The Brush-tailed Phascogale has been previously recorded from habitat similar to Site 4 at Stratford.

Cold and wet weather conditions during the survey period may have decreased the detectability of the target species during the survey.



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1. Introduction

1.1. Scope

Ecobiological was commissioned by Gloucester Coal Limited to undertake a targeted survey for the Squirrel Glider (*Petaurus norfolcensis*) and the Brush-tailed Phascogale (*Phascogale tapoatafa*) in the Gloucester Valley, New South Wales (NSW) (herein referred to as the study area) (Figure 1). Both species are listed as 'Vulnerable' under the NSW *Threatened Species Conservation Act 1995* (TSC Act).

The objective of the targeted survey programme was to investigate the occurrence of the Squirrel Glider and the Brush-tailed Phascogale and their habitats at various sites in the Gloucester Valley, NSW. This report outlines the methods used and the subsequent results.

1.2. Background on the Squirrel Glider and Brush-tailed Phascogale

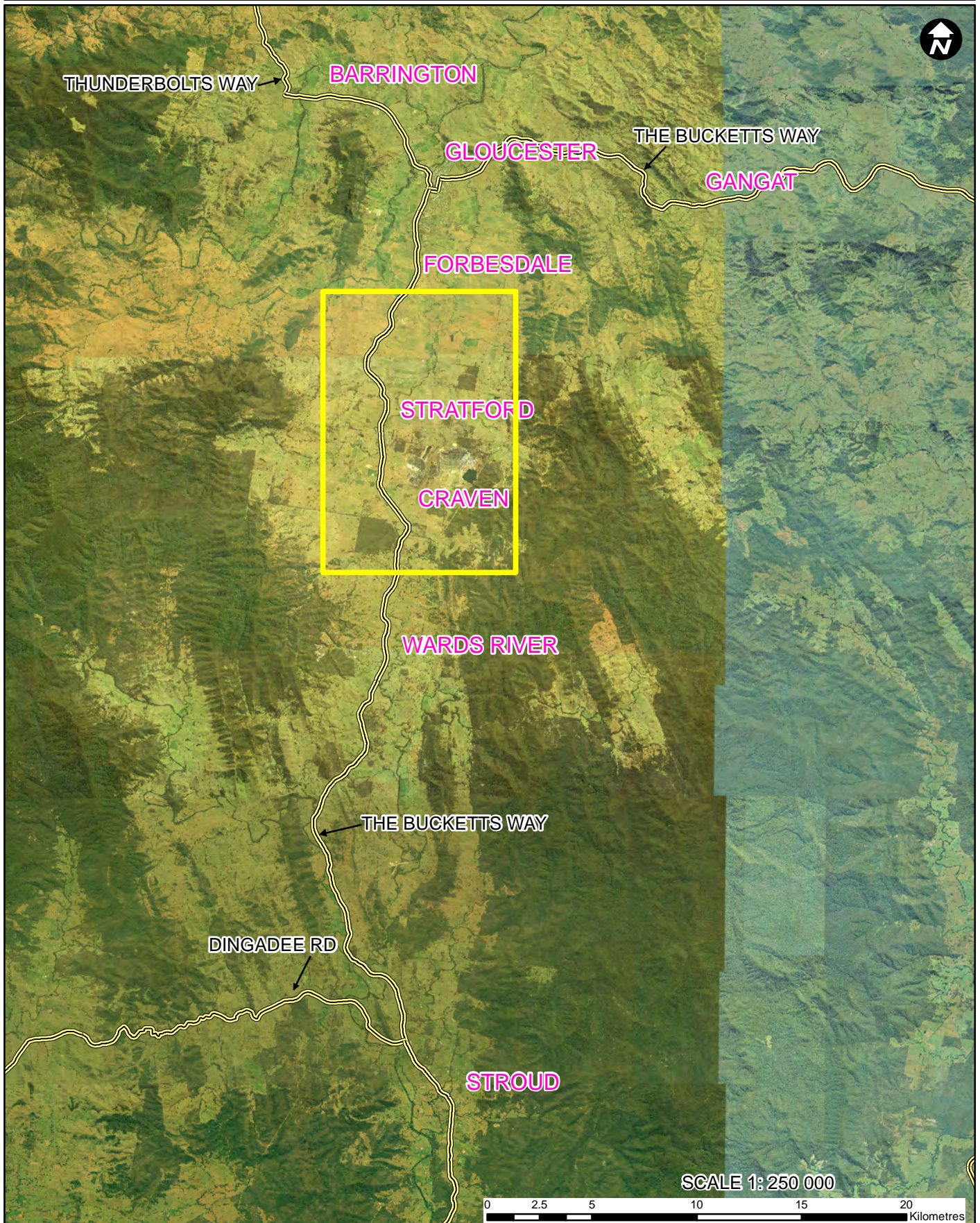
Squirrel Glider (Petaurus norfolcensis)

Petaurus norfolcensis, Family Petauridae, also known as the Squirrel Glider, is a medium-sized arboreal marsupial. It has a head and body length between 180 and 230 millimetres (mm) and a tail length between 220 and 300 mm. Its body weight ranges between 190 and 300 grams (g) with an average weight of 230 g (Van der Ree and Suckling, 2008).


The Squirrel Glider is distributed across the east coast of Australia, including Tasmania, Victoria (VIC), NSW and Queensland (QLD). It can also be found west of the Great Dividing Range. It is found throughout the Gloucester Valley from Gloucester to Stroud Road (NSW National Parks and Wildlife Service [NPWS], 2010). One record of this species has been previously recorded at one location within Mining Lease 1360 (Stratford) during surveys in 2007 (Ecobiological, in prep.).

The Squirrel Glider is listed as 'Vulnerable' under the TSC Act. There are also two endangered populations (Wagga Wagga and Barrenjoey Peninsula, north of Bushrangers Hill). It is listed as 'Endangered' in VIC (Menkhorst *et al.* 1988), while in South Australia (SA) it is known from only three records (Van de Ree and Suckling, 2008). It is regarded as common in QLD.

Figure 1 - Study Area



Legend / Notes

 Study Area



Map Projection:

NSW Lambert's Conformal Conic

Data Sources:

OpenStreetMap - 2010
NearMap - 2010
ecobiological - 2010

Project Ref: 245-746

Plot Date: 22/7/11

Revision: Glenn 001 V2



Brush-tailed Phascogale (Phascogale tapoatafa)

Phascogale tapoatafa, Family Dasyuridae, also known as the Brush-tailed Phascogale or Tuon, is a small arboreal marsupial. It has a head and body length between 140 and 260 mm and a tail length between 160 and 234 mm. Its body weight ranges between 106 and 311 g with an average weight of 230 g for males and 156 g for females. Individuals from Victoria are 20 to 30% larger than those from elsewhere (Soderquist and Rhind, 2008).

The Brush-tailed Phascogale is restricted to more-or-less coastal areas of mainland Australia, including Western Australia, SA, VIC, NSW and Qld, although in Eastern Australia it can be found west of the Great Dividing Range. It is found throughout the Gloucester Valley from Barrington to Stroud Road (NPWS, 2010). Two individuals were trapped from two locations within Mining Lease 1360 (Stratford) during 2007 (*ecobiological*, in prep.).

The Brush-tailed Phascogale is listed as 'Vulnerable' under the TSC Act.



2. Methods

2.1. Sampling Sites

Five sampling sites were selected across the study area (Table 1; Figure 2). Each sampling site was approximately 100 m in length.

Table 1: Sampling Site Locations

Site (transect)	Northing	Easting
T1A	-32.09206257	151.97559
T1B	-32.09390198	151.9760831
T2A	-32.1546204	151.9388494
T2B	-32.15591348	151.9372937
T3A	-32.16937155	151.9670008
T3B	-32.16850788	151.9682066
T4A	-32.16620411	151.9683358
T4B	-32.16657736	151.9676636
T5A	-32.16640695	152.0020846
T5B	-32.16828961	152.0017571

Note: A = start of transect; B = end of transect.

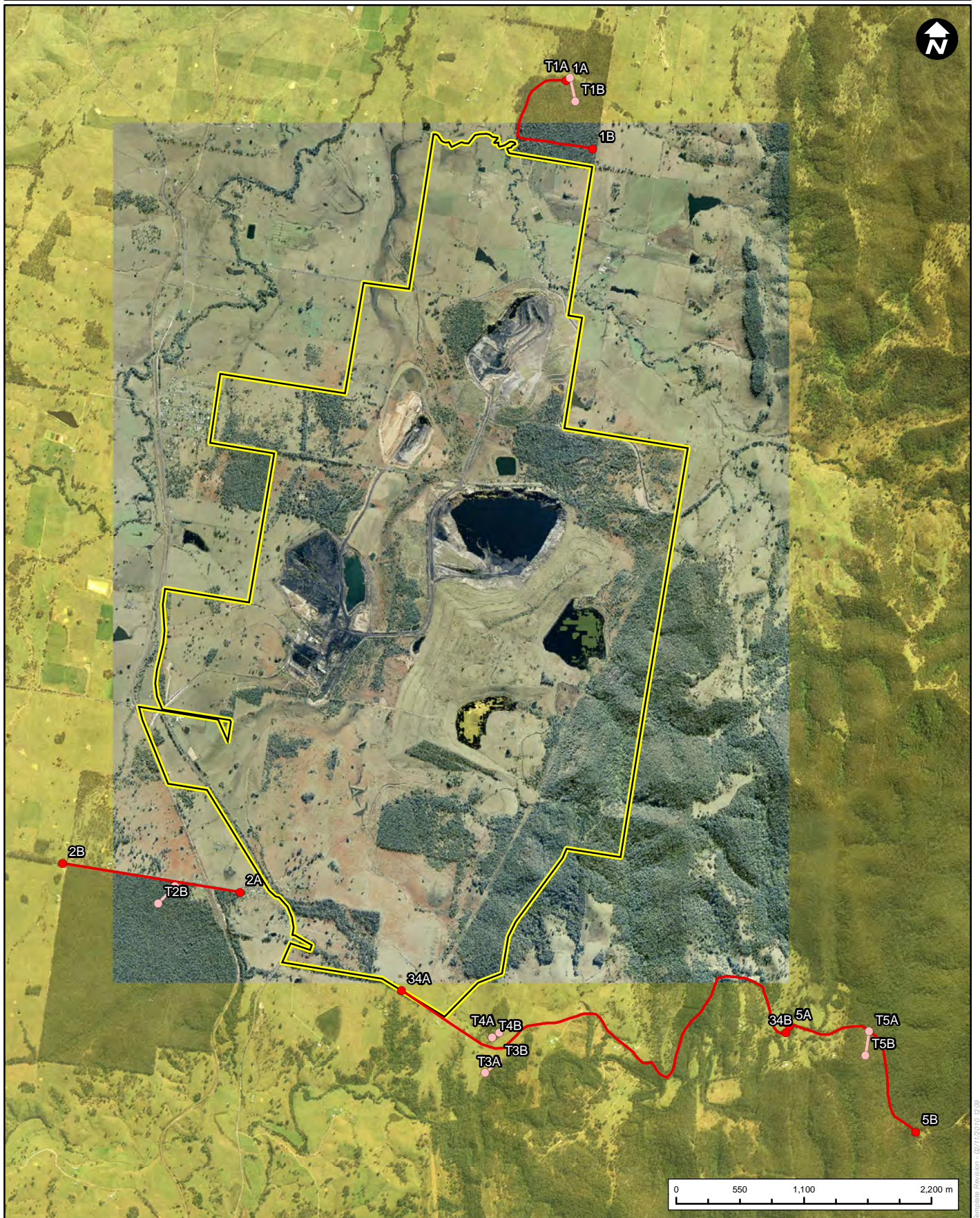
Sites 1 and 2 were located in lowland forest, subject to past grazing and logging, though now with few current anthropogenic impacts, except for low intensity grazing at Site 1.

Sites 3 and 4 were located within a few hundred metres of each other. Site 3 was located in the upper reaches of a moist gully zone, with a relatively thick, mesic understorey. Site 4 was located at the lower reaches of a low ridge on Buckley's Range, is currently grazed and the understorey was recently burnt prior to the survey.

Site 5 was located within upslope habitat within the Glenn Nature Reserve. The habitat there may be characterised as being a shrubby dry sclerophyll forest.

Photographs of the study sites are illustrated in Appendix 1. Detailed habitat assessments were undertaken at each site (see Section 3.4).

Figure 2 - Fauna survey effort



Legend / Notes

- Road Spotlight
- Sampling Transect
- Study Area



Project Ref:	245-746
Plot Date:	09/12/2010 0914
Revision:	JRN 001

Map Projection:
NSW Lamberts Conformal Conic

Data Sources:
Google Earth - 2010
NearMap - 2010
ecobiological - 2010



2.2. Survey Techniques and Effort

The potential presence of the Squirrel Glider and Brush-tailed Phascogale were investigated using a range of techniques including spotlighting, trapping, remote photography, call playback and searching for the presence of their traces and key resources. Hair tubes were not used because of animal welfare concerns regarding the potential deaths of non-target species.

All traps were checked each morning within 1.5 hours of sunrise. Nocturnal surveys were conducted between sunset and midnight.

Field surveys were conducted between the 1st and 5th of November 2010.

2.2.1. Spotlighting on Foot

At each site and the immediate surrounds, spotlighting on foot was undertaken for two hours on two nights. Walking was undertaken at approximately 1 kilometre (km)/hour. This resulted in 20 hours of spotlighting on foot.

2.2.2. Spotlighting from a Vehicle

Near each site, spotlighting from a vehicle was undertaken to target the edge of woodland patches and adjacent scattered woodland trees. The speed of the vehicle was kept to around 5 km/hour. Vehicle transects were driven over two nights.

2.2.3. Elliott Trapping

Elliott traps (Type B) were placed in suitable trees on a bracket 2 to 3 metres (m) above ground level (Plate 1). At each site, six traps were installed and left over four consecutive nights (24 trap nights per site). One hundred and twenty trap nights were utilised in this segment of the programme.

The tree traps were baited with a mixture of peanut butter, rolled oats and honey. A water honey solution was sprayed on trap trees from trap site to ground and upper tree trunk to act as an attractant. This was done each day to maximise the effect of the attractant. Each trap was provided with enough nesting material to keep captured animals warm, and partially covered with a stout plastic bag to keep animals dry in the event of rainfall. Any captured animal was weighed, measured and sexed and in the case of female captures, their breeding status was determined. Ant activity was also observed to determine if their presence was likely to adversely impact trapped animals.



2.2.4. Tree Pipe Traps

Twelve PVC tree pipe traps were used to supplement the trapping programme. These were developed by Winning and King (2008) as an alternative method to capture small gliders and to eliminate tail damage that can sometimes occur when using Elliott traps. Winning and King (2008) reported a doubling of the glider catch rate using this trapping method.

At each site, two PVC tree pipe traps were installed and left over four consecutive nights (eight trap nights per site). The trees where pipe traps were installed were sprayed with a honey/water mixture, as previously described for Elliott traps; to serve as an attractant for gliders.



Plate 1. Elliott Trap (left) and Pipe Trap (right)

2.2.5. Remote Cameras

Remote cameras (Reconyx “Hyperfire” type motion sensitive colour cameras) were set at each site, for four nights. Twenty camera nights were utilised in this segment of the programme.

The remote cameras were baited with a mixture of peanut butter, rolled oats and honey. A water honey solution was also be sprayed from the bait station to the upper tree trunk to act as an attractant.



2.2.6. Call Playback

Call playback technology was used to target the Squirrel Glider. Each session commenced with a five minute listening period, followed by spotlighting of the surrounding vegetation. The calls of the Squirrel Glider were played for three to five minutes separated by 10 minutes of listening. Following the completion of playing the Squirrel Glider calls, a further spotlight scan was made of the surrounding vegetation.

Two call playback locations were chosen at each site (at the start and the beginning of the transect). This resulted in a total of 10 call playback locations. Each location was surveyed twice over different nights.

2.2.7. Secondary Evidence

At each survey site, searches were conducted for faecal pellets on the ground. Any faecal pellets suspected to be from the Squirrel Glider or Brush-tailed Phascogale were collected for further identification. Searches were conducted for evidence of sap feeding locations on tree trunks.

2.2.8. Habitat Assessment

A rapid habitat assessment was conducted at each survey site. The following parameters were assessed:

- estimate of the density of trees with hollows (hollows per hectare [ha]);
- estimate of the average height of the hollows above ground (m);
- average tree height (m);
- list of suitable feeding tree species and an assessment of their relative abundance;
- presence/absence of flowering eucalypts;
- presence/absence of Acacias;
- presence/absence of trunk scratches;
- presence/absence of sap feeding sites;
- number of habitat layers (i.e. 1-4);
- estimate of canopy cover (%);
- estimate of midstorey cover (%);
- estimate of groundstorey cover (%);
- hollow log abundance (absent; low <8 m; moderate 8-12 m; high >12 m);



- stock usage (absent; low [old signs]; moderate [current usage at low intensity]; high [current usage at high intensity];
- patch size (ha);
- external connectivity (poor [low width, high distance], moderate [high width, low distance]; and good [high width, low distance]; and
- overall tree age.

Categories of “low”, “moderate” and “high” for hollow log abundance are based on the benchmark standards for these vegetation types (Hunter-Macleay Dry Sclerophyll Forests), as identified in the BioMetric benchmark database (DECC 2009).

Using these data, a judgement was made as to the condition and dynamics (whether habitat values were more-or-less stable, improving or worsening) of these habitats for each of the target species.

2.2.9. Opportunistic Observations

A list of any fauna observed using the above methods was recorded for each site. The purpose of this list is to demonstrate that the methods were successful in recording other species, if not the target species.



3. Results

3.1. Weather at the Time of the Survey

Weather at the time of the survey ranged from fine to wet and cool conditions (Table 2). Despite widespread rainfall in the region at the time of the surveys, there was little or no wind at the time of the survey. The moon phase at the time of survey was in the last quarter coming into the full moon on the 6th of November. However, at the time of the nocturnal surveys, the moon was not present due to its rising during the early hours of the morning.

Lostock weather station is some 50 km to the south-west of the study area.

Table 2: Weather Conditions at Lostock Station

Day	Temperature (°C)		Rainfall (mm)	Evaporation (mm)	Wind (1-8)*	% Cloud cover*	Moon rise	Moon set
	Min.	Max.						
1/11/10	-	21.9	-		0	50	2.50	14.15
2/11/10	11.4	21.5	56	19.2	0	40-60	3.22	15.26
3/11/10	10.2	25.0	0	4.0	0	0	3.53	16.37
4/11/10	12.0	16.2	0	3.2	0	50	4.25	17.39
5/11/10	11.6	-	9.4	3.4	0	100	4.59	19.02

*At the time of nocturnal surveys

Source: Bureau of Meteorology (2010); Museum of Victoria Planetarium (2010)

°C = Degrees Celsius.

3.2. Arboreal Fauna Detected

Both the Squirrel Glider and the Brush-tailed Phascogale were recorded during the survey (Table 3; Figure 3). A single female Squirrel Glider was trapped in arboreal Elliott traps mounted in Grey Ironbark (*Eucalyptus siderophloia*) while a single Brush-tailed Phascogale was observed during foot spotlight searches in a White Stringybark tree. A scat belonging to the Brush-tailed Phascogale was also detected at Site 1 and confirmed by the identification of hairs (see Plate 3 in Appendix 2).

The results of the trapping and spotlight programme for all arboreal species are shown below in Table 3. The most frequently detected species was the Common Brushtail Possum (*Trichosurus vulpecula*) with 11 individuals detected. No possums were trapped though possums were recorded by the camera on two separate nights. These recordings may have been of the same individual.



Table 3: Arboreal Fauna Species Detected at each Sampling Site (Trapping, Spotlighting & Calls)

Species	Sampling Site					Detection Method
	1	2	3	4	5	
	Northern Block	Craven Block	Gully, Glenn Road	Southern edge of escarpment	The Glenn NR	
Squirrel Glider (<i>Petaurus norfolcensis</i>)	1					Trapped
Sugar Glider (<i>Petaurus breviceps</i>)		1				Trapped
Yellow-bellied Glider (<i>Petaurus australis</i>)					2	Observation/calls
Common Brushtail (<i>Trichosurus vulpecula</i>)	2	3		3#	3	Observation and camera
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	1*					Observation and scat
Koala (<i>Phascolarctos cinereus</i>)		1			2	Observation/calls
Total No. of Species	3	3	0	1	3	

does not include two separate recordings on the camera at Site 4

*does not include scat found at Site 1.

Koalas (*Phascolarctos cinereus*) were recorded at two sites (Sites 2 and 5) (Table 3; Figure 3). A Koala was detected at Site 2 on consecutive nights. Whether or not this was the same individual could not be determined. Koalas were detected on consecutive nights at Site 5 (one by spotlighting and the second individual other by calls).

Two Yellow-bellied Gliders (*Petaurus australis*) were detected by observation and by call identification at Site 5 (Table 3; Figure 3).

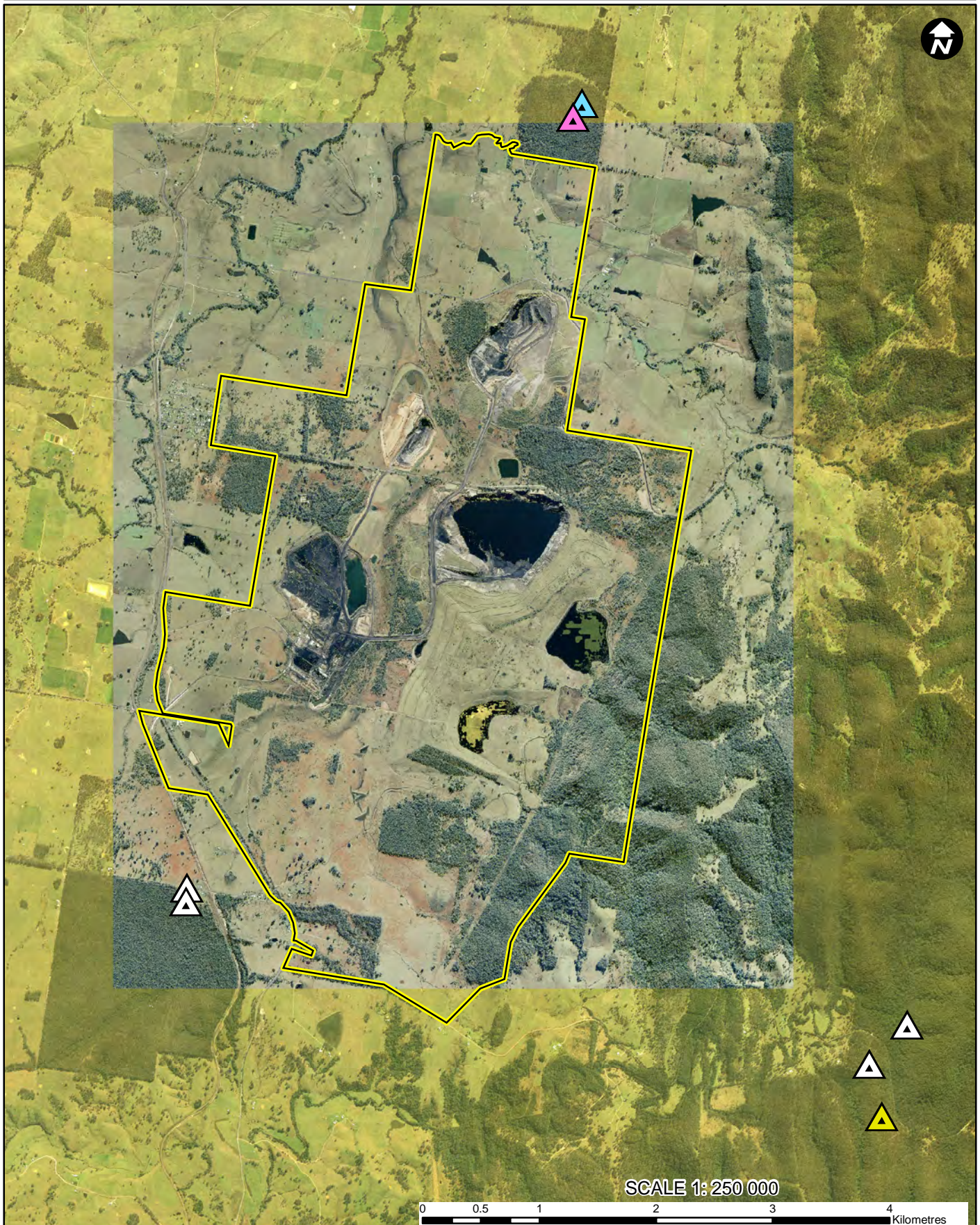
No animals were trapped in pipe traps. No responses were given to call playbacks.

The biological data for the two petaurids caught during the survey are presented in Table 4.

Table 4: Biological Data for Captured Gliders

Species	Sex	Age	Weight (g)	Snout Vent length (mm)	Tail Length (mm)
Squirrel Glider	Female	Adult	211	200	240
Sugar Glider	Female	Sub-adult	93	160	160

Figure 3 - Threatened fauna species locations



Legend / Notes

- Study Area
- ▲ Yellow-bellied Glider
- ▲ Koala
- ▲ Brush-tailed Phascogale
- ▲ Squirrel Glider



Project Ref:	245-746
Plot Date:	09/12/2010 0713
Revision:	JRN 001

Map Projection:

NSW Lambert's Conformal Conic

Data Sources:

Google Earth - 2010
NearMap - 2010
ecobiological - 2010



3.3. Other Fauna Detected

Details of other mammal and bird species recorded during the survey are listed in Table 5, while Table 6 lists the reptile and amphibian species recorded during the survey. Six non-arboreal mammals (two bandicoots, three species of macropod and a Water Rat) were detected during nocturnal surveys at the sampling sites (Table 5). Three nocturnal birds were detected by observations and call identification (Table 5).

Table 5: Other Mammal and Bird Species Detected

Species	Sampling Site						Detection method
	1	2	3	4	5	Opportunistic	
Northern Brown Bandicoot (<i>Isodon macrourus</i>)	X	X	X				Observed
Long-nosed Bandicoot (<i>Perameles nasuta</i>)				X	X		Observed
Eastern Grey Kangaroo (<i>Macropus giganteus</i>)	X						Observed
Red-necked Wallaby (<i>Macropus rufogriseus</i>)			X				Observed
Red-necked Pademelon (<i>Thylogale thetis</i>)					X		Observed
Water Rat (<i>Hydromus chrysogaster</i>)						X	Observed
Tawny Frogmouth (<i>Podargus strigoides</i>)	X						Observed
Owlet Nightjar (<i>Aegotheles cristatus</i>)	X	X					Call identification
Boobook Owl (<i>Ninox novaeseelandiae</i>)	X						Call identification
Total No. of Species	5	2	2	1	2	1	

One reptile and 14 frogs were detected during nocturnal surveys of the sampling sites (Table 6). All frogs were detected using a combination of observation and call identification. An unconfirmed record of one threatened species, the Giant Barred Frog, was heard calling from a permanent creek in the Glenn Nature Reserve (near Site 5) (Figure 2). A photograph of the habitat associated with the creek is given in Appendix 1. A frog call suspected to be of the Giant Barred Frog was heard 100-200 m from Site 5.



Table 6: Reptile and Amphibian Species Detected

Species	Sampling Site					Detection method
	1	2	3	4	5	
Small-eyed Snake (<i>Rhinoplocephalus nigrescens</i>)	X		X			Observed
Giant barred Frog (<i>Mixophyes iteratus</i>)*					X	Call identification
Great Barred Frog (<i>Mixophyes fasciolatus</i>)				X		Call identification
Red-backed Toadlet (<i>Pseudophryne coriacea</i>)					X	Call identification
Common Froglet (<i>Crinia signifera</i>)		X	X	X		Call identification
Whirring Tree Frog (<i>Litoria revelata</i>)				X	X	Call identification
Spotted Grass Frog (<i>Limnodynastes tasmaniensis</i>)	X	X	X	X		Observed
Striped Marsh Frog (<i>Limnodynastes peronii</i>)		X		X		Observed
Bleating Tree Frog (<i>Litoria dentata</i>)	X					Call identification
Peron's Tree Frog (<i>Litoria peronii</i>)			X	X	X	Observed
Tyler's Tree Frog (<i>Litoria tyleri</i>)				X		Call identification
Red-eyed Tree Frog (<i>Litoria chloris</i>)					X	Call identification
Reed Frog (<i>Litoria fallax</i>)			X	X	X	Observed
Forest Toadlet (<i>Uperoleia fusca</i>)				X		Observed
Tusked Frog (<i>Adelotus brevis</i>)				X		Call identification
Total No. of Species	3	3	5	10	6	

* unconfirmed record and warrants verification.

3.4. Habitat Assessment Results

The habitat attributes of all the sites are presented in Table 7.



Table 7: Habitat Attributes for Sampling Sites

Attributes	Sampling Site				
	1	2	3	4	5
Density of trees with hollows (per ha)	16	14	20	25	10
Average height of hollows above ground (m)	10-15	10-15	10-20	10-15	10-15
Average tree height (m)	25	25	30	20	25
Suitable feeding tree species	<i>C. maculata</i> <i>E. amplifolia</i> <i>E. acmenoides</i> <i>E. globoidea</i> <i>E. punctata</i> <i>E. siderophloia</i>	<i>C. maculata</i> <i>E. amplifolia</i> <i>E. acmenoides</i> <i>E. globoidea</i> <i>E. punctata</i> <i>E. siderophloia</i>	<i>C. maculata</i> <i>E. carnea</i> <i>E. punctata</i> <i>E. fibrosa</i> <i>E. tereticornis</i> <i>E. saligna</i>	<i>C. maculata</i> <i>E. carnea</i> <i>E. punctata</i> <i>E. fibrosa</i> <i>E. tereticornis</i>	<i>C. maculata</i> <i>E. carnea</i> <i>E. propinqua</i> <i>E. tereticornis</i> <i>E. resinifera</i>
Flowering Eucalypts	limited	limited	limited	limited	limited
Acacia spp	Common	present	present	present	present
Trunk scratches	present	present	present	present	present
Sap feeding sites	present	present	present	present	present
Number of habitat layers	3	3	3	3	4
Canopy cover (%)	60	60	70	70	50
Midstorey cover (%)	0	0	30	20	30
Groundstorey cover (%)	90	90	90	50	90
Hollow Log abundance	Moderate	Moderate	High	Low	Moderate
Stock usage	low	absent	moderate	moderate	absent
Patch size (ha)	79	238	>500	4.5	>500
External connectivity	poor	poor	good	moderate	good
Overall tree age*	Mixed	Mixed	old	old	intermediate
Habitat condition	Good	Good	Good	Moderate	Good
Habitat dynamics	Rehabilitating	Rehabilitating	Climax	Disturbed understorey	Maturing

* Tree age: Mixed = mixture of young and mature trees; Intermediate = overall age not yet mature; Old = climax tree age

Key to tree species:

<i>Corymbia maculata</i>	Spotted Gum
<i>Eucalyptus acmenoides</i>	White Mahogany
<i>Eucalyptus amplifolia</i>	Cabbage Gum
<i>Eucalyptus carnea</i>	Thick-leaved Mahogany
<i>Eucalyptus fibrosa</i>	Red Ironbark
<i>Eucalyptus globoidea</i>	White Stringybark
<i>Eucalyptus propinqua</i>	Small-fruited Grey Gum
<i>Eucalyptus punctata</i>	Grey Gum
<i>Eucalyptus resinifera</i>	Red Mahogany
<i>Eucalyptus saligna</i>	Sydney Bluegum
<i>Eucalyptus siderophloia</i>	Grey Ironbark
<i>Eucalyptus tereticornis</i>	Forest Redgum



The Squirrel Glider and the Brush-tailed Phascogale were only detected at Site 1, therefore, the data from this site is compared to the other sites.

Site 1 is characterised as being a mixed association eucalypt forest with six suitable feeding tree species present, possessing virtually no mid-storey and a developed mixed shrubby/grassy understorey. The vegetation encountered at Site 2 was the same association and topographic position.

The density of hollows at both these sites was not high (between 14 and 16 per ha). This is a reflection of the historic use of these remnant areas, with widespread signs of past tree removal. This density estimate is roughly equivalent to the density of large trees. The height of hollows was approximately the same at all sites.

The age of the trees was mixed in both Sites 1 and 2. The patches both contained many young regenerating trees, an artifact of historic tree removal.

All sites had limited eucalypt flowering, though some of the ironbarks and stringybarks were in flower. Trees where animals were trapped in Sites 1 and 2 were both flowering (Grey Ironbark [*E. siderophloia*] at Site 1 and White Stringybark [*E. globoidea*] at Site 2). It was difficult to ascertain the peak flowering times for these tree species, as anecdotal observations of different areas of the Stratford area over the last year has shown very little flowering.

Trunk scratches were detected at all sites, particularly on the smooth-barked trees, in particular Grey Gums (*E. punctata*), Spotted Gums (*C. maculata*) and Cabbage Gums (*E. amplifolia*). Most of these scratches can be attributed to the Brushtail Possums and it is difficult to distinguish between these and other species (ie. Koalas and gliders). Small scratch marks, most likely attributable to gliders, were observed on all three smooth-barked trees recorded at Sites 1, 2 and 5.

Sap-producing tree species at the sites were generally found to be the Spotted Gum (*C. maculata*). This species was found at all sites and is widely distributed in the Gloucester Valley region. However, no sap-feeding sites were noticed as being used by arboreal mammals (ie. no signs of scratch marks near exuding sap locations). All sites also had Acacias present of various species, though Sites 1 and 2 had the most Acacias, generally *Acacia ulicifolia*. Acacias are recognised sap food trees for petaurids (Sharpe and Goldingay, 2006; Suckling, 2008).



There was a lot of variation in the patch size and landscape connectivity between the sites. The two sites where petaurids were trapped, were moderately sized remnants but with a low level of physical connectivity with other remnant areas.

In relation to habitat condition and dynamics of the sites in terms of habitat preferences of the two target species, the following may be summarised.

A chief determinant of habitat suitability for the Squirrel Glider is the presence of suitable hollow-bearing trees and availability of feeding sites (Menkhorst *et al.* 1988). All sites surveyed had average or high numbers of hollows in terms of benchmark standards for these vegetation types. Sites 1 and 2 show signs of historic logging activity, and although having a mixed tree age, levels of hollow density currently at these sites would seem to be sufficient to support the use of this remnant by Squirrel Gliders. Site 1 has a poor level of habitat connectivity with other remnant habitat yet the glider was detected here, indicating an ability to traverse areas of low tree cover and use linear strips (Van der Ree, 2002). Trees at Sites 1 and 2 also tend to grow straight and tall, which may promote hollow development or habitat structure favoured by this species. In time, as hollow recruitment at Site 1 and 2 improves, these areas will become more important for the local arboreal fauna including the Squirrel Glider. The understorey at these two sites was a mixed grassy/shrubby composition, with scattered mid-storey high wattles and native cherry, potential sap feeding sites were most numerous at Sites 1 and 2.

For the Brush-tailed Phascogale, its preference for mature trees (including dead trees) and relatively open understorey were conditions found at Sites 1 and 2.

Site 3 is a mature forest community with habitat apparently suitable for both target species, however, the main difference between this site and Sites 1 and 2 is the presence of thick mid- and understorey vegetation. Thick understorey vegetation is not favoured by the Brush-tailed Phascogale, which spends considerable time on the ground (Soderquist and Rhind 2008). For the Squirrel Glider, the types of understorey at Site 3 are a more mesic and may not be suitable food species. However, the low sampling effort in this vegetation type does not preclude the possible use of gullies by either species and further sampling is required to assess the mammal diversity in wet gullies.



Though a mature tree community, the condition of the understorey at Site 4 may have been a critical factor. Recent burning has eliminated much of the understorey and may also have affected invertebrate activity, perhaps lessening the suitability of habitat here for both species. This may be only a temporary effect as the understorey habitats mature. This site also recorded the most number of Brushtail Possums which may also increase competition for nesting sites.

Site 5, was habitat in good condition (little disturbance), though with the trees at the site itself being relatively immature on average, hollow availability was the lowest of all the sites. The understorey here was relatively thick and shrubby, habitats not favoured by the Brush-tailed Phascogale. However, again, more sampling in this forest type is required to fully assess its fauna diversity.



4. Conclusions

During the targeted surveys, one Squirrel Glider and one Brush-tailed Phascogale were recorded at one site (Site 1) of five surveyed sites. A scat identified as belonging to the Brush-tailed Phascogale was also found at the same site.

Site 1 is characterised as being a medium-sized remnant with poor external physical connectivity. It is a lowland mixed association eucalypt forest of a mixed age growth. At least five tree species are probably used by these species for their resources at this site, namely; Cabbage Gum (*Eucalyptus amplifolia*), White Stringybark (*Eucalyptus globoidea*), Grey Gum (*Eucalyptus punctata*), Grey Ironbark (*Eucalyptus siderophloia*) and Spotted Gum (*Corymbia maculata*). This site also contains potential *Acacia* and other sap-bearing tree feeding sites.

Site 2 is virtually identical to Site 1 in terms of floristic composition and structure, and it is likely that both target species are also present at Site 2 despite lack of detection during this survey.

Site 3 – 5 may also provide habitat suitable for these species though all records of the Squirrel Glider from Stratford and Duralie Mine areas are from habitats similar to Sites 1 and 2. The Brush-tailed Phascogale has been previously recorded from habitat similar to Site 4 at Stratford.

Cold and wet weather conditions as well as lack of moonshine during the time of the survey may have decreased the detectability of the target species.



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Appendix 1: Study Sites



Site 1: Northern Block



Site 2: Craven Block



Site 3: Gully Site, Glenn Road



Site 4: Southern edge of escarpment



Site 5: The Glenn Nature Reserve



Wards River flowing out of The Glenn Nature Reserve (same creek where *Mixophyes iteratus* was possibly detected)



Appendix 2: Fauna Photographs



Plate 1: Squirrel Glider (Site 1)



Plate 2: Sugar Glider (Site 2)



Plate 3: Phascogale scat (Site 1)



Plate 4: Common Brushtail Possum captured on camera (Site 4)



Appendix 3: Threatened Species Locations

Name	Location	Lat	Long
Koala	Craven Block	-32.16843345	152.0016558
Koala	Craven Block	-32.16543177	152.0051385
Koala	Glenn NR	-32.15432385	151.9398297
Koala	Glenn NR	-32.15537419	151.9397437
Yellow-bellied Glider	Glenn NR	-32.17249784	152.0027508
Brush-tailed Phascogale	Northern Block	-32.09401376	151.9764124
Squirrel Glider	Northern Block	-32.09507367	151.9755652



Appendix 4: Contributions and Qualifications of EcoBiological Staff

Name	Qualification	Title	Contribution
David Paull	M.Sc	Senior Ecologist	Fauna and habitat survey, animal handling, report preparation
Kim Stephan	B.Sc (Hons)	Ecologist	Fauna survey, animal handling
Luke Foster	B. Env Sc.	Ecologist	Fauna survey
Johnathan Nagy	Assoc. Dip. GIS	GIS Manager	GIS mapping
Adam Blundell	B.Env.Sc	Principal Environmental Scientist	Report review



Appendix 5: Licensing Matters Relating to the Survey

ecobiological and employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act 1974* (License Number: S12398, Expiry: 30 November 2010) 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.

Additional approval from DECCW (Gloucester Office) was obtained to survey for arboreal fauna in the Glenn Nature Reserve.

Appendix K: List of threatened fauna species and survey methods

A number of threatened species listed under the TSC Act and EPBC Act were identified as known or with potential to occur within the study area and surrounds based on the results of database searches (see Section 3.1). The survey methods used and the species that were targeted by these methods are indicated in the table below.

Scientific Name	Common Name	Conservation Status ¹		Survey Method
		TSC Act	EPBC Act	
Amphibians				
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Nocturnal transects, tadpole surveys and call playback (Appendix F).
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	Nocturnal survey and call playback (Appendix H).
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	Searches, call playback and tadpole surveys (Appendices F and H).
<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	Nocturnal transects, tadpole surveys and call playback (Appendix F).
<i>Litoria daviesae</i>	Davies' Tree Frog	V	–	Tadpole surveys, call playback, and nocturnal searches (Appendix F).
Reptiles				
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Habitat search and spotlighting (Appendix F).
<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V	–	Habitat search and spotlighting (Appendix F).
Birds				
<i>Anseranas semipaimata</i>	Magpie Goose	V	–	Avifauna census near water bodies (Appendix F).
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	–	Avifauna census near water bodies (Appendix F).
<i>Botaurus poiciloptulis</i>	Australasian Bittern	V	E	Avifauna census near water bodies (Appendix F).
<i>Circus assimilis</i>	Spotted Harrier	V	–	Avifauna census (Appendix F).
<i>Hieraaetus morphnoides</i>	Little Eagle	V	–	Avifauna census (Appendix F).
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	–	Avifauna census and call playback (Appendix F).
<i>Irediparra glalinacea</i>	Comb-crested Jacana	V	–	Avifauna census (Appendix F).
<i>Turnix maculosus</i>	Red-backed Button-quail	V	–	Avifauna census (Appendix F).
<i>Rostratula australis</i>	Australian Painted Snipe	E	V	Avifauna census near water bodies (Appendix F).
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V	–	Avifauna census (Appendix F).
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V	–	Avifauna census (Appendix F).
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V	–	Avifauna census (Appendix F).
<i>Calyptorhynchus lathami</i>	Glossy Black-cockatoo	V	–	Avifauna census, habitat search (Appendix F).
<i>Callocephalon</i>	Gang-gang Cockatoo	V		Avifauna census (Appendix F).

Scientific Name	Common Name	Conservation Status ¹		Survey Method
		TSC Act	EPBC Act	
<i>fimbriatum</i>				
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	V	–	Avifauna census (Appendix F).
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	–	Avifauna census (Appendix F).
<i>Neophema pulchella</i>	Turquoise Parrot	V	–	Avifauna census (Appendix F).
<i>Lathamus discolor</i>	Swift Parrot	E	E	Avifauna census (Appendices F and G).
<i>Tyto tenebricosa</i>	Sooty Owl	V	–	Avifauna census, call playback and spotlighting (Appendix F).
<i>Tyto novaehollandiae</i>	Masked Owl	V	–	Avifauna census, call playback and spotlighting (Appendix F).
<i>Tyto capensis</i>	Grass Owl	V	–	Call playback (Appendix F).
<i>Ninox strenua</i>	Powerful Owl	V	–	Avifauna census, call playback and spotlighting (Appendix F).
<i>Ninox connivens</i>	Barking Owl	V	–	Avifauna census, call playback and spotlighting (Appendix F).
<i>Atrichornis rufescens</i>	Rufous Scrub-bird	V	–	Avifauna census (Appendix F).
<i>Climacteris picumnus</i>	Brown Treecreeper	V	–	Avifauna census (Appendix F).
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	V	–	Avifauna census (Appendix F).
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E	Avifauna census (Appendices F and G).
<i>Epthianura albifrons</i>	White-fronted Chat	V	–	Avifauna census (Appendix F).
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	–	Avifauna census (Appendix F).
<i>Petroica phoenicea</i>	Flame Robin	V	–	Avifauna census (Appendix F).
<i>Petroica boodang</i>	Scarlet Robin	V	–	Avifauna census (Appendix F).
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	V	–	Avifauna census (Appendix F).
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	–	Avifauna census (Appendix F).
<i>Pachycephala olivacea</i>	Olive Whistler	V	–	Avifauna census (Appendix F).
<i>Coracina lineata</i>	Barred Cuckoo-shrike	V	–	Avifauna census (Appendix F).
<i>Stagonopleura guttata</i>	Diamond Firetail	V		Avifauna census (Appendix F).
Mammals				
<i>Dasyurus maculatus maculatus (SE mainland population)</i>	Spotted-tailed Quoll	V	E	Spotlighting, cage traps, scats and hair tubes in trees and on ground (Appendix F).
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	–	Hair tubes, Elliot traps and scats (Appendix F).
<i>Planigale maculata</i>	Common Planigale	V	–	Hair tubes (Appendix F); Elliot traps, which have been known to detect this species on occasion*, were also used

Scientific Name	Common Name	Conservation Status ¹		Survey Method
		TSC Act	EPBC Act	
				(Appendix F).
<i>Phascogale carolinensis</i>	Koala	V	–	Call playback, spotlighting, SAT habitat characterisation and secondary evidence (Appendix F).
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	–	Spotlighting, hair tubes, Elliot traps (Appendix F).
<i>Petaurus australis</i>	Yellow-bellied Glider	V	–	Spotlighting, hair tubes, call playback, Elliot traps and scats (Appendix F).
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	–	Spotlighting, hair tubes, call playback, Elliot traps and scats (Appendix F).
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V	–	Cage traps, scats and hair tubes (Appendix F).
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	V	V	Scats and hair tubes (Appendix F).
<i>Macropus parma</i>	Parma Wallaby	V	–	Hair tubes, scats and opportunistic observations (Appendix F).
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Hair tubes, scats and opportunistic observations (Appendix F).
<i>Thylogale stigmatica</i>	Red-legged Pademelon	V	–	Hair tubes, scats and opportunistic observations (Appendix F).
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Identification of roosting habitat and spotlighting (Appendix F).
<i>Pseudomys novahollandiae</i>	New Holland Mouse	–	V	Elliot traps (Appendices F and I).
<i>Pseudomys oralis</i>	Hastings River Mouse	E	E	Hair tubes, Elliot traps (Appendix F).
Various threatened bats		various	various	Anabat detecting, harp traps and spotlighting (Appendix F).

* Note: the only record of the species within a 25 km radius of the Project area is from a capture in an Elliot trap at the Duralie Mine Site, 20 km south of the Project area.

¹ Threatened fauna species status under the TSC Act and/or EPBC Act (current as at 16 February 2012).

V = Vulnerable, E = Endangered, CE = Critically Endangered