ENVIRONMENTAL ASSESSMENT

Duralie Extension Project

APPENDIX E
TERRESTRIAL FLORA AND FAUNA ASSESSMENT

GLOUCESTER COAL

ResourceStrategies

APPENDIX E

DURALIE EXTENSION PROJECT

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

ResourceStrategies

PREPARED BY

CENWEST ENVIRONMENTAL SERVICES
AND RESOURCE STRATEGIES

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EXECUTIVE SUMMARY

This terrestrial flora and fauna assessment has been prepared by Cenwest Environmental Services and Resource Strategies for Duralie Coal Pty Ltd (DCPL) as part of the Environmental Assessment (EA) for the Duralie Extension Project (the Project).

The Duralie Coal Mine (DCM) is an existing mine situated within Mining Lease (ML) 1427, located approximately 10 kilometres (km) north of the village of Sroud and approximately 20 km south of Stratford in the Gloucester Valley, New South Wales (NSW). The Project would predominantly involve an extension of the existing approved open pit and the development of an adjacent pit, with additional supporting infrastructure.

The Project was determined by the Director-General of NSW to be a Major Project to which Part 3A of the *Environmental Planning and Assessment Act, 1979* applies. The purpose of this document is to provide an assessment of the potential impacts on flora and fauna associated with the Project in accordance with the Part 3A requirements.

Assessment Methods

The assessment methodology used in this document was developed in consideration of the NSW Department of Environment and Conservation and NSW Department of Primary Industries *Draft Guidelines for Threatened Species Assessment*. This terrestrial flora and fauna assessment utilised relevant databases sources, a review of past and recent surveys conducted in the Project area and surrounds combined with a supplementary flora and fauna habitat assessment.

Various flora and fauna surveys have been undertaken in the Project area and surrounds, mainly associated with environmental assessments for various developmental stages of the DCM. The most recent flora and fauna surveys were undertaken between 2007 and 2009 by EcoBiological. The EcoBiological flora and fauna survey report is provided as an attachment to this terrestrial flora and fauna assessment.

The survey methodology utilised by EcoBiological generally conformed with the NSW Department of Environment and Climate Change and Water (DECCW) *Threatened Biodiversity Survey and Assessment Guidelines*. Flora surveys were undertaken in May 2007, September 2008 and April 2009, while fauna surveys were undertaken in April, July and November 2007, August 2008, as well as in January, February and April 2009. The survey techniques included: targeted searches for threatened flora species; flora quadrats; random meanders; and for vertebrate fauna; trapping, hair tubes, spotlighting, habitat searches, bat call recording, call playback and bird census. All potentially occurring threatened species were targeted during the surveys.

During the preparation of this assessment, further habitat assessments were undertaken to characterise the habitats of threatened flora and fauna species which could potentially occur in the Project area and surrounds.

Flora

The Project is situated in a valley which is bound by ridgelines to the east (Buckleys Range) and west (Linger and Die Ridge). The surrounding area is rural and the land uses are cattle grazing on native and improved pastures, along with some poultry farming and other kinds of agricultural production. Almost all of the pre-European forest and woodland which once occurred in the Project area has been extensively cleared and/or logged at least once and in some cases very likely twice.

The vegetation community patches in the Project area are mostly regrowth woodland and forest formations comprising predominantly Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest (approximately 61 hectares [ha]) and Red Gum Grassy Woodland (approximately 20 ha). Tree regeneration is typically in forest-formation density, with the estimated age of regrowth trees varying between 10 to 50 years. The largest continuous treed area, approximately 45 ha, occurs in the north of the Project area.

Smaller areas (<3 ha) of Spotted Gum – Grey Ironbark – Thick-leaved Mahogany, Grey Gum – Red Gum - Apple Riparian Forest, and Stringybark – Paperbark Forest also occur in the Project area.

Under appropriate management conditions it is very likely that the majority of the native vegetation remnants in the Project area could eventually exhibit many of the values of the pre-European vegetation communities from which they were derived.

The vegetation communities to be cleared are recognised in the DECCW Vegetation Type database as moderately cleared vegetation types within the Hunter/Central Rivers Catchment Management Authority region.

A total of 362 flora taxa, of which 305 are native, have been located within the Project area and surrounds during the flora surveys from 1996 to 2009. The most prevalent families of native flora recorded are the Poaceae (Grasses), Myrtacea (e.g. Eucalypts) and Fabacea (Legume).

Introduced flora species are moderately diverse and represented by 57 species, and are associated with relatively high rainfall and past/present agricultural land use. Introduced flora species are more abundant along drainage areas than elsewhere.

No threatened flora species listed under the NSW *Threatened Species Conservation Act, 1995* (TSC Act) or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) have been recorded, or are considered likely to occur, within the Project area.

No threatened ecological communities (TECs) listed under the TSC Act or EPBC Act have been recorded within the Project area. However, three threatened ecological communities (TECs) listed under the TSC Act have been recorded in the surrounds, namely the:

- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community (River-Flat Eucalypt Forest EEC);
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community (Freshwater Wetlands on Coastal Floodplains EEC); and
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion Endangered Ecological Community (Lowland Rainforest on Floodplain EEC).

These three ecological communities are associated with the floodplains and land adjacent to the Mammy Johnsons River.

Vertebrate Fauna

The broad fauna habitat types in the Project area are associated with the secondary grassland (with or without scattered regrowth trees) and relatively small discontinuous secondary woodland and forest remnants. Four broad fauna habitat types are recognised in the Project area:

- Secondary Grassland;
- Secondary Grassland with Regrowth Open Woodland/Forest;
- Regrowth Open Forest; and
- Water Sources (including farm dams, Coal Shaft Creek and unnamed drainage lines).

The Mammy Johnsons River flows to the east of the DCM, and provides significant habitat resources for local vertebrate fauna.

A total of 197 native vertebrate species have been located within the Project area and surrounds during the fauna surveys from 1996 to 2009, comprising 18 amphibians, 14 reptiles, 128 birds and 37 mammals. Fauna species are represented by terrestrial, aquatic and aboreal amphibians, reptiles, woodland and forest birds and arboreal and ground dwelling mammals.

A total of 18 threatened fauna species listed under the TSC Act and/or EPBC Act have been recorded in the Project area and/or surrounds. Most of these species were recorded outside of the Project area within the habitat along the Mammy Johnsons River (e.g. Giant Barred Frog) or on Buckleys Range to the east (e.g. Gang-gang Cockatoo). Four threatened birds and four threatened mammals have been recorded in the Project area, namely the Swift Parrot, Brown Treecreeper (eastern subspecies), Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale, Squirrel Glider, Eastern Freetail-bat and Eastern Bentwing-bat. Of these, only the Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale and Squirrel Glider listed under the TSC Act are considered likely to have viable populations residing within the Project area. However the populations of these four species are unlikely to be confined within ML 1427 since there are records of these species outside of the Project area and there is sufficient connectivity between the habitats within and outside of the Project area. The Swift Parrot and Eastern Bentwing-bat, although they may utilise foraging habitat resources in the Project area, are unlikely to breed within the Project area given the lack of suitable breeding resources. The single record of a pair of Brown Treecreepers (eastern subspecies) in the Project area suggests that this species is unlikely to be resident in the Project area. It could not be determined if the sighting represented a bonded pair and/or a dispersal/migratory movement. The Large-footed Myotis has been recorded in the surrounds and given that potential habitat for this species occurs in the Project area, it is also likely to be affected.

No threatened species or TECs listed under the *Fisheries Management Act, 1994* (FM Act) are considered relevant to this terrestrial flora and fauna assessment.

This document assesses the potential impacts on each threatened fauna species, either present or likely to occur in the Project area.

Evaluation of Potential Impacts on Flora and Fauna

The magnitude, extent, and significance of potential impacts on threatened species, populations and ecological communities, and their habitats have been identified and described in this assessment. This included consideration of key threatening processes listed under the TSC Act, FM Act and EPBC Act. The potential adverse flora and fauna impacts resulting from the Project include the:

- clearing of regrowth woodland and forest (approximately 87 ha), as well as derived grasslands (109 ha) and 11 ha of cropping land, some of which is known habitat for threatened fauna species under the TSC Act;
- reduction in the connectivity of habitat resources for some flora and fauna species;
- reduction of limited ephemeral water resources along Coal Shaft Creek and unnamed drainage lines;
- irrigation of 28 ha native vegetation communities with excess mine water; and
- displacement and/or loss of native vertebrate fauna associated with native vegetation clearing.

No threatened flora species or TECs listed under the TSC Act, FM Act or EPBC Act would be adversely impacted by the Project.

The Project disturbance would remove known habitat and potentially displace resident Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale and Squirrel Glider, although the Project is not likely to lead to local populations of these species being placed at risk of extinction.

The Project is not expected to have a measurable impact on the flora and fauna or habitats of the Mammy Johnsons River. The proposed Project offset measures would enhance the connectivity between the Mammy Johnsons River, the large area of remnant vegetation associated with Buckleys Range, the rehabilitation of the final Project landforms and the wooded ridgeline to the west of ML 1427.

Impact Avoidance, Mitigation and Offset Measures

To reduce potential impacts on flora and fauna, a number of measures are proposed as part of the Project, including:

- Impact avoidance measures: These include measures outlined in the existing Vegetation Clearance Protocol. This would enable species captured during clearing to be relocated to nearby suitable locations.
- Impact mitigation measures: These include measures to control weeds and animal pests, and measures to minimise potential impacts from irrigation.
- Offset measures: The provision of an offset area located on Gloucester Coal Ltd/DCPL owned land immediately south-east of the DCM, would provide long-term tenure security and management of appropriate land to be set aside for conservation purposes.

The proposed offset area consists of approximately 214 ha of forest/woodland communities, approximately 0.2 ha of freshwater wetland community and approximately 230 ha of derived grasslands. The latter would be revegetated with native species to enhance local and regional connectivity of flora and fauna habitats. Ecological gains from the proposed offset include:

- an increase in the area of vegetation/habitat in the medium to long-term;

- conservation and/or enhancement of similar vegetation communities/fauna habitats as is located in the Project area;
- an adjacent suitably located area of benefit to flora and fauna populations (biodiversity values) impacted by the Project;
- enhanced connectivity of existing habitat areas via linkages with the Mammy Johnsons River, rehabilitated final Project landforms and the wooded ridgeline to the west of ML 1427;
- conservation and enhancement of approximately 14 ha of the Lowland Rainforest on Floodplain EEC;
- conservation and enhancement of approximately 8 ha of the River-Flat Eucalypt Forest EEC;
- conservation and enhancement of approximately 0.2 ha of the Freshwater Wetlands on Coastal Floodplains EEC;
- known habitat for the Giant Barred Frog, Glossy Black Cockatoo, Speckled Warbler, Brush-tailed Phascogale, Eastern Freetail-bat, Eastern Bentwing-bat and Large Footed Myotis; and
- potential habitat for the Rose-crowned Fruit-Dove, Swift Parrot, Brown Treecreeper (eastern subspecies), Grey-crowned Babbler (eastern subspecies) and Squirrel Glider.

The proposed offset measures, would constitute a suitable area to offset residual flora and fauna impacts associated with the Project, given the existing biodiversity values of the proposed offset as well as the anticipated improvement in the flora and fauna habitat values in the medium to long-term.

Conclusion

In summary the following conclusions were made:

- Disturbance associated with the Project would result in the removal of fauna habitats and the displacement and/or loss of native vertebrate individuals. However the proposed impact avoidance, mitigation (e.g. rehabilitation and revegetation of final landforms) and offset measures are likely to maintain regional fauna biodiversity in the short-term and to improve it in the medium to long-term.
- Disturbance associated with the Project would result in a decrease in the diversity of flora in the local area. The enhancement and conservation measures proposed as part of the offset would help maintain (and possibly improve) the flora biodiversity values of a substantial area of vegetation outside of the Project area.
- The Project disturbance would remove known habitat of the following threatened species as well as displace resident individuals: Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale and Squirrel Glider, although the Project is unlikely to lead to the local extinction of any threatened fauna species or place any at risk of local or regional extinction.
- The Project would not impact any listed threatened flora species, TECs or threatened populations.
- The Project would not impact any critical habitat as no critical habitats are known to occur within the vicinity of the Project area.

E1 INTRODUCTION

This terrestrial flora and fauna assessment has been prepared by Cenwest Environmental Services and Resource Strategies for Duralie Coal Pty Ltd (DCPL) as part of the Environmental Assessment (EA) for the Duralie Extension Project (the Project). DCPL is a wholly owned subsidiary of Gloucester Coal Ltd (GCL).

The Duralie Coal Mine (DCM) is an existing mine situated within Mining Lease (ML) 1427, located approximately 10 kilometres (km) north of the village of Stroud and approximately 20 km south of Stratford in the Gloucester Valley, New South Wales (NSW) (Figure E-1). The potential environmental impacts associated with the development of the DCM were assessed in the *Duralie Coal Environmental Impact Statement* (Duralie Coal EIS) (DCPL, 1996). To accompany the Duralie Coal EIS, Woodward-Clyde (1996a) conducted assessments of significance under Section 5A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) for the existing DCM. The assessment concluded that the DCM was unlikely to have a significant effect on any threatened species, populations or ecological communities, or their habitats. The NSW Minister for Urban Affairs and Planning granted Development Consent for the mine in August 1997.

The purpose of this report is to provide an assessment of the potential impacts on flora and fauna associated with the Project which is proposed to be assessed under Part 3A of the EP&A Act. A detailed description of the Project is provided in Section 2 in the Main Report of the EA and the Project general arrangement is shown on Figure E-2. The main activities associated with development of the Project would include:

- continued development of open pit mining at the DCM to facilitate a run-of-mine (ROM) coal production rate of up to approximately 3 million tonnes per annum, including:
  - extension of the existing approved open pit in the Weismantel Seam to the north-west (i.e. Weismantel Extension open pit) within ML 1427 and Mining Lease Application (MLA) 1;and
  - open pit mining operations in the Clareval Seam (i.e. Clareval North West open pit) within ML 1427 and MLA 1;
- ongoing exploration activities within existing exploration tenements;
- progressive backfilling of the open pits with waste rock as mining develops, and continued and expanded placement of waste rock in out-of-pit waste rock emplacements;
- increased ROM coal rail transport movements on the North Coast Railway between the DCM and Stratford Coal Mine (SCM) in line with increased ROM coal production;
- continued disposal of excess water through irrigation (including development of new irrigation areas within ML 1427 and MLA 1);
- raising of the existing approved Auxiliary Dam No. 2 from relative level (RL) 81 metres (m) to approximately RL 100 m to provide significant additional on-site storage capacity to manage excess water on-site;
- progressive development of dewatering bores, pumps, dams, irrigation infrastructure and other water management equipment and structures;
- development of new haul roads and internal roads;
- upgrade of existing facilities and supporting infrastructure as required in line with increased ROM coal production;
- continued development of soil stockpiles, laydown areas and gravel/borrow pits;

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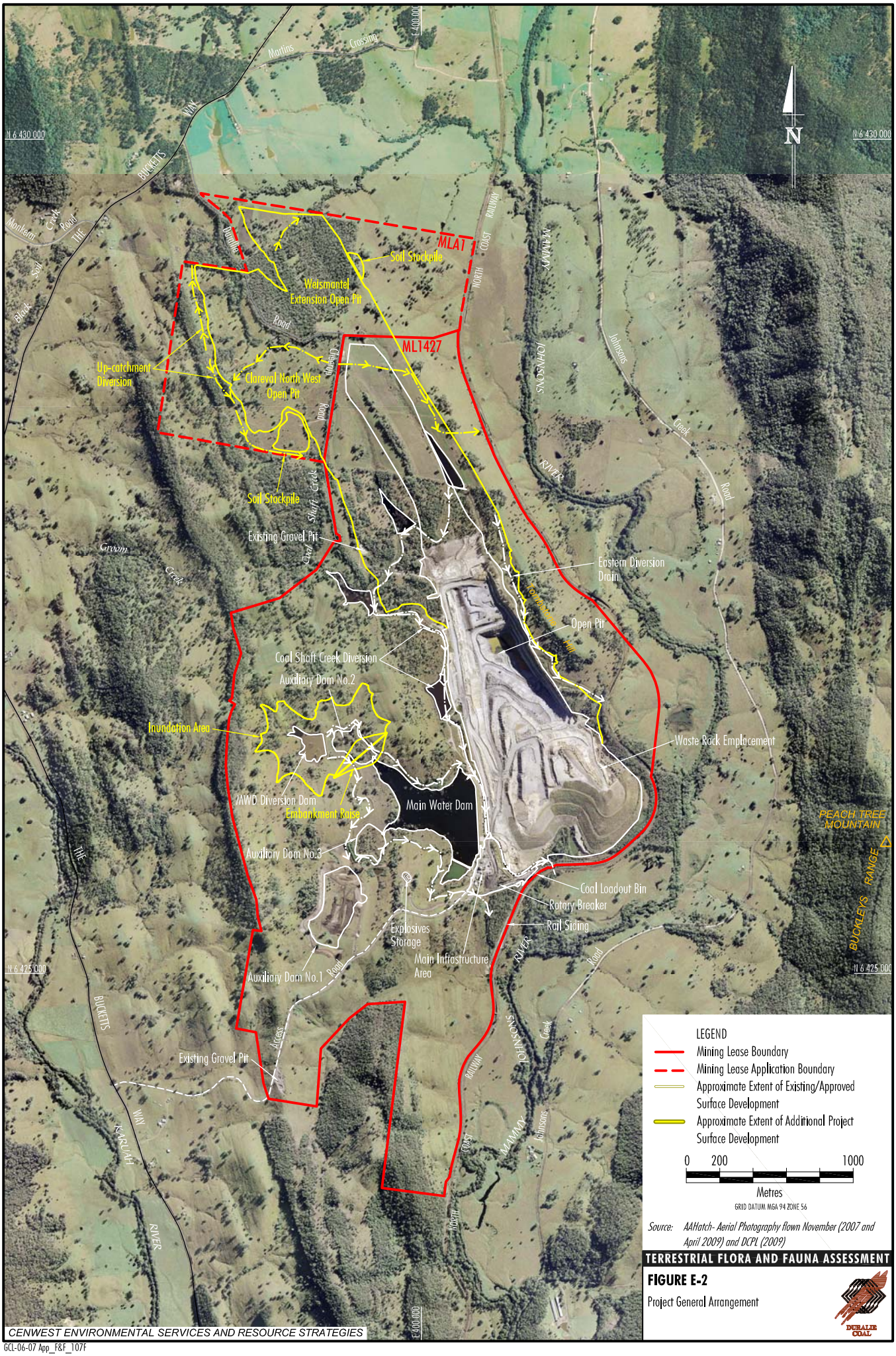

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

FIGURE E-2

Project General Arrangement

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- establishment of a permanent Coal Shaft Creek alignment adjacent to the existing DCM mining area;
- ongoing monitoring and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

Figure E-3 shows the approximate extent of the existing/approved irrigation areas as well as the proposed additional irrigation areas. An on-site irrigation system of pumps, piping and water distribution equipment is used to supply water from the Main Water Dam (MWD) to the irrigation areas.

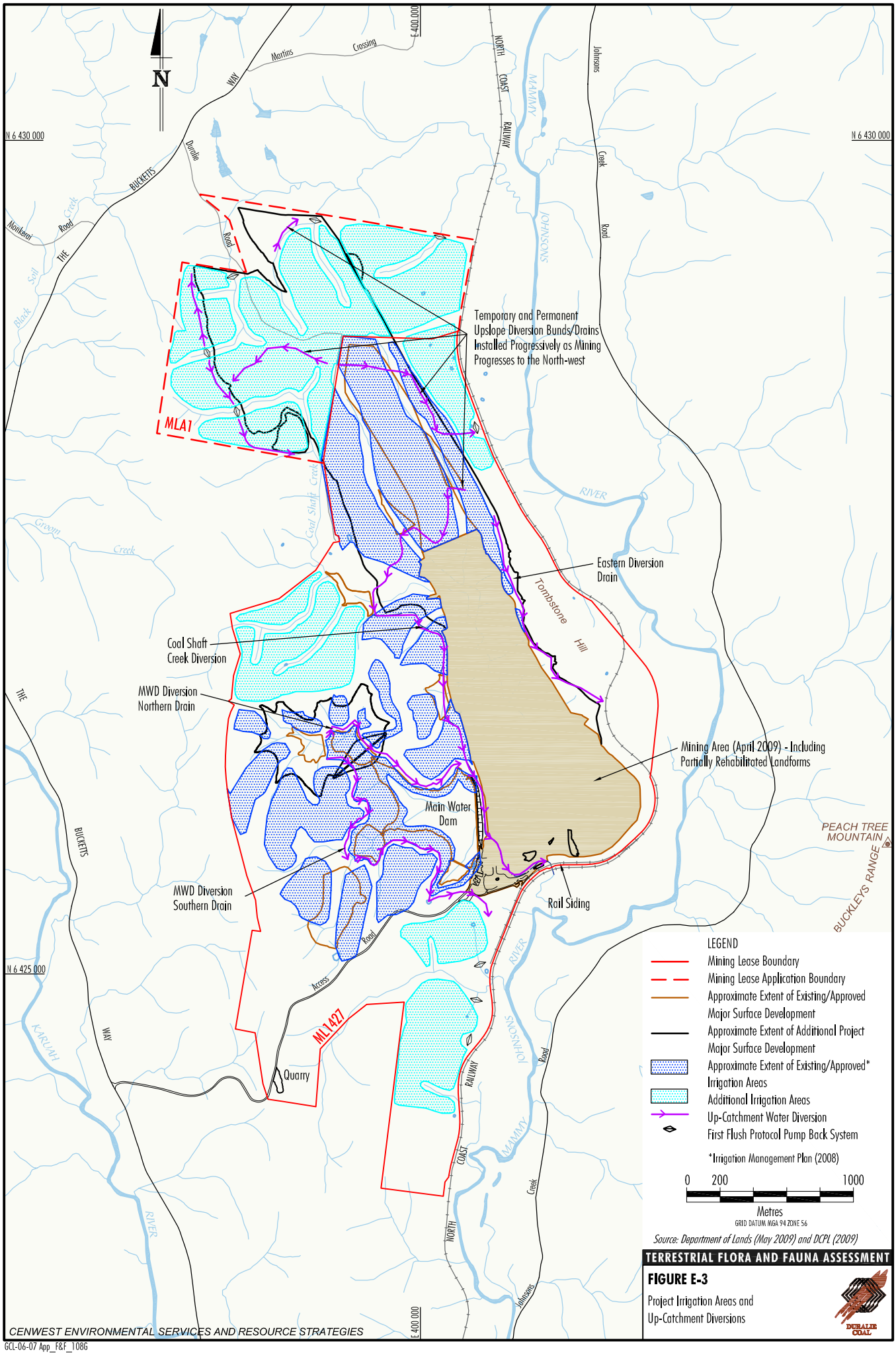
E1.1 ASSESSMENT OBJECTIVES

The objectives of this terrestrial flora and fauna assessment were to:

- assess potential impacts on flora and fauna arising from a development under Part 3A of the EP&A Act in consideration of the Director-General's Environmental Assessment Requirements (EARs) which requires the assessment of flora and fauna including:
  - *accurate predictions of any vegetation clearing on site;*
  - *a detailed assessment of the potential impacts of the project on any terrestrial and aquatic threatened species, populations, ecological communities or their habitats; and*
  - *a detailed description of the measures that would be implemented to maintain or improve the biodiversity values of the surrounding region in the medium to long term*); *and*
- the Draft *Guidelines for Threatened Species Assessment* (NSW Department of Environment and Conservation [DEC] and NSW Department of Primary Industries [DPI], 2005);
- identify the magnitude, nature and significance of impacts from the Project on flora species including threatened species, populations and ecological communities listed under the NSW *Threatened Species Conservation Act, 1995* (TSC Act), NSW *Fisheries Management Act, 1994* (FM Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act); and
- propose impact avoidance, mitigation and offset measures to address the potential impacts of the Project.

The Project area is defined as the area encompassing the additional Project surface disturbance and the additional irrigation areas.

In 2008, the NSW Department of Environment and Climate Change (DECC) (now NSW Department of Environment, Climate Change and Water [DECCW]) commenced the biobanking scheme in NSW, a voluntary scheme implemented under the TSC Act to offset biodiversity impacts resulting from development. DCPL have chosen not to participate in the biobanking scheme, and therefore this assessment assesses the impacts of the Project and proposes an offset in consideration of the EARs and relevant Part 3A development guidelines (e.g. DEC and DPI, 2005).


N
N 6 430 000
N 6 425 000
E 400 000
Martins Crossing Road
Duralie WAY
BUCKETTS WAY
Monkerai Road
Creek
THE
Soil
Black
Road
NORTH COAST RAILWAY
MAMMY
Johnsons Creek Road
JOHNSONS
RIVER
Coal Shaft Creek
Groom Creek
Temporary and Permanent Upslope Diversion Bunds/Drains Installed Progressively as Mining Progresses to the North-west
ML1427
Eastern Diversion Drain
Tombstone Hill
Coal Shaft Creek Diversion
MWD Diversion Northern Drain
Mining Area (April 2009) - Including Partially Rehabilitated Landforms
Main Water Dam
MWD Diversion Southern Drain
Rail Siding
PEACH TREE MOUNTAIN
BUCKLEYS RANGE
Access Road
Quarry
KARUAH WAY
LEGEND
Mining Lease Boundary
Mining Lease Application Boundary
Approximate Extent of Existing/Approved Major Surface Development
Approximate Extent of Additional Project Major Surface Development
Approximate Extent of Existing/Approved* Irrigation Areas
Additional Irrigation Areas
Up-Catchment Water Diversion
First Flush Protocol Pump Back System
*Irrigation Management Plan (2008)
0 200 1000
Metres
GRID DATUM MGA 94 ZONE 56
Source: Department of Lands (May 2009) and DCPL (2009)
TERRESTRIAL FLORA AND FAUNA ASSESSMENT
FIGURE E-3
Project Irrigation Areas and Up-Catchment Diversions
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E1.2 REGIONAL SETTING

The existing DCM is located in a rural area characterised by cattle grazing on native and improved pastures, along with some poultry farming and other agricultural production.

A number of reserved areas are located in the vicinity of the Project (Figure E-4), including the Myall River State Forest (located approximately 5 km to the south-east), Monkerai Nature Reserve (located approximately 7 km to the south-west), The Glen Nature Reserve (located approximately 11 km to the north-east) and Ghin-doo-ee National Park (located approximately 11 km to the east).

The Project area is located near the centre of the Hunter/Central Rivers Catchment Management Authority (CMA) region and near the western boundary of the Karuah Manning CMA sub-region (DECCW, 2009a). The Project is within the Great Lakes Local Government Area (LGA).

E1.3 BIOGEOGRAPHICAL, BOTANICAL AND ZOOGEOGRAPHIC REGIONS

The Project area is located towards the centre of the NSW North Coast Interim Biogeographic Regionalisation of Australia (IBRA) bioregion (Commonwealth Department of the Environment, Water, Heritage and Arts [DEWHA], 2009a). The NSW North Coast IBRA bioregion occurs along the east coast of NSW, from north of Newcastle to the Queensland (QLD) border. The bioregion supports sub-tropical and warm temperate rainforests/sclerophyll forests on soils derived from basalts, eucalypt forests on soils derived from granites and dune and estuary vegetation in coastal areas (DECCW, 2009a).

The NSW North Coast IBRA bioregion is similar to the North Coast Botanical Division of NSW defined by Harden (2000).

Spencer (1896) used distribution of fauna to divide Australia into three zoogeographic regions, namely Torresian, Bassian and Eyrean. The Project area is in the Bassian Zoogeographic Region, which occurs along the south-east coast of Australia (Spencer, 1896).

E1.4 DESCRIPTION OF THE PROJECT AREA AND SURROUNDS

A description of the Project area and surrounds is provided below.

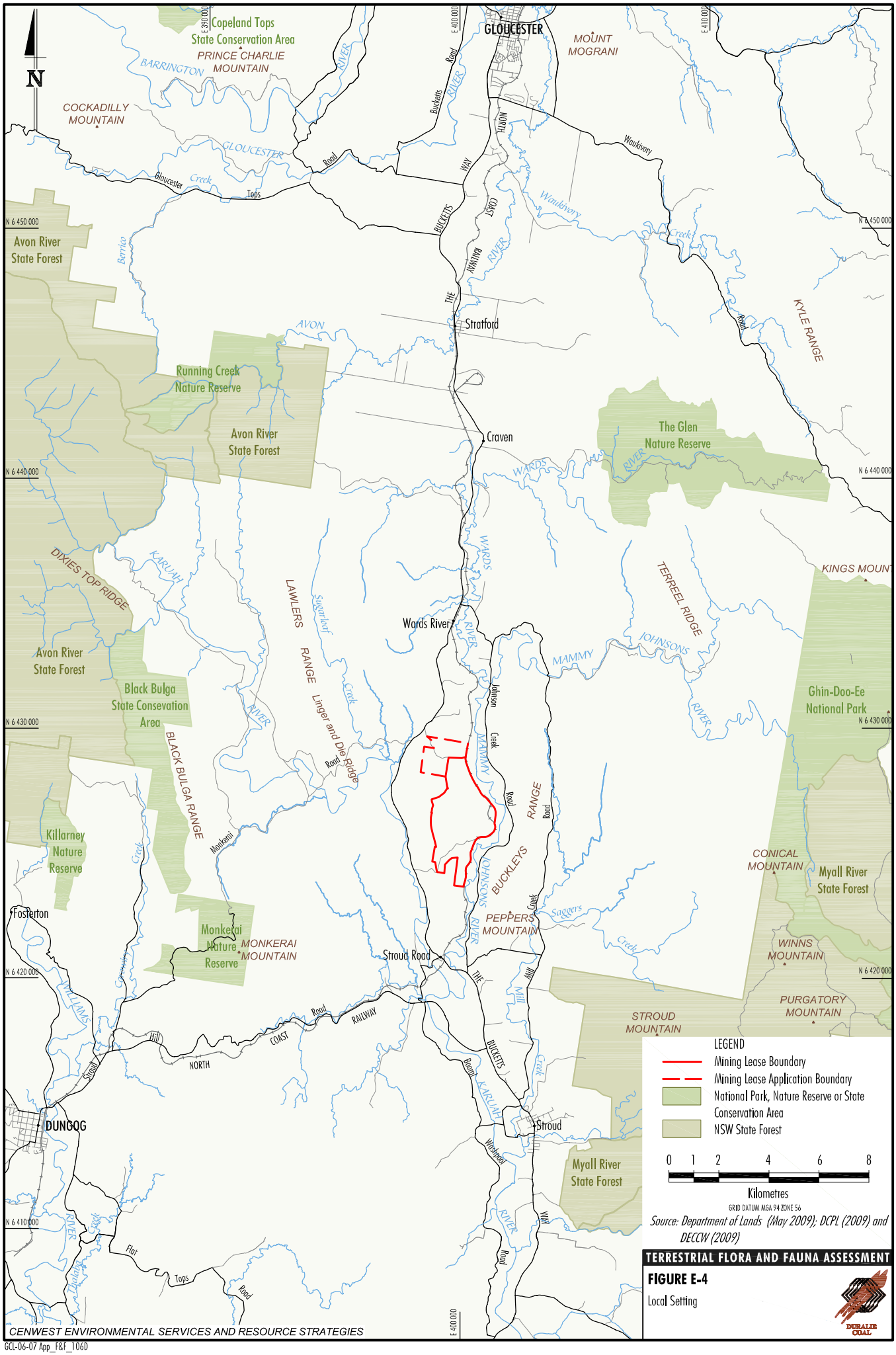
E1.4.1 Topography and Landforms

The Project is located in an area characterised by substantial local topographic relief. The DCM is situated in a valley which is bounded by ridgelines to the east (Buckleys Range) and west (Linger and Die Ridge) (Figure E-4).

Elevations within the DCM area generally range from approximately RL 50 m along the river flats of the Mammy Johnsons River to RL 180 m on the ridge tops to the west of the existing ML 1427. Within MLA 1, elevations range from RL 70 to 170 m and the topography is steeper in the west along a north-west to south-east oriented ridgeline, and more gently sloping in the north-east of MLA 1.

A prominent hill rising to an elevation of approximately RL 130 m, referred to as Tombstone Hill, is located to the east of the DCM open pit.

The DCM is situated mostly within the Coal Shaft Creek catchment, where elevations originally ranged from approximately RL 50 m to approximately RL 100 m. The development of the DCM has altered the pre-mining topography within the mining area, with the open pit and waste rock emplacement (up to RL 110 m) and water management structures being the primary alterations.



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E1.4.2 Geology and Soils

The geology of the Stroud-Gloucester area is dominated by the Permian Gloucester Basin, a north-south elongated syncline containing some 4,000 m of Permian strata along the central synclinal axis (DCPL, 1996). The Project area is situated in the southern part of the Gloucester Basin. The Permian sequence present in the valley area consists of the Gloucester Coal Measures and the Dewrang Group (Mammy Johnsons Formation, Weismantels Formation and Durallie Road Formation) (NSW Department of Industry and Investment, 2009). The ridgelines to the west of the Project, and Buckleys Range to the east of the Project area comprise Alum Mountain Volcanics (Department of Industry and Investment, 2009) which typically forms ranges as the geology is characteristically more resistant to erosion than the Permian materials. Quaternary Alluvium is associated with the Mammy Johnsons River and related floodplains (Department of Industry and Investment, 2009).

Soils derived from sandstones in the Dewrang Group cover most of the coal deposit (DCPL, 1996). The majority of the Project area is broadly mapped as the Wards River Soil Landscape by Henderson (2000). The soils tend to be low in fertility and have generally thin (100 millimetres [mm]) topsoil -A1 horizon and poorly structured topsoil - A2 horizon (DCPL, 1996). The soils of the Wards River Soil Landscape are highly erodible and produce a landscape which is characterised by rolling low hills (Henderson, 2000).

The soils associated with the Mammy Johnsons River and floodplains are described by Henderson (2000) as the stagnant alluvial Gloucester River Soil Landscape. These soils have low permeability which provides the capacity for holding water (Henderson, 2000). The vegetation between the existing DCM and the Mammy Johnsons River to the south is associated with a variant of the Gloucester River Soil Landscape, where alluvium drains from the Permian Alum Mountain Volcanics (after Henderson, 2000).

The footslopes of the Buckleys Range to the east of the Mammy Johnsons River are mapped as The Bucketts Road Soil Landscape (Henderson, 2000). The Bucketts Road Soil Landscape is known as a transferral soil landscape which is comprised of deep deposits of eroded colluvial soils formed beneath steep to precipitous sedimentary and volcanic material (Henderson, 2000), in this case, Buckleys Range. Due to the way in which this soil landscape is formed, the soils are highly erodible (Henderson, 2000).

Buckleys Range, to the east of the Project, is associated with the Gloucester Bucketts Soil Landscape (Henderson, 2000). The Gloucester Bucketts colluvial soils landscape is characterised by rolling to very steep hills on Permian basic and acidic volcanics and sediments (Henderson, 2000).

E1.4.3 Land Use

As previously described, the Project is located in a rural area characterised by cattle grazing on native and improved pastures, along with some poultry farming and other agricultural production. The majority of the Project area has been cleared as part of past rural land use practices and logging. The DCM and the SCM (which is located approximately 20 km to the north of the DCM) are the main mining developments in the area.

DCPL owns the land within ML 1427 and MLA 1. The eastern part of ML 1427 is currently subject to mining development, while the remainder of ML 1427 and MLA 1 is managed for agricultural use.

E1.4.4 Hydrology

The Project area is situated in the Mammy Johnsons River catchment. Mammy Johnsons River is a tributary of the Karuah River (Figure E-4), which rises in the Chichester State Forest and drains to Port Stephens some 40 km south of DCM. Mammy Johnsons River is similar in catchment area and length to the Karuah River at their confluence near the village of Stroud Road (Figure E-4). The Mammy Johnsons River is a permanent river which flows through an undulating landscape which has been extensively cleared for cattle grazing. The Mammy Johnsons River flows to the east of the DCM, in a southerly direction (Figure E-2).

Prior to the commencement of mining at the DCM, Coal Shaft Creek (a tributary of the Mammy Johnsons River) traversed a large proportion of the DCM deposit. Coal Shaft Creek has been diverted around the DCM.

Unnamed ephemeral drainage lines occur in the north of the Project area (Figure E-3). During periods of flow, surface water drains east to the Mammy Johnsons River.

E1.4.5 Climate

On-site weather data are collected at the meteorological station situated near the centre of ML 1427. An annual summary of the data collected from the station is reported in the Annual Environmental Management Report (AEMR). A regional meteorological station is situated at Stratford.

On-site temperature records from 2003 onwards indicate that in the summer months at the DCM, maximum temperatures would be expected to range from 20 to 44 degrees Celsius (^{o}C) while during winter months temperatures can fall as low as -3°C. The highest temperatures generally occur in January and the lowest occur during July.

Mean annual rainfall for the nearby district of Stroud over the period 1889 to 2007 is 1,144.7 mm (DCPL, 2008a). Historical records show that rainfall tends to be highest in March and lowest in September. On-site annual rainfall was reported at 899.2 mm for 2006 and 1,092 mm in 2007 (DCPL, 2007a; 2008a). Average daily evaporation rates calculated monthly for the 2008 AEMR reporting period ranged from 1.9 millimetres per day (mm/day) (February 2008) to 5.8 mm/day (October 2007) (DCPL, 2008a).

Climate statistics for the Commonwealth Bureau of Metorology (BoM) Paterson (Tocal AWS) weather station (Site Number 061250) are provided in Table E-1.

Table E-1
Climate Statistics for Paterson Weather Station

	Mean Monthly Statistics												Mean Annual Statistics
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Girvan State Forest (061022)													
Mean Daily Maximum Temperature (^{o}C)	29.6	28.7	26.9	24.2	20.7	17.8	17.3	19.4	22.3	25.0	26.6	29.1	24.0
Mean Daily Minimum Temperature (^{o}C)	17.5	17.5	15.6	12.4	9.7	7.5	6.1	6.5	8.9	11.4	13.8	16.2	11.9
Mean Rainfall (mm)	107.0	120.3	117.3	79.5	74.9	71.9	39.3	36.8	49.8	65.6	80.0	79.2	923.1

Source: BoM (2009).

Mean recorded temperatures indicate that the Project area experiences the warmest temperatures from November to March and the coolest from May to August (Table E-1). The highest average maximum daily temperature is recorded in January (29.6^{o}C) (Table E-1) (BoM, 2009).

The lowest average daily minimum temperatures are recorded in the winter months. July experienced the lowest mean daily minimum temperature (i.e. 6.1^{o}C) (Table E-1) (BoM, 2009).

Mean recorded rainfall was highest in February (120.3 mm), while August received the least amount of rainfall (36.8 mm) (Table E-1) (BoM, 2009). The mean annual rainfall for the recording period was 923.1 mm (Table E-1) (BoM, 2009).

E2 ASSESSMENT METHODS

The methodology used in this terrestrial flora and fauna assessment report was developed in consideration of the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). A summary of the databases searched and the methodology undertaken during previous flora and fauna surveys is provided in Sections E2.1 and E2.2, respectively.

E2.1 DATABASE SEARCHES

Threatened flora and fauna species listed under the TSC Act and EPBC Act previously recorded in the DCM area and wider region were identified using the following database searches:

- Australian Museum Fauna Database records within a search area of approximately 100 km by 100 km surrounding the Project area (Australian Museum, 2009a);
- Atlas of Australia Birds database records produced by Birds Australia (2009) within a search area of approximately 100 km by 100 km surrounding the Project area;
- DECCW Atlas of NSW Wildlife database records within a search area of approximately 100 km by 100 km (DECCW, 2009b);
- DECCW Atlas of NSW Wildlife database records for nearby Nature Reserves and National Parks (including Monkerai Nature Reserve, The Glen Nature Reserve, Ghin-Doo-Ee National Park [Figure E-4] and Barrington Tops National Park) (DECCW, 2009c);
- the Sydney Royal Botanic Gardens (SRBG) database (SRBG, 2009) (using a search area of approximately 100 km by 100 km surrounding the Project area);
- fauna database records produced by BioNet (NSW Government, 2009) (i.e. Australian Museum, DECCW, DPI) within a search area of approximately 100 km by 100 km surrounding the Project area; and
- an EPBC Act Protected Matters Search (DEWHA, 2009b) for an area of approximately 100 km by 100 km surrounding the Project area.

The results of these database searches were incorporated into this terrestrial flora and fauna assessment.

E2.2 FLORA AND FAUNA STUDIES IN THE PROJECT AREA AND SURROUNDS

A number of flora and fauna surveys have been carried out in recent years in the general locality of the DCM. A review of these studies was undertaken as part of this assessment and included (but was not limited to) the following:

- Appendices to DCPL (1996) Duralie Coal EIS, including:
  - ERM Mitchell McCotter (1996a) *Flora Survey for Proposed Duralie Coal Mine Near Gloucester*;
  - Woodward-Clyde (1996b) *Summer Flora Report*;
  - ERM Mitchell McCotter (1996b) *Winter Fauna Survey for Proposed Duralie Coal Mine Near Gloucester*;
  - Fly-by-Night Bat Surveys Pty Ltd (Fly-by-Night Bat Surveys) (1996) *Winter Survey of the Bat Fauna of the Proposed Duralie Coal Mine near Gloucester, New South Wales;*

  - Paul Webber Consulting Services (1996) *Herpetological Survey of the Proposed Duralie Coal Mine via Gloucester, NSW*;
  - Debus (1995) *Bird Survey of the Proposed Duralie Coal Mine Site, Stroud*; and
  - Woodward-Clyde (1996c) *Summer Fauna Report*.
- FloraSearch (2005) *Vegetation Mapping and Targeted Threatened Flora Species Search for Duralie Extended.*
- Place Planning and Design (2003) *Duralie Coal Mine – Pre-clearance Survey and Habitat Assessment*.
- EcoBiological (2009a) *Flora and Fauna Survey Report: Duralie Coal Mine, Gloucester, New South Wales*. Provided in Attachment EA.
- EcoBiological (2009b) *Flora and Fauna Survey Report: Gloucester Coal Properties East of the Bucketts Way, Gloucester, New South Wales.*
- Other local studies (Dowling, 2001; Mount King Ecological Surveys, 2001; Greg Richards and Associates, 2001; Australian Museum Business Services [AMBS], 1995).

A summary of the methodologies used in the various flora and fauna surveys is provided in the following sub-sections.

E2.2.1 Flora and Fauna Surveys Conducted for the Duralie Coal EIS and Subsequent Modifications

Flora and fauna surveys undertaken for the Duralie Coal EIS are discussed below.

1995/1996 Flora Surveys

A flora survey was conducted by ERM Mitchell McCotter (1996a) within ML 1427 and surrounds in 1995. Surveys were undertaken during two seasonal periods, one in winter (i.e. July) and one in spring (i.e. September). Vegetation analysis involved a combination of aerial photograph interpretation and qualitative field observations (ERM Mitchell McCotter, 1996a).

A summer flora survey was undertaken by Woodward-Clyde (1996b) within ML 1427 and surrounds in December 1995 and January, February and March 1996. Techniques used included searches for targeted threatened flora species.

1995 Fauna Survey

ERM Mitchell McCotter (1996b) undertook terrestrial vertebrate fauna surveys within ML 1427 and surrounds during June 1995, with the exception of bat species which were targeted by Fly-by-Night Bat Surveys (1996). Four fauna sampling sites were established within the study area, and each site was assessed for fauna species diversity. Fauna survey techniques included spotlighting on foot, herpetological searches, bird surveys, Elliot trapping (situated on the ground and in trees) opportunistic observations and a fauna tracks and traces search.

Fly-by-Night Bat Surveys (1996) undertook bat fauna surveys over the proposed DCM area during July 1995. Techniques used to survey bats included mist netting and harp trapping, recording and analysis of echolocation calls using Anabat^{TM} II bat detectors and spotlighting of potential food trees for flying-foxes.

Paul Webber Consulting Services (1996) undertook a herpetological survey at three survey sites located within the eastern and central portions of ML 1427 during December 1995. Herpetological survey techniques included pitfall trapping within three survey sites, spotlighting, searches under logs, rocks, tree bark and leaves, and opportunistic observations. Mammal and bird species encountered during the surveys were also recorded.

Debus (1995) undertook a bird survey in December 1995 within ML 1427, with the majority of survey effort occurring at Coal Shaft Creek. Bird survey techniques included traverses along transects, stationary observations, nocturnal searches, call playback, spotlighting and targeted searches for threatened bird species.

1996 Fauna Survey

A summer fauna survey was undertaken by Woodward-Clyde (1996c) within ML 1427 in March and July 1996. Several fauna survey techniques were used, including call playback and nest and roost surveys (including diurnal and nocturnal searches, as well as an examination of tree hollows); mammal surveys, including the use of Elliot traps, mammal cage traps and hair tubes (arboreal and ground); microchiropteran bat surveys utilising Anabat^{TM} II bat detectors, harp traps, mist nets and radio telemetry; targeted koala surveys, with the use of call playback and spot assessments; as well as general techniques including nocturnal surveys on foot, active searching, general observations and identification of habitat trees.

2005 Flora Survey

In early 2006, a modification to the DCM was lodged with the NSW Department of Planning (DoP), which involved an extension of the DCM open pit and waste emplacement. The environmental implications of the modification were assessed via the *Duralie Extended Modification Statement of Environmental Effects* (Duralie Extended SEE) (DCPL, 2006). As part of the Duralie Extended SEE, FloraSearch (2005) undertook vegetation mapping and a targeted threatened flora species search of the modification area.

E2.2.2 Pre-Clearance Survey and Habitat Assessment

Place Planning and Design (2003) undertook a pre-clearance survey and habitat assessment of a portion of Coal Shaft Creek during July 2003 in accordance with the *Duralie Coal Mine Vegetation Clearance Protocol* (DCPL, 2002).

Habitat assessment survey techniques included a desktop review to determine the fauna species present or likely to use the area to be modified, identification of potential habitat (including tree analysis), spotlighting, potential nest site searches and stag-watching for potential owl species.

The principal pre-clearance fauna management strategy employed during these surveys was the capture and release programme which focussed on threatened fauna known from the DCM area, namely the Brush-tailed Phascogale and Squirrel Glider (Place Planning and Design, 2003). Methods employed during the pre-clearance surveys included the use of ground Elliot A traps, arboreal Elliot B traps and ground cage traps (Place Planning and Design, 2003).

E2.2.3 2007 to 2009 Flora and Fauna Surveys

EcoBiological undertook flora and fauna surveys at the DCM within ML1427 and MLA 1 between 2007 and 2009 (Attachment EA). The survey methodology was generally as described in the DEC (2004a) *Threatened Biodiversity Survey and Assessment Guidelines*. A summary of the survey techniques and survey effort is provided in Table E-2.

Table E-2
Flora Survey Techniques Used During the 2007 to 2009 Surveys

Survey Techniques	Summary of Survey Technique and Survey Effort
Flora surveys were undertaken in May 2007, August 2007, September 2008, January 2009 and April 2009.	
Quadrats	A stratified random sampling design was adopted for placement of flora quadrats, following an initial site visit. Thirty-two (20 x 20 m) quadrats were sampled inside and outside of remnant vegetation patches. Twenty quadrats were undertaken in May 2007, three quadrats were undertaken in September 2008 and nine quadrats were undertaken in April 2009. In each quadrat, species and their cover were recorded.
Random Meanders and Targeted Searches for Threatened Flora Species	Random meanders (a minimum of 30 minutes for each quadrat sampled within the same vegetation type [Ecobiological, pers. comm., 2009]) were undertaken across the site and all flora species observed were recorded. Targeted searches were undertaken for threatened flora species.
Vegetation Community Mapping	Vegetation communities were defined by the dominant plant species in each vegetation stratum. Mapping boundaries were defined by walking the boundaries of each community with a GPS. Statistical analysis of the flora data was undertaken by Bell (2009) to support the classification of the vegetation communities.

Source: Attachment EA.

Fauna surveys were undertaken in April, July and November 2007, August 2008, as well as, January, February and April 2009, under clear weather conditions (Attachment EA). A summary of the fauna survey techniques and the survey effort is provided in Table E-3.

Table E-3
Fauna Survey Techniques Used During the 2007 to 2009 Surveys

	April 2007	July 2007	November 2007	August 2008	January/ February 2009	April 2009	Total Sampling Effort
Hair Tubes - Tree	35 traps, 4 nights	-	-	-	-	109 traps, 4 nights	576 hair tube nights
Hair Tubes - Ground	-	-	-	-	-	31 traps, 4 nights	124 hair tube nights
Elliot A	60 traps, 4 nights	-	-	-	-	50 traps, 4 nights	440 trap nights
Elliot B - Tree	15 traps, 4 nights	-	-	-	-	12 traps, 4 nights	108 trap nights
Elliot B - Ground	-	-	-	-	-	50 traps, 4 nights	200 trap nights
Cage	11 traps, 4 nights	-	-	-	-	12 traps, 4 nights	92 trap nights
Harp Trap	4 traps, 4 nights	-	-	-	-	-	16 trap nights
Type IV Funnel Traps	12 traps, 4 nights	-	-	-	-	-	48 trap nights
Spotlighting	✓	✓	-	✓	✓	✓	21.5 person hours
Anabat Call Recording	✓	✓	-	✓	✓	✓	✓
Nocturnal Call Playback	✓	✓	-	✓	-	✓	✓
Bird Surveys	✓	✓	✓	✓	✓	✓	12.5 person hours
Reptile Searches	✓	-	✓	-	✓	✓	23 person hours
Amphibian Searches	✓	-	✓	-	✓	✓	16 person hours
Opportunistic Observations	✓	✓	✓	✓	✓	✓	-

Source: Attachment EA.

The sampling site locations are presented in Attachment EA. Ecobiological also undertook limited habitat assessment within the Project area (Attachment EA).

E2.2.4 2007 to 2009 Flora and Fauna Surveys on Gloucester Coal Owned Properties

EcoBiological (2009b) undertook a flora survey and terrestrial vertebrate fauna survey of GCL owned properties located east and north-east of the existing DCM in August 2008 and January 2009.

Flora survey techniques included floristic surveys and plant identification, meandering transects, quadrat plot surveys and vegetation community mapping (EcoBiological, 2009b).

A fauna habitat assessment was undertaken and survey techniques included arboreal and ground Elliot traps, cage traps, hair tubes, harp traps, Type IV funnel traps, spotlighting, Anabat^{TM} call recording, nocturnal call playback, bird surveys, herpetological surveys, targeted surveys for threatened species, spotlighting, opportunistic observations and a fauna tracks and traces search (EcoBiological, 2009b).

E2.2.5 Aquatic Fauna Reports

Environmental Management and Planning Services (1996) conducted aquatic macroinvertebrate, fish and water quality sampling along the upper Karuah and Mammy Johnsons Rivers, Coal Shaft Creek and Ramstation Creek (a small tributary of the Karuah River) in August 1995 and March 1996. Since September 2002, Invertebrate Identification Australasia (2008a to 2008n; 2009), has undertaken quarterly aquatic macroinvertebrate monitoring in the Mammy Johnsons River.

In 1996, a platypus survey was undertaken by Goldney and Cox (1996) within the Mammy Johnsons River and Coal Shaft Creek. The survey techniques included gill netting, fyke netting, pool observations, an assessment of platypus habitat suitability and flow regimes. Six individuals were recorded in the Mammy Johnsons River reach targeted during the survey (Goldney and Cox, 1996).

E2.2.6 Other Local Flora and Fauna Studies

The SCM is located approximately 20 km north of the DCM. In 2001, an EIS was prepared for an extension to the SCM, known as Bowens Road North. As part of the EIS, flora (Dowling, 2001), terrestrial fauna (Mount King Ecological Surveys, 2001) and bat surveys (Greg Richards and Associates, 2001) were undertaken.

In 1995, the AMBS (1995) prepared a *Fauna Impact Statement for the Gloucester and Chichester Management Areas*. The species recorded during the survey have been considered in this assessment.

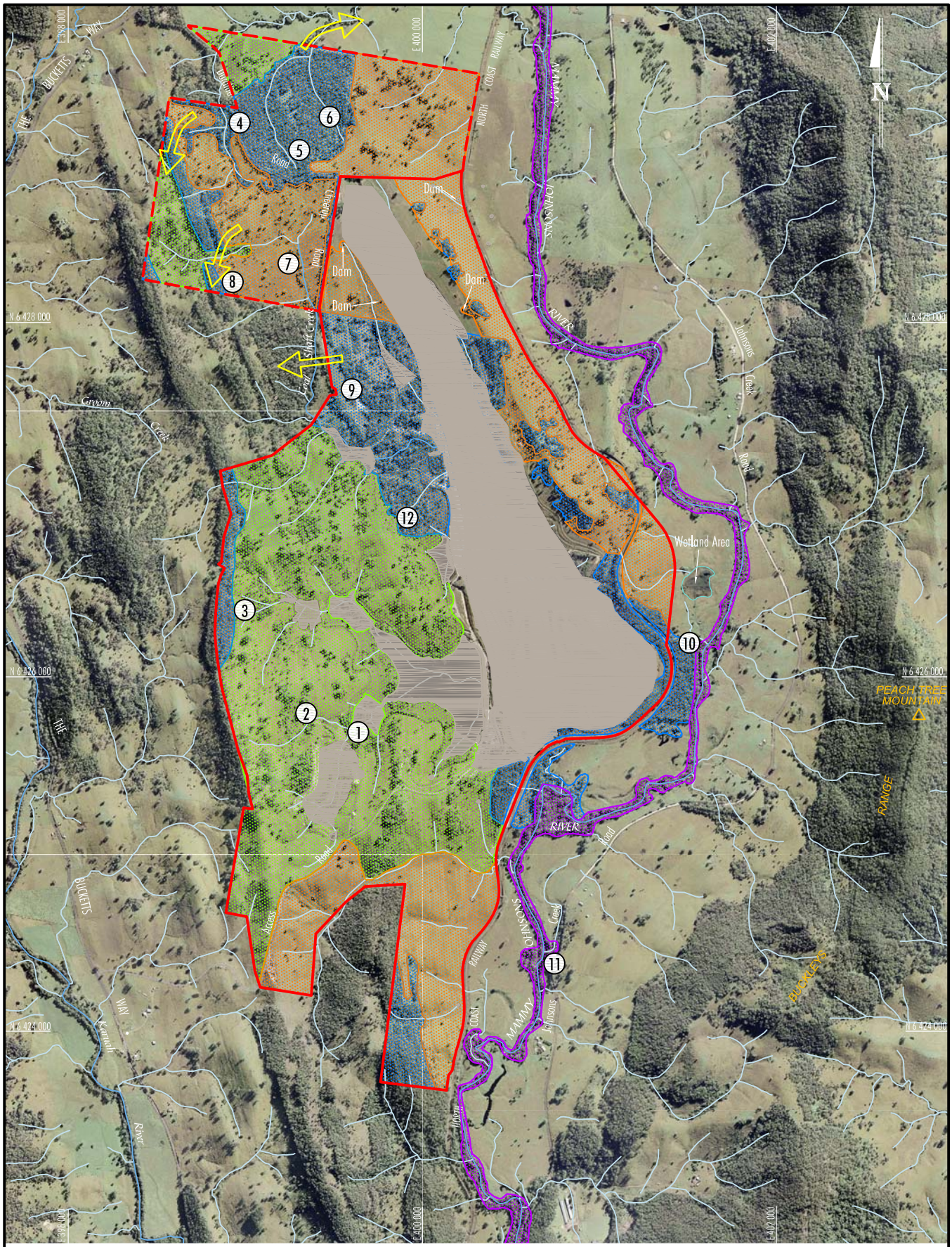
E2.2.7 Supplementary Habitat Assessment

A habitat assessment was conducted in the Project area and surrounds by Cenwest Environmental Services and Resource Strategies on 4 September 2009 in accordance with the *Threatened Biodiversity Survey and Assessment Guidelines* (DEC, 2004a) and in consideration of the DECCW *Field Survey Methods* (DECCW, 2009d).

Potential habitat for threatened flora species was evaluated based on the habitat requirements of threatened species which could possibility occur in the Project area (Section E2.2.8). Local records of threatened flora species were obtained from database searches as described in Section E2.1.

A habitat assessment for protected and threatened vertebrate fauna species was conducted using a rapid habitat assessment pro-forma at the sites shown on Figure E-5. The following habitat components were recorded and the quality and dynamics of sample sites assessed:

- landform;
- internal and external connectivity;
- vegetation type;
- dominant groundcover;
- dominant mid-storey;
- dominant upper-storey;
- percentage (%) bare soil cover;
- % and depth of litter cover;
- % rock cover;
- % sticks and logs;
- % herb cover;
- % grass cover;
- % shrub cover;
- average mid-storey tree height;
- average upper-storey tree height;
- presence of mistletoe;
- structural classification;
- successional stage;
- tree health;
- hollows present;
- trees regenerating;
- water sources;
- evidence of fire;
- evidence of logging;
- dieback;
- understorey disturbance;
- presence of herbaceous and woody weeds;
- average tree density;
- trunk diameter at breast height (DBH) average and range;
- conservation rating;
- ecosystem function;
- conservation values; and
- conservation trends.



LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- Approximate Extent of Existing/Approved Surface Disturbance
- (5) Habitat Assessment Point

Broad Habitat Types

- Secondary Grassland
- Secondary Grassland with Regrowth Open Woodland/Forest
- Regrowth Open Forest
- Riparian Forest
- Possible Wildlife Corridor (associated with the Project area)

0 200 1000

Metres

GRID DATUM: MGA 94 ZONE 56

Source: AAHatch- Aerial Photography flown (April 2009) and DCPL (2009)

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

FIGURE E-5

Habitat Assessment Points

DULHUNTY COAL

CENWEST ENVIRONMENTAL SERVICES AND RESOURCE STRATEGIES

GCL-06-07 App_F&F_102H

The above information was used to characterise the quality and dynamics of potential and available habitats in the Project area and surrounds for threatened fauna species which could possibility occur within the Project area (Sections E.3.2.1 and E.3.2.2). Local records of threatened fauna species were obtained from database searches (Section E2.1) and relevant flora and fauna studies (Section E2.2).

Recovery plans, threatened species profiles and seminal texts were used to support the identification of potential habitats for threatened species.

Additional habitat information was sourced from Attachment EA, including the abundance and size of tree hollows, fauna key food trees (e.g. *Allocasuarina* sp. for the Glossy Black-cockatoo or winter flowering Eucalypts for the Swift Parrot) and subterranean bat roosts (e.g. caves, culverts, disused mine shafts).

The results are provided in Attachment EB.

E2.2.8 Targeted Surveys for Threatened Species

A preliminary assessment of potentially occurring threatened species was undertaken.

Attachment EC provides a list of threatened species compiled from database searches (Section E2.1) and relevant flora and fauna studies (Section E2.2). The likelihood of the threatened species occurring within the Project area was assessed based on the potential habitat in the Project area (Section E2.2.7). A refined list of threatened species which could potentially occur or do occur in the Project Area is provided in Table E-4. Table E-4 also indicates the specific survey technique utilised by EcoBiological (Attachment EA) (Section E2.2.3) in the Project area to target each threatened species.

Although some dry woodlands represent habitat for *Melaleuca groveana* (DECCW, 2009f), the dry woodland which occurs on-site is not a recognised habitat type for this species in the region (DECCW, 2009f). In support of this, various flora surveys undertaken in the Project area over the past years (Section E2.2) have not identified this species on-site.

Table E-4
Threatened Species which could Potentially Occur or have been Previously Located in the Project Area

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds[8]	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments	Targeted Survey Technique Utilised by EcoBiological (Attachment EA)
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECCW[4]	BioNet[5]	Protected Matters[6]	SRBG[7]				
Flora													
Asperula asthenes	Trailing Woodruff	V	V	-	-	X	-	X	X	-	Possible but unlikely	Not previously recorded, despite appropriate surveys	Quadrats, random meanders and targeted searches
Eucalyptus glaucina	Slaty Red Gum	V	V	-	-	X	-	X	X	-	Possible but unlikely	Not previously recorded, despite appropriate surveys	Quadrats, random meanders and targeted searches
Grevillea guthrieana	Guthrie's Grevillea	E	E	-	-	X	-	-	X	-	Possible but unlikely	Not previously recorded, despite appropriate surveys	Quadrats, random meanders and targeted searches
Syzygium paniculatum	Magenta Lilly Pilly	V	V	-	-	X	-	X	X	-	Possible but unlikely	Not previously recorded, despite appropriate surveys	Quadrats, random meanders and targeted searches
Cynanchum elegans	White-flowered Wax Plant	E	E	-	-	X	-	X	X	-	Possible but unlikely	Not previously recorded, despite appropriate surveys	Quadrats, random meanders and targeted searches
Amphibians													
Mixophyes balbus	Stuttering Frog	E	V	-	X	X	X	X	-	-	Possible	Wet Eucalypt Forest, creeklines and Mammy Johnsons River may provide suitable habitat	Amphibian day searches and spotlighting
Mixophyes iteratus	Giant Barred Frog	E	E	-	X	X	X	X	-	A	Known to Occur	Creeklines and Mammy Johnsons River provides suitable habitat	Amphibian day searches, spotlighting and call playback
Litoria aurea	Green and Golden Bell Frog	E	V	-	X	X	X	X	-	-	Possible but unlikely	No nearby records	Amphibian day searches, spotlighting and call playback

Table E-4 (Continued)
Threatened Species which could Potentially Occur or have been Previously Located in the Project Area

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds[8]	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments	Targeted Survey Technique Utilised by EcoBiological (Attachment EA)
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECCW[4]	BioNet[5]	Protected Matters[6]	SRBG[7]				
Amphibians (Continued)													
Litoria booroolongensis	Booroolong Frog	E	E	-	X	X	X	X	-	-	Possible but unlikely	Riparian vegetation may provide suitable habitat, but no nearby records	Amphibian day searches, spotlighting and call playback
Litoria brevipalmata	Green-thighed Frog	V	-	-	-	X	X	-	-	-	Possible but unlikely	Riparian vegetation may provide suitable habitat, but no nearby records	Amphibian day searches and spotlighting
Reptiles													
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	-	X	X	X	-	-	-	Possible	Suitable habitat present within the Project area and surrounds	Reptile searches
Hoplocephalus stephensii	Stephens' Banded Snake	V	-	-	X	X	X	-	-	-	Possible	Suitable habitat present within the Project area and surrounds	Reptile searches
Birds													
Stictonetta naevosa	Freckled Duck	V	-	X	-	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area	Avifauna census near waterbodies
Oxyura australis	Blue-billed Duck	V	-	X	-	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area	Avifauna census near waterbodies
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	X	X	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area	Avifauna census near waterbodies
Botaurus poiciloptilus	Australasian Bittern	V	-	X	-	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area	Avifauna census
Falco hypoleucos	Grey Falcon	V	-	-	-	X	X	-	-	-	Possible	Possible vagrant in the area	Avifauna census and spotlighting
Pandion haliaetus	Osprey	V	-	X	-	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area	Avifauna census and spotlighting

Table E-4 (Continued)
Threatened Species which could Potentially Occur or have been Previously Located in the Project Area

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds[8]	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments	Targeted Survey Technique Utilised by EcoBiological (Attachment EA)
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECCW[4]	BioNet[5]	Protected Matters[6]	SRBG[7]				
Birds (Continued)													
Lophoictinia isura	Square-tailed Kite	V	-	X	-	X	X	-	-	-	Possible	Wide ranging species	Avifauna census and spotlighting
Burhinus grallarius	Bush Stone-curlew	E	-	X	X	X	X	-	-	-	Possible	Limited habitat, no nearby records	Call playback, avifauna census and spotlighting
Ptilinopus magnificus	Wompoo Fruit-Dove	V	-	X	X	X	X	-	-	-	Possible	Riparian Vegetation along the Mammy Johnsons River may provide suitable habitat	Avifauna census
Ptilinopus superbus	Superb Fruit-Dove	V	-	X	-	X	X	-	-	-	Possible	Riparian Vegetation along the Mammy Johnsons River may provide suitable habitat	Avifauna census
Ptilinopus regina	Rose-crowned Fruit-Dove	V	-	X	-	X	X	-	-	B	Previously recorded	Riparian Vegetation along the Mammy Johnsons River may provide suitable habitat	Avifauna census
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	X	X	X	X	-	-	-	Possible.	Limited habitat	Avifauna census and targeted habitat search
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	X	-	X	X	-	-	-	Possible.	Limited habitat	Avifauna census and targeted habitat search
Neophema pulchella	Turquoise Parrot	V	-	X	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds	Avifauna census
Lathamus discolor	Swift Parrot	E	E	X	-	X	X	X		A	Previously recorded	Possible vagrant in the area	Avifauna census
Tyto tenebricosa	Sooty Owl	V	-	X	-	X	X	-	-	C	Previously recorded	Potential habitat present within the Project area and surrounds	Call playback, avifauna census, spotlighting and secondary evidence

Table E-4 (Continued)
Threatened Species which could Potentially Occur or have been Previously Located in the Project Area

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds[8]	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments	Targeted Survey Technique Utilised by EcoBiological (Attachment EA)
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECCW[4]	BioNet[5]	Protected Matters[6]	SRBG[7]				
Birds (Conrtinued)													
Tyto novaehollandiae	Masked Owl	V	-	X	X	X	X	-	-	-	Possible	Some potential habitat	Call playback, avifauna census, spotlighting and secondary evidence
Tyto capensis	Grass Owl	V	-	X	-	X	X	-	-	-	Possible	Some potential habitat	Call playback, avifauna census, spotlighting and secondary evidence
Ninox strenua	Powerful Owl	V	-	X	X	X	X	-	-	B	Previously recorded	Potential habitat present within the Project area and surrounds	Call playback, avifauna census, spotlighting and secondary evidence
Ninox connivens	Barking Owl	V	-	X	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds	Call playback, avifauna census, spotlighting and secondary evidence
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	-	X	-	X	X	-	-	A	Known to Occur	Continuous areas of woodland	Avifauna census
Pyrrholaemus saggitatus	Speckled Warbler	V	-	X	-	X	X	-	-	A	Previously recorded	Potential habitat present within the Project area and surrounds	Avifauna census
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	X	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds	Avifauna census
Anthochaera phrygia	Regent Honeyeater	E	E	X	X	X	X	X	-	-	Possible	Suitable habitat present within the Project area and surrounds	Avifauna census
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	X	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds	Avifauna census

Table E-4 (Continued)
Threatened Species which could Potentially Occur or have been Previously Located in the Project Area

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds[8]	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments	Targeted Survey Technique Utilised by EcoBiological (Attachment EA)
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECCW[4]	BioNet[5]	Protected Matters[6]	SRBG[7]				
Birds (Continued)													
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	X	X	X	X	-	-	A	Previously recorded	Potential habitat present within the Project area and surrounds	Avifauna census
Pachycephala olivacea	Olive Whistler	V	-	X	X	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area	Avifauna census
Stagonopleura guttata	Diamond Firetail	V	-	X	X	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area	Avifauna census
Mammals													
Dasyurus maculatus	Spotted-tailed Quoll	V	E	-	X	X	X	X	-	-	Possible	Potential habitat present within the Project area and surrounds	Cage traps, scats and hair tubes
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	-	X	X	X	-	-	A, B, D	Previously recorded	Potential habitat present within the Project area and surrounds	Hair tubes, Elliot traps and scats
Planigale maculata	Common Planigale	V	-	-	-	X	X	-	-	D	Previously recorded	Potential habitat present within the Project area and surrounds	Hair tubes, Elliot traps, owl pellets
Phascolarctos cinereus	Koala	V	-	-	X	X	X	-	-	B, E	Previously recorded	Potential habitat present within the Project area and surrounds	Call playback, spotlighting, habitat characterisation, scats and secondary evidence
Petaurus australis	Yellow-bellied Glider	V	-	-	-	X	X	-	-	-	Possible	Potential habitat in the surrounds	Call playback, hair tubes, Elliot traps and secondary evidence

Table E-4 (Continued)
Threatened Species which could Potentially Occur or have been Previously Located in the Project Area

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds[8]	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments	Targeted Survey Technique Utilised by EcoBiological (Attachment EA)
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECCW[4]	BioNet[5]	Protected Matters[6]	SRBG[7]				
Mammals (Continued)													
Petaurus norfolcensis	Squirrel Glider	V	-	-	X	X	X	-	-	A, D, F	Previously recorded	Potential habitat present within the Project area and surrounds	Call playback, hair tubes and Elliot traps
Macropus parma	Parma Wallaby	V	-	-	X	X	X	-	-	-	Possible	Potential habitat in the surrounds	Hair tubes, scats and opportunistic observations
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	-	X	X	X	X	-	-	Possible	Potential habitat present within the Project area and surrounds	Identification of roost habitat and spotlighting
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	-	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds	Anabat detecting, harp traps and spotlighting
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	-	X	X	X	-	-	A, B	Previously recorded	Potential habitat present within the Project area and surrounds	Anabat detecting and harp traps
Kerivoula papuensis	Golden-tipped Bat	V	-	-	X	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds	Harp traps
Miniopterus australis	Little Bentwing-bat	V	-	-	X	X	X	-	-	-	Possible	Predominately foraging habitat only	Anabat detecting and harp traps
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	-	-	X	X	-	-	A, B, G	Previously recorded	Potential habitat present within the Project area and surrounds	Identification of roost habitat and harp traps
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	-	-	X	X	X	-	-	Possible	Foraging habitat only	Identification of roost habitat, harp traps and Anabat detecting

Table E-4 (Continued)
Threatened Species which could Potentially Occur or have been Previously Located in the Project Area

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds[8]	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments	Targeted Survey Technique Utilised by EcoBiological (Attachment EA)
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECCW[4]	BioNet[5]	Protected Matters[6]	SRBG[7]				
Mammals (Continued)													
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	-	X	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds	Harp traps
Myotis adversus	Large-footed Myotis	V	-	-	X	X	X	-	-	A, B, G	Previously recorded	Potential habitat present within the Project area and surrounds	Harp traps and spotlighting
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	-	X	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds	Anabat detecting
Vespadelus troughtoni	Eastern Cave Bat	V	-	-	-	X	X	-	-	-	Possible	Foraging habitat only	Identification of roost habitat and harp traps

[1] Conservation Status under the TSC Act and EPBC Act (current as of September 2009) E – Endangered, V – Vulnerable.

[2] Birds Australia (2009).

[3] Australian Museum (2009a).

[4] DECCW (2009c).

[5] NSW Government (2009).

[6] DEWHA (2009b).

[7] SRBG (2009).

[8] Survey Reports:

A Attachment EA.
B Woodward-Clyde (1996c).
C Paul Webber Consulting Services (1996).
D Place Planning and Design (2003).
E ERM Mitchell McCotter (1996b).
F DCPL (2007a).
G Fly-By-Night Bat Surveys (1996).

E3 RESULTS

This section provides a summary of the results from the various flora and fauna studies relevant to the Project.

E3.1 FLORA

Introductory Comments

Vegetation formations and vegetation classes in NSW have been described and mapped on a broad scale by Keith (2004) *Ocean Shores to Desert Dunes: The Native Vegetation of NSW and ACT*. The vegetation formations and classes described by Keith (2004) provide a framework for the finer scale vegetation types listed in the DECCW's Vegetation Types Database (DECCW, 2009e). The Vegetation Types Database (DECCW, 2009e) contains a list of vegetation types which occur in each CMA region in NSW. It was originally created for use with the BioMetric tool under the NSW *Native Vegetation Act, 2003*, but is now also used with the NSW Biobanking Credit Calculator under the TSC Act (DECCW, 2009a).

Regional vegetation mapping covering the Project area was undertaken by the NSW National Parks and Wildlife Service (NPWS) (1999a) as part of the *Forest Ecosystem Classification and Mapping for the Upper and Lower North East CRA Regions.* This low precision broad mapping, produced from air photo interpretation indicates that South-coast Shrubby Grey Gum (Map Unit 134), South-coast Tallowwood-Blue Gum (Map Unit 135) and Southern Wet Sydney Blue Gum (Map Unit 137) occur in the Project area, although, fine-scale surveys by EcoBiological (Attachment EA and 2009b) suggests that the majority of vegetation in the Project area more closely resembles the Seaham Spotted Gum Iron Bark Forest (Map Unit 16) described by similar NPWS mapping for the Lower Hunter and Central Coast Region, located south of the Project area (NPWS, 2000a; House, 2003).

Floyd (1990) describes the major rainforest communities in NSW and the Vegetation Types Database (DECCW, 2009e) indicates that some of the major rainforest communities identified by Floyd (1990) are related to the vegetation types in the Project area and surrounds (Table E-5).

On a local scale, vegetation communities in the DCM area were first described and mapped in 1996 by ERM Mitchell McCotter (1996a). ERM Mitchell McCotter (1996a) described and mapped the vegetation based on structural characteristics and dominant species in each stratum. Since 1996, vegetation has regenerated in areas previously mapped by ERM Mitchell McCotter (1996a) as cleared land.

Table E-5 presents the vegetation communities recorded within the Project area and/or surrounds by EcoBiological (Attachment EA and 2009b), compared to vegetation types previous mapped by ERM Mitchell McCotter (1996a) and assigned against the best fitting communities in the Vegetation Types Database (DECCW, 2009e).

Table E-5
Vegetation Communities Recorded in the Project Area and/or Surrounds

Vegetation Communities Mapped by EcoBiological		ERM Mitchell McCotter (1996a)	Vegetation Type (DECCW, 2009e) assigned by EcoBiological (Attachment EA; EcoBiological, 2009b)	Vegetation Type Source (in DECCW, 2009e)
Vegetation Community	**Dominant Species**			
Dry Sclerophyll Forest Formation – Hunter Macleay Dry Sclerophyll Forest Class				
Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest	Spotted Gum, Thick-leaved Mahogany, Tallowwood and Red Ironbark – *Corymbia maculata, E. carnea, E. microcorys* and *E. fibrosa*	Low Open Forest	Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	REMS Map unit 16 (NPWS, 2000a)
Spotted Gum – Grey Ironbark - Thick-leaved Mahogany Forest	Spotted Gum, Grey Ironbark, Narrow-leaved Ironbark, Tallowwood, Grey Gum and Thick-leaved Mahogany - *Corymbia maculata, Eucalyptus siderophloia, E. crebra, E. microcorys, E. canaliculata* and *E. carnea*	Open Forest (including Ridge Open Forest)	Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	REMS Map unit 16 (NPWS, 2000a)
	Variant- *Corymbia maculata, Eucalyptus siderophloia*			
	Variant- *Corymbia maculata, E. microcorys*			
	Variant- *Allocasuarina torulosa*, *E. microcorys*			
Grassy Woodlands Formation – Coastal Valley Grassy Woodland				
Red Gum Grassy Woodland	Forest Red Gum, Grey Box and Grey Ironbark – *E. tereticornis, E. moluccana* and *E. siderophloia*	-	Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast	FE 54 (NPWS, 1999a)
Grey Gum – Red Gum – Apple Riparian Forest	Grey Gum, Rough-barked Apple, White Mahogany and Forest Red Gum – *Eucalyptus canaliculata, Angophora floribunda, E. acmenoides* and *E. tereticornis*	-	Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast	FE 54 (NPWS, 1999a)
Cabbage Gum Floodplain Forest	Cabbage Gum – *Eucalyptus amplifolia* subsp. *amplifolia*	Low Closed Forest	Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands	FE 46 (NPWS, 1999a)

Table E-5 (Continued)
Vegetation Communities Recorded in the Project Area and/or Surrounds

Vegetation Communities Mapped by EcoBiological		ERM Mitchell McCotter (1996a)	Vegetation Type (DECCW, 2009e) assigned by EcoBiological (Attachment EA; EcoBiological, 2009b)	Vegetation Type Source (in DECCW, 2009e)
Vegetation Community	**Dominant Species**			
Rainforest Formation – Dry Rainforest Class				
Riparian Closed Forest	Weeping Lilly Pilly, Water Gum and River Oak - *Waterhousea floribunda*, *Tristaniopsis laurina* and *Casuarina cunninghamii*	Closed Forest	Weeping Lilly Pilly - Water Gum riparian rainforest of the southern North Coast	Castanospermum - *Waterhousia floribunda* Alliance, Suballiance 26 (Floyd, 1990)
Dry Sclerophyll Forests Formation (Shrubby Subformation) – North Coast Dry Sclerophyll Forest Class				
Stringybark - Paperbark Forest	White Mahogany, Thick-leaved Mahogany, Prickly-leaved Paperbark – *Eucalyptus acmenoides, E. carnea* and *Melaleuca nodosa*	Forest (including Swamp Sclerophyll Forest, Dry Sclerophyll Forest (regenerating) and Ecotone Forest	Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin	FE 11, 130 and 145 (NPWS, 1999a)
Rainforest Formation – Subtropical Rainforest Class				
Dry Gully Rainforest	Rusty Fig and Two-leaved Tuckeroo with Giant Stinging Tree - *Ficus rubiginosa* and *Rhysotoechia bifoliolata* subsp. *bifoliolata with Dendrocnide excelsa*	-	Giant Stinging Tree - Fig dry subtropical rainforest of the North Coast and Brigalow Belt South	Dendrocnide - Ficus Alliance (Floyd, 1990); BBS: Goulburn River NP Grey Myrtle (*Backhousia myrtifolia*) Rainforest API addition; BBS: Towarri Lilly Pilly (*Syzygium smithii*), Daphnandra sp A, *Alectryon subcinereus* Rainforest API addition. (Planning NSW, 2004)
Wet Sclerophyll Forests Formation (Shrubby Subformation) – North Coast Wet Sclerophyll Forest Class				
Blue Gum Moist Forest	Sydney Blue Gum and Brush Box - *Eucalyptus saligna* and *Lophostemon confertus*	-	Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	FE 135 (NPWS, 1999a)
Forested Wetland Formation – Eastern Riverine Forest Class				
Perch Sedgeland	Slender Tea-tree, Erect Guinea-flower, Kerrawang, Box Thorn, Hop Bush and Forest Oak - *Leptospermum trinervium, Hibbertia riparia*, *Rulingia dasyphylla*, *Bursaria spinosa* subsp. *spinosa*, *Dodonaea triquetra* and *Allocasuarina littoralis*	-	Tea-tree shrubland of drainage areas of the slopes and tablelands	BBS Units 10 and 137 (Planning NSW, 2004); Nandewar Units 49 and 108 (Wall, 2004) and FE 199 (NPWS, 1999a)

E3.1.1 Vegetation in the Project Area

This section describes natural vegetation communities within the Project area, as well as human modified communities such as derived grassland and cropped areas.

Vegetation Communities within the Project Area

The native vegetation community patches in the Project area are mostly regrowth, regenerating from previous land clearing, (logging, pasture and limited cropping) with scattered old growth trees (Attachment EA). As a result of past clearing, there is very likely a greater mixing of flora species in regrowth areas across the landscape than likely would have occurred in pre-European climax vegetation communities.

The vegetation communities recorded within the Project area are shown on Figures E-6a and E-6b and listed in Table E-6. Figure E-6a shows the vegetation community mapping over the proposed approximate extent of additional Project surface disturbance and Figure E-6b shows the vegetation mapping over the approximate extent of additional irrigation areas (outside of the additional Project surface disturbance). Potential impacts on vegetation from these aspects are discussed in Sections E4.1 to E4.3.

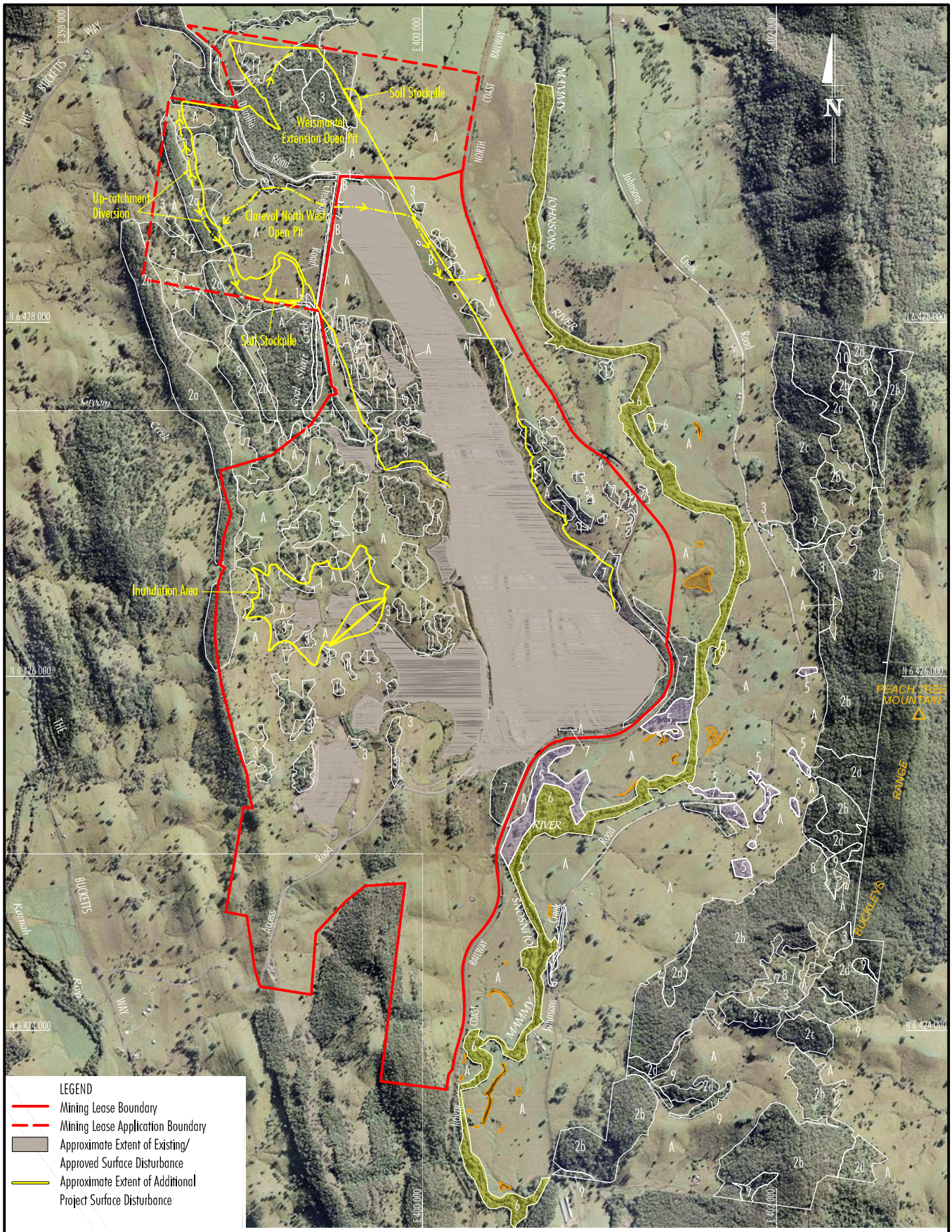
Table E-6
Vegetation Communities Recorded within the Project Area

Vegetation Community Number (Figures E-6a and E-6b)	Vegetation Community	Dominant Species	Equivalent Vegetation Community Number in Attachment EA
Dry Sclerophyll Forest Formation – Hunter Macleay Dry Sclerophyll Forest Class			
1	Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest	Spotted Gum, Red Ironbark, Thick-leaved Mahogany, Tallowwood and Red Ironbark – *Corymbia maculata, Eucalyptus fibrosa, E. carnea* and *E. microcorys*	5
2a*	Spotted Gum – Grey Ironbark - Thick-leaved Mahogany Forest	Spotted Gum, Grey Ironbark, Narrow-leaved Ironbark, Tallowwood, Grey Gum and Thick-leaved Mahogany – *Corymbia maculata, E. siderophloia, E. crebra, E. microcorys, E. canaliculata* and *E. carnea*	7
Grassy Woodlands Formation – Coastal Valley Grassy Woodland			
3	Red Gum Grassy Woodland	Forest Red Gum, Grey Box and Grey Ironbark – *E. tereticornis, E. moluccana* and *E. siderophloia*	4
4	Grey Gum – Red Gum – Apple Riparian Forest	Grey Gum, Rough-barked Apple, White Mahogany and Forest Red Gum – *E. canaliculata, Angophora floribunda, E. acmenoides* and *E. tereticornis*	6
Dry Sclerophyll Forests Formation (Shrubby Subformation) – North Coast Dry Sclerophyll Forest Class			
7	Stringybark - Paperbark Forest	White Mahogany, Thick-leaved Mahogany, Prickly-leaved Paperbark – *E. acmenoides, E. carnea* and *Melaleuca nodosa*	3

Source: after Attachment EA.

* Vegetation Community 2b to 2d are variants of this community that are mapped on Figures E-6a and E-6b, but do not occur in the Project area.

A description of each vegetation community is provided below. The species associated with each vegetation community were described by EcoBiological as detailed in Attachment EA.



Vegetation Communities

1 Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest

2a-2d Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest

3 Red Gum Grassy Woodland

4 Grey Gum – Red Gum – Apple Riparian Forest

5 Cabbage Gum Floodplain Forest - River-flat Eucalypt Forest on Coastal Floodplains Endangered Ecological Community

6 Riparian Closed Forest - Lowland Forest on Floodplain Endangered Ecological Community

7 Stringybark – Paperbark Forest

8 Dry Gully Rainforest

9 Blue Gum Moist Forest

10 Perch Sedgeland

11 Freshwater Wetlands Endangered Ecological Community

Vegetation Map Units

A Derived Grasslands

B Cropping

0 200 1000

Metres

GRID DATUM: MGA 94 ZONE 56

Source: AAHatch- Aerial Photography flown April 2009; DCPL (2009) and Vegetation - Ecobiological (2009a and b)

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

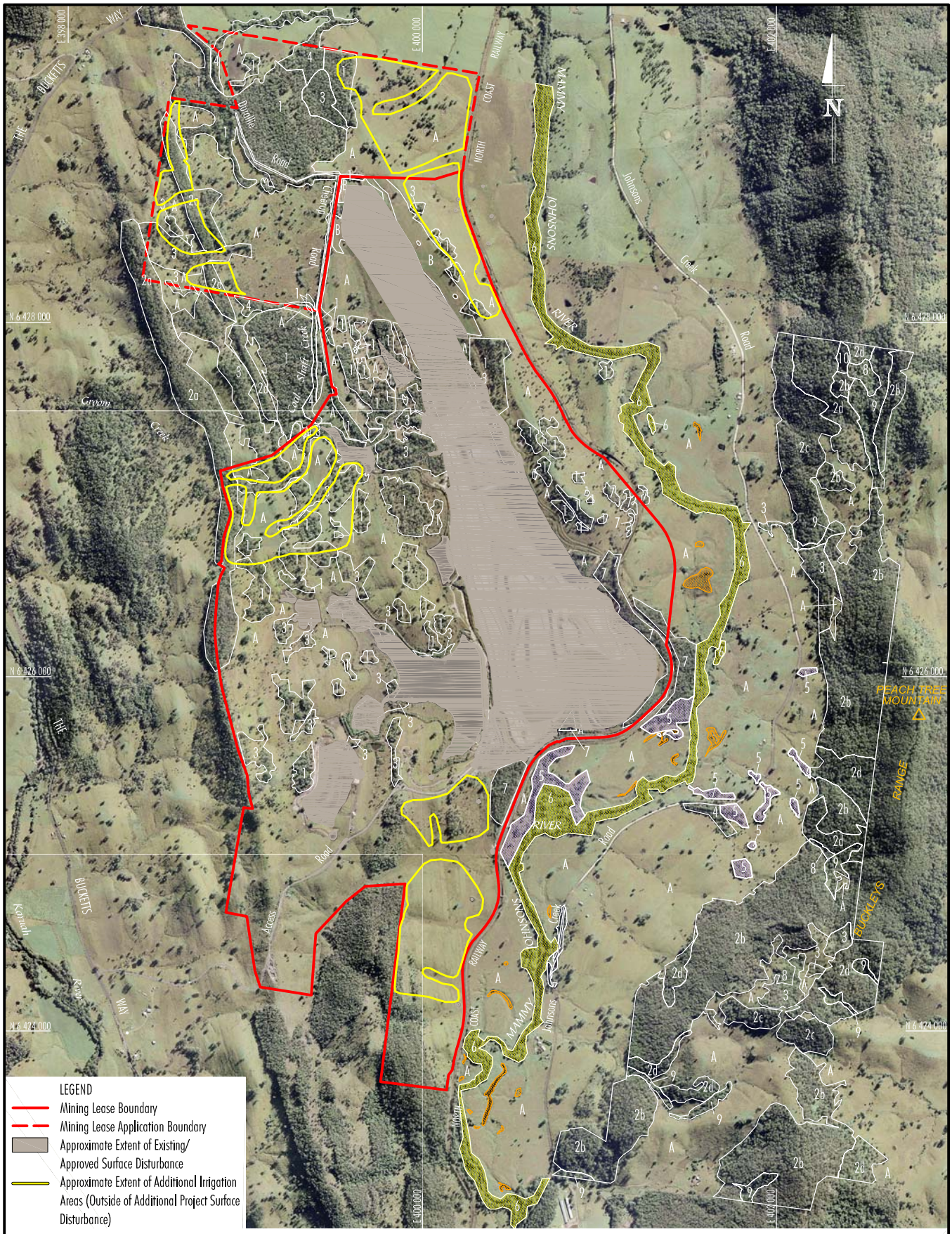
FIGURE E-6a

Vegetation Communities and Vegetation Mapping Units

DUGALDE COAL

CENWEST ENVIRONMENTAL SERVICES AND RESOURCE STRATEGIES

GCL-06-07 App_F&F_103G



LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- Approximate Extent of Existing/ Approved Surface Disturbance
- Approximate Extent of Additional Irrigation Areas (Outside of Additional Project Surface Disturbance)

Vegetation Communities

- 1 Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest
- 2a-2d Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest
- 3 Red Gum Grassy Woodland
- 4 Grey Gum – Red Gum – Apple Riparian Forest
- 5 Cabbage Gum Floodplain Forest - River-flat Eucalypt Forest on Coastal Floodplains Endangered Ecological Community
- 6 Riparian Closed Forest - Lowland Forest on Floodplain Endangered Ecological Community
- 7 Stringybark – Paperbark Forest
- 8 Dry Gully Rainforest
- 9 Blue Gum Moist Forest
- 10 Perch Sedgeland
- 11 Freshwater Wetlands Endangered Ecological Community

Vegetation Map Units

- A Derived Grasslands
- B Cropping

0 200 1000

Metres

GRID DATUM: MGA 94 ZONE 56

Source: AAHatch- Aerial Photography flown April 2009; DCPL (2009) and Vegetation - Ecobiological (2009a and b)

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

FIGURE E-6b

Vegetation Communities and Vegetation Mapping Units

DUNDALE COAL

CENWEST ENVIRONMENTAL SERVICES AND RESOURCE STRATEGIES

GCL-06-07 App_F&F_109G

Vegetation Community 1 - Spotted Gum–Red Ironbark–Thick-leaved Mahogany Forest

Vegetation Community 1, the Spotted Gum–Red Ironbark–Thick-leaved Mahogany Forest, is the most commonly occurring vegetation community in the Project area and occurs on undulating hills and slopes within the Project area and surrounds (Figures E-6a and E-6b).

Vegetation Community 1 is also the dominant vegetation community in the largest remnant patch of native vegetation in the Project area, located to the north in the Weismantel Extension open pit area (Figure E-6a). Smaller areas of this vegetation community are also associated with the proposed additional inundation areas of the augmented Auxiliary Dam No. 2 (Figure E-6a) and existing and proposed irrigation areas (Figure E-6b).

A significant area of this vegetation community in the Project area has regenerated since ERM Mitchell McCotter (1996a) mapped the vegetation within ML 1427.

EcoBiological noted variations in this vegetation community such as the variability in the dominance of ironbarks (Red Ironbark [*Eucalyptus fibrosa*] and Grey Ironbark [*E. siderophloia*]) (Attachment EA).

EcoBiological (Attachment EA) assigned this vegetation community to the *Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast* Vegetation Type described in DECCW (2009e) (Table E-5) and described the floristic composition of this vegetation community as:

> *… dominated by Corymbia maculata (Spotted Gum), E. siderophloia (Grey Ironbark) and E. carnea (Thick-leaved Mahogany), with localised E. microcorys (Tallowwood) and E. fibrosa (Red Ironbark) co-dominant.*
>
> *The mid layer was moderate to relatively sparse across its range. The most common species was Allocasuarina torulosa (Forest Oak).*
>
> *The shrub layer was sparse and common species were Bursaria spinosa (Blackthorn), Leucopogon juniperinus (Prickly Beard-heath), Daviesia ulicifolia (Gorse Bitter Pea), Breynia oblongifolia (Coffee Bush) and Acacia ulicifolia (Prickly Moses).*
>
> *The grasses Entolasia stricta (Wiry Panic), Aristida vagans, Themeda australis (Kangaroo Grass), Echinopogon caespitosus (Hedgehog-grass) and Cymbopogon refractus (Barbed Wire Grass) dominated the ground cover across its range. Other indicative ground species included Cheilanthes sieberi subsp. sieberi (Poison Rockfern), Lomandra multiflora (Many-flowered Mat-rush), Pratia purpurescens, Pomax umbellata, Opercularia diphylla, Vernonia cinerea and Brunoniella australis (Blue Trumpet). The typical ground vines were Glycine tabacina, Desmodium varians (Slender Tick-trefoil) and Billardiera scandens var. scandens (Hairy Apple Berry).*

During the Project surveys, a total of 111 native species and six introduced species were recorded in this vegetation community (Attachment EA). The number of native species recorded in a quadrat ranged from 12 to 33 species (Attachment EA).

Introduced species recorded within Vegetation Community 1 include *Paspalum dilatatum, Andropogon virginicus, Cyperus Eragrostis, Verbena bonariensis* and *Hypochaeris radicata* (Attachment EA).

The habitat (Section E2.2.7) condition of this vegetation community was impacted by past and present grazing and high intensity past logging.

Vegetation Community 2a - Spotted Gum–Grey Ironbark–Thick-leaved Mahogany Forest

Vegetation Community 2a, the Spotted Gum–Grey Ironbark–Thick-leaved Mahogany Forest, occurs on slopes and ridges in the west of the Project area (Attachment EA). Only relatively small areas of this vegetation community occur in the Project area, and these are located within the proposed Clareval North West open pit and the Up-catchment Diversion (Figure E-6a). This vegetation community also occurs within the proposed additional irrigation areas (outside of the additional Project surface disturbance) (Figure E-6b).

This vegetation community is similar to Vegetation Community 1 in that Spotted Gum (*Corymbia maculata*) is a dominant species, but the composition of the vegetation communities differ, likely due to the difference in substrate, the most notable difference being the lack of Red Ironbark (*Eucalyptus fibrosa*) (Attachment EA). EcoBiological (Attachment EA) described the floristic composition of this vegetation community as:

> *The dominant canopy species are Corymbia maculata (Spotted Gum), Eucalyptus siderophloia (Grey Ironbark), E. crebra (Narrow-leaved Ironbark), E. microcorys (Tallowwood), E. canaliculata (Grey Gum) and E. carnea (Thick-leaved Mahogany).*
>
> *The mid stratum consisted almost entirely of Allocasuarina torulosa (Forest Oak). The shrub layer was relatively sparse at most locations. The common species were Persoonia linearis (Narrow-leaved Geebung), Podolobium ilicifolium, Bursaria spinosa (Blackthorn) and Acacia ulicifolia (Prickly Moses).*
>
> *The ground cover had native grasses (typically Themeda australis [Kangaroo Grass] and Imperata cylindrica [Blady Grass]) and common herbs were typically Pratia purpurascens (Whiteroot), Gonocarpus teucrioides (Raspwort), Hibbertia diffusa (Wedge Guinea Flower) and Leucopogon juniperinus (Prickly Beard-heath).*

During the Project surveys, a total of 93 native species and 12 introduced species were recorded in this vegetation community (Attachment EA). The number of native species recorded in a quadrat ranged from 45 to 50 species (Attachment EA).

Introduced species that occur within Vegetation Community 2a include *Bidens pilosa, Cirsium vulgare, Conyza bonariensis, Conzya* sp.*, Euchiton sphaericus, Senecio madagascariensis, Taraxacum officinale, Lantana camara, Verbena bonariensis, Lilium formosanum, Andropogon virginicus* and *Paspalum dilatatum* (Attachment EA).

The habitat (Section E2.2.7), condition of this vegetation community was observed to be relatively good considering that it is regrowth vegetation with some weed species present.

Vegetation Community 3 - Red Gum Grassy Woodland

Red Gum Grassy Woodland occurs on the lower slopes in the Project area, defined by the dominance of Forest Red Gum (*E. tereticornis*) (Attachment EA). This vegetation community occurs within the proposed additional inundation area of Auxiliary Dam No. 2, Weismantel Extension open pit area, Clareval North West open pit area (Figure E-6a) and within the proposed additional irrigation areas (outside of the additional Project surface disturbance) (Figure E-6b).

The composition of this vegetation community varies through-out the Project area, from almost a monoculture of Forest Red Gum (*E. tereticornis*) occurring in the north of the area (Figures E-6a), to areas of more sparse regrowth, together with other Eucalypts, particularly Grey Box (*E. moluccana*) and Grey Ironbark (*E. siderophloia*). Some highly fragmented areas of this community have very little Forest Red Gum (*E. tereticornis*) present.

This vegetation community was a reasonable match for the *Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast* Vegetation Type described in DECCW (2009e) (Table E-5).

EcoBiological (Attachment EA) described the floristic composition of the Red Gum Grassy Woodland as:

> *The dominant species was E. tereticornis (Forest Red Gum), with E. moluccana (Grey Box) and E. siderophloia (Grey Ironbark) as co-dominants. Eucalyptus amplifolia subsp. amplifolia (Cabbage Gum), E. fibrosa (Red Ironbark), E. globoidea (White Stringybark) and Angophora floribunda (Rough-barked Apple) were also common species.*
>
> *Allocasuarina torulosa (Forest Oak) was common throughout the community. The mid layer was relatively sparse, yet on the drainage lines the occurrence of Melaleuca linariifolia (Flax-leaved Paperbark), M. styphelioides (Prickly-leaved Tea Tree) and Callistemon salignus (Willow Bottlebrush) became moderate to dense.*
>
> *The lower slope and gully had a moderate shrub cover consisting of Leucopogon juniperinus (Prickly Beard-heath), Breynia oblongifolia (Coffee Bush), Gahnia clarkei (Tall Saw-sedge) and a moderate diversity of ground cover species.*
>
> *The higher slopes had a grassy woodland structure, having a mixture of native grasses, ferns and herbs. Most common were grasses such as Themeda australis (Kangaroo Grass), Aristida vagans (Threeawn Speargrass), Cymbopogon refractus (Barbed Wire Grass) and Imperata cylindrica (Blady Grass).*

During the Project surveys, a total of 97 native species and five introduced species were recorded in this vegetation community (Attachment EA). The number of native species recorded in a quadrat ranged from 17 to 33 species (Attachment EA).

Introduced species that occur within Vegetation Community 3 are *Euchiton pensylvanicum, Hypochaeris radicata, Paspalum dilatatum* and *Pennisetum clandestinum* (Attachment EA).

The habitat (Section E2.2.7) condition of this vegetation community was observed to be relatively good considering that it is regrowth vegetation with some weed species present. With the exception of the northern patch of Vegetation Community 3 (Figure E-6a), the majority of this vegetation community occurs as fragmented patches.

Vegetation Community 4 - Grey Gum–Red Gum–Apple Riparian Forest

Vegetation Community 4, the Grey Gum–Red Gum–Apple Riparian Forest, occurs as riparian vegetation along the ephemeral unnamed drainage line in the north of the Project area (Figure E-6a). Following sufficient rainfall, the unnamed drainage line drains north-east to the Mammy Johnsons River.

EcoBiological (Attachment EA) described the floristic composition of this vegetation community as:

> *The dominant canopy trees included Eucalyptus canaliculata (Grey Gum) with either sub dominant or co dominant Angophora floribunda (Rough-barked Apple) and E. acmenoides (White Mahogany). E. tereticornis (Forest Red Gum) was present throughout the community.*
>
> *The mid stratum on the drainage lines was relatively dense with Melaleuca styphelioides (Prickly-leaved Tea Tree), M. linariifolia (Flax-leaved Paperbark) and Glochidion ferdinandi var. ferdinandi (Cheese Tree) on banks of the drainage line. Some Casuarina cunninghamii was present along these watercourses although sparse. Acacia irrorata (Green Wattle), Leucopogon juniperinus (Prickly Beard-heath), Bursaria spinosa (Blackthorn) and Breynia oblongifolia (Coffee Bush) were common shrubs throughout.*

The wetter drainage lines generally had dense cover of Gahnia clarkei (Tall Saw-sedge), Leptospermum polygalifolium subsp. cismontanum (Tantoon), Carex appressa (Tall Sedge) and Hibbertia aspera (Rough Guinea Flower). Native grasses included Entolasia marginata (Bordered Panic), Themeda australis (Kangaroo Grass) and Imperata cylindrica (Blady Grass). Common herbs were Dichondra repens (Kidney Weed) and Adiantum aethiopicum (Common Maidenhair) and orchids Chiloglottis diphylla and Acianthus fornicatus (Pixie Caps), also indicative of a moist or protected environment.

During the Project surveys, a total of 69 native species were recorded in this vegetation community (Attachment EA). The number of native species recorded in a quadrat ranged from 12 to 34 species (Attachment EA).

The habitat (Section E2.2.7), condition of this vegetation community was observed to be moderately disturbed with Lantana prevalent.

Vegetation Community 7 - Stringybark - Paperbark Forest

Vegetation Community 7, Stringybark - Paperbark Forest, occurs on sandy soils on rises adjacent to Vegetation Community 5 (Figure E-6a).

EcoBiological (Attachment EA) described the floristic composition of this vegetation community as:

The dominant species were Eucalyptus acmenoides (White Mahogany) and E. carnea (Thick-leaved Mahogany). Other common species were E. amplifolia subsp. amplifolia (Cabbage Gum), E. fibrosa (Red Ironbark), E. siderophloia, E. globoidea (White Stringybark) and Angophora floribunda (Rough-barked Apple).

The mid layer had dense Melaleuca nodosa (Paperbark) dominant throughout the surveyed areas, with Acacia ulicifolia (Prickly Moses) also common. Leptospermum polygalifolium subsp. cismontanum (Tantoon), Breynia oblongifolia (Coffee Bush) and Zieria smithii (Sandfly Zieria) were dominant and common on the drainage lines.

The forested areas had a moderate to sparse shrub and ground layer, mainly due to a dense mid layer. Hibbertia aspera (Rough Guinea Flower), H. diffusa (Wedge Guinea Flower). Leucopogon juniperinus (Prickly Beard-heath), Pteridium esculentum (Common Bracken) and Gahnia clarkei (Tall Saw-sedge) were common shrub species.

The common grasses included Entolasia stricta (Wiry Panic) and E. marginata (Bordered Panic), Microlaena stipioides, Imperata cylindrica var. major (Blady Grass) and Lomandra longifolia (Spiny-headed Mat-rush). The common herbs were Gonocarpus teucrioides (Raspwort), Dichondra repens (Kidney Weed), Pratia purpurascens (Whiteroot) and Lindsaea linearis (Screw Fern). Orchid species were regularly recorded, typically being Chiloglottis diphylla and Acianthus fornicatus (Pixie Caps).

The vines Glycine microphylla (Small-leaf Glycine) and Parsonsia straminea (Common Silkpod) were common throughout the community.

During the Project surveys, a total of 93 native species and six introduced species were recorded in this vegetation community (Attachment EA). The number of native species recorded in a quadrat ranged from 25 to 41 species (Attachment EA).

Introduced species that occur within Vegetation Community 7 are *Facelis retusa, Chrysanthemoides monulifera, Hypochaeris radicata, Senecio madagascariensis, Ligustrum sinense* and *Andropogon virginicus* (Attachment EA).

The habitat (Section E2.2.7) condition of this vegetation community was observed to be relatively good.

Derived Grasslands

Derived Grasslands occur in the majority of the Project area and are a result of past land use practices, where trees have been removed for timber, and limited cropping and pasture improvement undertaken (Figures 6a and 6b). Scattered remnant trees are also present in this map unit.

The Derived Grasslands are a mixture of native and introduced species. Native species present include *Sporobolus elongatus, Capillipedium parviflorum, Imperata cylindrical, Themeda australis, Bothriochloa macra, Desmodium brachypodum, Goodenia paniculata* and *Lotus australis.*

Introduced species present include *Axonopus fissifolius, Paspalum dilatatum, Hypochaeris radicata, Verbena bonariensis, Cyperus brevifolius, Eragrostis curvula, Panicum capillare, Plantago lanceolata*, and *Trifolium fragiferum*.

These grassland areas are likely to represent the Derived Blady Grass in Central/Upper Hunter Vegetation Type and Derived Grasslands in Coastal Valleys Vegetation Type (DECCW, 2009e)

During the Project surveys, a total of 55 native species and 46 introduced species were recorded in this vegetation community (Attachment EA). The number of native species recorded in a quadrat ranged from 13 to 26 species (Attachment EA).

Cropping Areas

Small areas of previous cropped land also occur in the Project area, and are predominantly used for growing irrigated crops (e.g. Sorghum) in association with the existing DCM (Figures 6a and 6b).

E3.1.2 Vegetation in the Project Area Surrounds

Additional vegetation communities which occur in the general area surrounding the Project area are described below, namely Vegetation Communities 5, 6 and 11. Vegetation Communities 8, 9 and 10 are not described below as these vegetation communities occur further way from the Project on Buckleys Range. Vegetation Community 9 is described in Section E6 in relation to the proposed offset area.

Vegetation Community 5 - Cabbage Gum Floodplain Forest

Vegetation Community 5, Cabbage Gum Floodplain Forest, occurs on the floodplains adjacent to Vegetation Community 6 and the Mammy Johnsons River.

EcoBiological (Attachment EA) report that the Cabbage Gum Floodplain Forest is equivalent to the River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions Endangered Ecological Community (River-Flat Eucalypt Forest EEC) listed under the TSC Act.

EcoBiological (Attachment EA) describes the floristic composition of this vegetation community as:

> *… strongly dominated by Eucalyptus amplifolia subsp. amplifolia (Cabbage Gum). Occasional species were E. siderophloia (Grey Ironbark), E. resinifera (Red Mahogany), E. saligna (Sydney Blue Gum) and E. globoidea (White Stringybark).*

The mid stratum varied from absent in disturbed areas to dense Melaleuca nodosa thicket in disturbed areas and M. decora, M. styphelioides (Prickly-leaved Tea Tree) and M. linariifolia (Flax-leaved Paperbark). Pittosprum undulatum and Callistemon salignus (Willow Bottlebrush) were also common throughout the community.

The shrub stratum was generally elevated to about 2m, with M. nodosa, Breynia oblongifolia (Coffee Bush), Exocarpos cupressiformis (Cherry Ballart), Leptospermum polygalifolium subsp. cismontanum, and Ozothamnus diosmifolius (Rice Flower) as common species.

The ground stratum had many wet or moist species such as Carex appressa (Tall Sedge), Lomandra longifolia (Spiny-headed Mat-rush), Hibbertia aspera (Rough Guinea Flower) and Juncus usitatus. The typical grasses were Microlaena stipoides var stipoides (Weeping Grass), Entolasia marginata (Bordered Panic), Entolasia stricta (Wiry Panic) and Oplismenus imbecillis. Common ground herbs were Hydrocotyl peduncularis, Galium propinquum and Gonocarpus teucrioides (Raspwort).

The vine Parsonsia straminea (Common Silkpod) was common throughout the forested areas.

Vegetation Community 6 – Riparian Closed Forest

As previously described, the Mammy Johnsons River is situated to the east of the Project area (Figure E-2). Riparian Closed Forest (Vegetation Community 6) of Weeping Lilly Pilly (*Waterhousea floribunda*), Water Gum (*Tristaniopsis laurina*) and River Oak (*Casuarina cunninghamii*) occurs as riparian vegetation along the Mammy Johnsons River (Figure E-6a). The Riparian Closed Forest vegetation community was previously described by ERM Mitchell McCotter (1996a) as Closed Forest.

EcoBiological (Attachment EA) describes the floristic composition of this vegetation community as:

The typical canopy composition had Waterhousea floribunda (Weeping Lilly Pilly), Tristaniopsis laurina (Water Gum) and Casuarina cunninghamii (River Oak) as dominant species. The common emergents were Eucalyptus saligna (Sydney Blue Gum) with E. amplifolia subsp. amplifolia (Cabbage Gum) common at permanent depressions and swampy areas and often adjacent to mapped Cabbage Gum Floodplain forests.

The mid stratum was diverse and the common species throughout the mapped community were Callistemon salignus (Willow Bottlebrush), Ficus coronata (Sandpaper Fig), Guioa semiglauca, Streblus brunonianus (Whalebone Tree) and Wilkiea huegeliana (Veiny Wilkiea).

The ground and river bank stratum consisted typically of Lomandra longifolia (Spiny-headed Mat-rush), Maytenus silvestris (Orangebark), Adiantum hispidulum (Rough Maidenhair Fern), Doodia aspera (Prickly Rasp Fern), Pellaea falcata (Sickle Fern) and Urtica urens (Small Nettle).

The riparian strip is heavily infested with weeds, particularly mid stratum species such as Ligustrum sinense (Small-leaved Privet), Solanum mauritianum (Wild Tobacco Bush), and ground and riverine species such as Ageratina riparia (Mistflower), Rubus fruticosus (Blackberry), Tradescantia fluminensis (Wandering Jew) and grasses such as Pennisetum clandestinum (Kikuyu Grass).

This vegetation association is equivalent to the Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion Endangered Ecological Community (Lowland Rainforest on Floodplain EEC).

Vegetation Community 11 – Freshwater Wetland Complex

EcoBiological (Attachment EA) report that the Freshwater Wetland Complex is equivalent to the Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions Endangered Ecological Community (Freshwater Wetlands on Coastal Floodplains EEC) listed under the TSC Act. EcoBiological report that the community had key indicator species in rushes, grasses, aquatic plants and forbs (Attachment EA).

E3.1.3 Flora Species

Table ED-1 in Attachment ED presents a complete list of flora species that have been identified in surveys of the DCM area to April 2009 (ERM Mitchell McCotter, 1996a; Attachment EA and FloraSearch, 2005). Two main flora survey reports have been prepared covering the DCM area, by ERM Mitchell McCotter (1996a) and EcoBiological (Attachment EA). The FloraSearch (2005) survey was only a small area inside the existing approved surface disturbance, but nonetheless the flora species recorded by FloraSearch have been included in Attachment EA for completeness.

Table E-7 provides a summary of the total number of flora species recorded by EcoBiological (Attachment EA), ERM Mitchell McCotter (1996a) and FloraSearch (2005). Notably, EcoBiological (Attachment EA) recorded many more native and introduced species than the earlier studies by ERM Mitchell McCotter (1996a) and FloraSearch (2005). This is due in part to the more extensive study area covered by EcoBiological (Attachment EA), and therefore more vegetation communities and habitats being encountered, and also to the increase in native vegetation regeneration since 1996.

Table E-7
Flora Species Composition Recorded in the Project Area and Surrounds

	EcoBiological (Attachment EA)	ERM Mitchell McCotter (1996a)	FloraSearch (2005)
Total Native Flora Species	274	102	65
Total Introduced Flora Species	57	13	12
Total Flora Species	331	115	77

A total of 305 native flora taxa have been located within the Project area and surrounds during the flora surveys from 1996 to 2009 (Attachment ED). The most prominent families of native plants in descending order were the Poaceae – 39 species, Myrtaceae – 37 species, Fabaceae (Faboideae) - 28 species, Cyperaceae – 20 species and Fabaceae (Mimosoideae) – 12 species. The dominant families of introduced species were Asteraceae – 17 species, Poaceae – 11 species, Verbenaceae – 4 species and Fabaceae (Faboideae) and Cyperaceae – each with three species (Attachment ED).

E3.1.4 Threatened Flora Species and/or Potential Habitat

No threatened flora species listed under the TSC Act or EPBC Act have been recorded in the Project area or immediate surrounds based on the findings already reported and a review of database records (Section E2.1) and relevant literature (Section E2.2).

As stated in Section E2.2.7, potential habitat for threatened flora species was evaluated based on the habitat requirements of threatened species which could possibily occur in the Project area (Attachment EC). In particular, damp areas at the edge of streams/rivers may provide potential habitat for the Trailing Woodruff (*Asperula asthenes*); moderately fertile soils for Slaty Red Gum (*Eucalyptus glaucina*); creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil for Guthrie's Grevillea (*Grevillea guthrieana*); and litteral rainforest on sandy soil for Magenta Lilly Pilly (*Syzygium paniculatum*).

Potential habitat for the White-flowered Wax Plant (*Cynanchum elegans*) (i.e. Forest Red Gum open forest and woodland and Spotted Gum open forest and woodland) was noted.

E3.1.5 Threatened Flora Populations

Twenty-three plant populations are listed as endangered under the TSC Act as of October 2009. None are located within the Project area.

E3.1.6 Threatened Ecological Communities

Sixteen threatened ecological communities (TECs) listed under the TSC Act and one ecological community subject to a preliminary determination are known to occur on the North Coast of NSW (after DECCW, 2009f), one of which is also listed under the EPBC Act (Table E-8). The potential occurrence of these ecological communities in the Project area is assessed in Table E-8.

As indicated in Table E-8, three TECs occur in the Project area surrounds, namely the Freshwater Wetlands on Coastal Floodplains EEC, Lowland Rainforest on Floodplain EEC and River-Flat Eucalypt Forest EEC listed under the TSC Act.

Table E-8
Threatened Ecological Communities Known from the North Coast, NSW

Threatened Ecological Communities	Conservation Status		Comment
	TSC Act	EPBC Act	
Coastal Cypress Pine Forest in the NSW North Coast Bioregion	PD	-	Cypress Pine does not occur in the Project area (Attachment ED).
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	-	Not applicable to the Project area as coastal saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea (DECCW, 2009a).
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	-	The wetland areas to the east of the Project meets the criteria for this TEC, given (after NSW Scientific Commitee, 2008a): • the site is on a coastal floodplain (after DECC, 2007a[1]) of the North Coast Bioregion; • the site maintains permanent freshwater; • the site consists of relatively few woody plants; and • there are more than a few species present characteristic of the TEC.
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	E	-	The Project area is located in the Great Lake LGA which is north of the core area of this community (after DECCW, 2009a). The Red Gum which occurs in the Project area forms an association with other dominant Eucalypt species.
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	E	This ecological community occurs on coastal headlands, dunes, sea-cliffs or other places influenced by the sea (DECCW, 2009a). This community is not relevant to the Project area as the Project is located inland.
Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	V	-	This community typically occurs on Carboniferous sediments of the Barrington footslopes in the Hunter Valley (DECCW, 2009a). This community does not occur in the Project area.
Lower Hunter Spotted Gum Ironbark Forest	E	-	EcoBiological have not identified this TEC in the Project area or surrounds (Attachment EA). The Project area is located outside the distribution of this TEC and the main soil types that this TEC is found on do not occur in the Project area.
Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion	E	-	EcoBiological have not identified this TEC in the Project area or surrounds (Attachment EA). This community does not occur in the Project area.

Table E-8 (Continued)
Threatened Ecological Communities Known from the North Coast, NSW

Threatened Ecological Communities	Conservation Status		Comment
	TSC Act	EPBC Act	
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	E	-	EcoBiological (Attachment EA) have identified this TEC along the Mammy Johnsons River (Vegetation Community 6) as: • it is on a coastal floodplain defined by the DECC (2007a[1]); and • a vegetation community equivalent to Floyd (1990) Suballiance 26: *Waterhousea floribunda – tristaniopsis laurina* was recorded by EcoBiological along the Mammy Johnsons River (Attachment EA).
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps	E	-	No peatlands occur in the Project area.
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	-	This community typically occurs south of Port Stephens and the Project area occurs 40 km north of Port Stephens. Regardless, EcoBiological considers that Vegetation Community 5 meets the criteria for this TEC, given (after DECCW, 2009f): • the site is on a coastal floodplain (after DECC, 2007a[1]); • the site is on silty, clay or sandy loam soil; • the site is located on a river flat or terrace; • the site is consists of an open forest or woodland with a mixture of Eucalypt and Angophora trees; • some characteristic groundcovers and shrubs are present; and • there are relatively low numbers of paperbarks present.
Sub-tropical Coastal Floodplain Forest of the NSW North Coast Bioregion	E	-	Vegetation Community 3 in the Project is similar to this TEC though Vegetation Community 3 does not occur on a coastal floodplain (after DECC, 2007a[1]).
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	-	Swamp Oak (*Casuarina glauca*) does not occur in the Project area (Attachment ED). This species was recorded by FloraSearch (2005) within the existing/approved surface disburbance area.
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	-	The main flora species associated with this community (Swamp Mahogany [*Eucalyptus robusta*], and Broad-leaved paperbark [*Melaleuca quinquenervia*]) (DECCW, 2009a) do not occur in the Project area.
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	E	-	This TEC is associated with sand dunes and low-nutrient sandplains along coastal areas which do not occur in the Project area.
Themeda Grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	-	This community occurs on seacliffs and coastal headlands (DECCW, 2009a). This community is not relevant to the Project area as the Project is located inland.
White Gum Moist Forest in the NSW North Coast Bioregion	E	-	White Gum (*Eucalyptus dunnii*) does not occur in the Project area (Attachment ED).

[1] The DECCW has produced a series of maps that provide the indicative location of coastal floodplain communities in NSW. The map shows coastal floodplain associated with the Mammy Johnsons River.

E3.1.7 Introduced Flora Species and Noxious Weeds

A total of 57 introduced flora species have been recorded during the previous surveys, 57 by EcoBiological (Attachment EA), 13 by ERM Mitchell McCotter (1996a) and 12 by FloraSearch (2005). EcoBiological report that weed species were more commonly found in the cleared and disturbed areas, which is to be expected (Attachment EA).

Five weeds that are listed as noxious in the Great Lakes LGA (Great Lakes Council, 2008) have been recorded as follows (Attachment ED):

- Noogoora Burr (*Xanthium occidentale*);
- Bittou Bush (*Chrysanthemoides monilifera*);
- Blackberry (*Rubus fruticosus*);
- Crofton Weed (*Ageratina adenophora*); and
- Lantana (*Lantana camara*).

The above species are listed as a Class 4 weeds in the Great Lakes LGA (Great Lakes Council, 2006). Class 4 noxious weeds are '*plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area*' (Great Lakes Council, 2008).

The growth and spread of Class 4 plants must be controlled according to the measures specified by the local control authority (Great Lakes Council, 2008).

No noxious weeds were recorded in existing or proposed irrigation areas (after EcoBiological [Attachment EA]).

Noogoora Burr (Xanthium occidentale)

The Noogoora Burr (also known as Cockle Burr or Californian Burr) was recorded by EcoBiological (Attachment EA), immediately north-west of the existing approved DCM open pit in 2007. EcoBiological (Attachment EA) reported the Noogoora Burr in one survey quadrat at a cover estimate of <5%.

Noogoora Burr is an erect, summer-growing annual which grows 1 to 3 m high (NSW Agriculture, 2004). The Noogoora Burr is found in low-lying areas subject to inundation and is therefore widespread along waterways and riparian flats (Botanic Gardens Trust, 2009a) north of Sydney, in central and western NSW, and in the other mainland States (NSW Agriculture, 2004).

The Noogoora Burr seeds germinate in late spring following favourable weather conditions, or on the edges of waterways following a rise and fall of water levels when temperatures are high (NSW Agriculture, 2004). Its success as a weed is partly due to the fact that of the two seeds in each burr, one will germinate under favourable conditions in the first season after seeding, and the second may not germinate until the second or third year or longer (NSW Agriculture, 2004). The seedlings grow rapidly during the summer, and flowering starts in early March (NSW Agriculture, 2004). Late germinations produce burrs at a very early age when plants are only a few centimetres high. The plants die off in late autumn but the burrs hold on to the dead plant until the next season.

The Noogoora Burr spreads easily due to the burr's hooked spines, though burrs can also spread in flood waters which accounts for the distribution along rivers and streams (NSW Agriculture, 2004).

Bitou Bush (Chrysanthemoides monilifera)

The Bitou Bush was recorded opportunistically by EcoBiological (Attachment EA) in Vegetation Community 7, though a location or description of the infestation was not reported by EcoBiological. A portion of Vegetation Community 7 occurs in the Project disturbance area (Figure E-6a).

The species invades a range of environments from open exposed dunes to shaded forests (Great Lakes Council, 2006). The Bitou Bush can outcompete and/or totally replace native flora and invades undisturbed and disturbed areas (DPI, 2005a).

Invasion of Native Plant Communities by Bitou bush and Boneseed is a key threatening process under the TSC Act. Infestations of Bitou Bush drastically alter the environment for many native birds and animals and tend to create a favourable environment for other highly invasive weeds (e.g. asparagus fern, lantana and glory lily) (DPI, 2005a). The Bitou Bush flowers throughout most of the year, chiefly between August and December (Botanic Gardens Trust, 2009b).

Blackberry (Rubus fruticosus)

The Blackberry was recorded opportunistically by EcoBiological (Attachment EA) in Vegetation Community 6, though a location or description of the infestation was not reported by EcoBiological. Vegetation Community 6 occurs outside the Project area along the Mammy Johnsons River. The species was also previously recorded by ERM Mitchell McCotter (1996a).

The Blackberry is a sprawling shrub producing herbaceous canes, generally armed with prickles (Botanic Gardens Trust, 2009c). The species is a highly invasive weed (Great Lakes Council, 2006). Blackberry has invaded the banks of watercourses, roadsides, pastures, orchards, plantations, forests and bushland throughout temperate Australia (DPI, 2005b).

Crofton Weed (Ageratina adenophora)

The Crofton Weed was recorded opportunistically by EcoBiological (Attachment EA) in Vegetation Community 6, though a location or description of the infestation was not reported by EcoBiological. Vegetation Community 6 occurs outside the Project area along the Mammy Johnsons River.

The Crofton Weed is an erect, branched herb with a short rootstock which flowers in spring (Botanic Gardens Trust, 2009d). The species grows in disturbed moist sites on fertile soils, north from Kiama (Botanic Gardens Trust, 2009d).

The Crofton Weed spread rapidly and has become a nuisance in many areas along the eastern coast of Australia (DPI, 2005c). The species is particularly invasive on cleared land that is not grazed, such as public reserves (DPI, 2005c).

Lantana (Lantana camara)

Lantana was recorded by EcoBiological (Attachment EA), on the ridgeline located in the south-west of MLA 1. EcoBiological (Attachment EA) reported Lantana in one survey quadrat at a cover estimate of <5%. During the habitat assessment (Section E2.2.7), Lantana was found to be common along the unnamed drainage line in the north of the Project area (Vegetation Community 4).

Lantana occurs on the east coast of Australia (DPI, 2005d) and is widespread near habitation, in schlerophyll forest and disturbed rainforest and in coastal districts north from the Bega area (Botanic Gardens Trust, 2009e).

Invasion, establishment and spread of Lantana camara is a key threatening process under the TSC Act. Lantana readily invades disturbed or neglected areas and where native woodlands have been thinned or cleared for grazing (DPI, 2008). Lantana is a major weed along roadsides, river banks, fence-lines, forestry, pastures and waste areas (DPI, 2008). It also invades open native woodlands and sub-tropical rainforest fringes (DPI, 2008).

The species can spread vegetatively, but is mainly spread by fruit-eating birds and mammals, movement of water, contaminated soil and machinery. The seed is able to remain viable in dry conditions for up to two years (DPI, 2008).

E3.2 VERTEBRATE FAUNA

This section provides a summary of the results from the various vertebrate fauna studies.

E3.2.1 Vertebrate Fauna Habitat Types in the Project Area

Almost all of the pre-European forest and woodland has been extensively cleared and/or logged at least once and in some cases very likely twice. Relatively few climax (old growth) trees are present across this landscape. Figure E-7 shows historic aerial photography covering ML 1427, MLA 1 and the proposed offset area (Section E6). It can be seen that in 1980 the majority of ML 1427 was clear, and while the patch of vegetation to the north of MLA1 is present in the photo, this patch of vegetation is also regrowth likely from mid 1990s.

Four broad fauna habitat types are recognised within the Project area (Figure E-5):

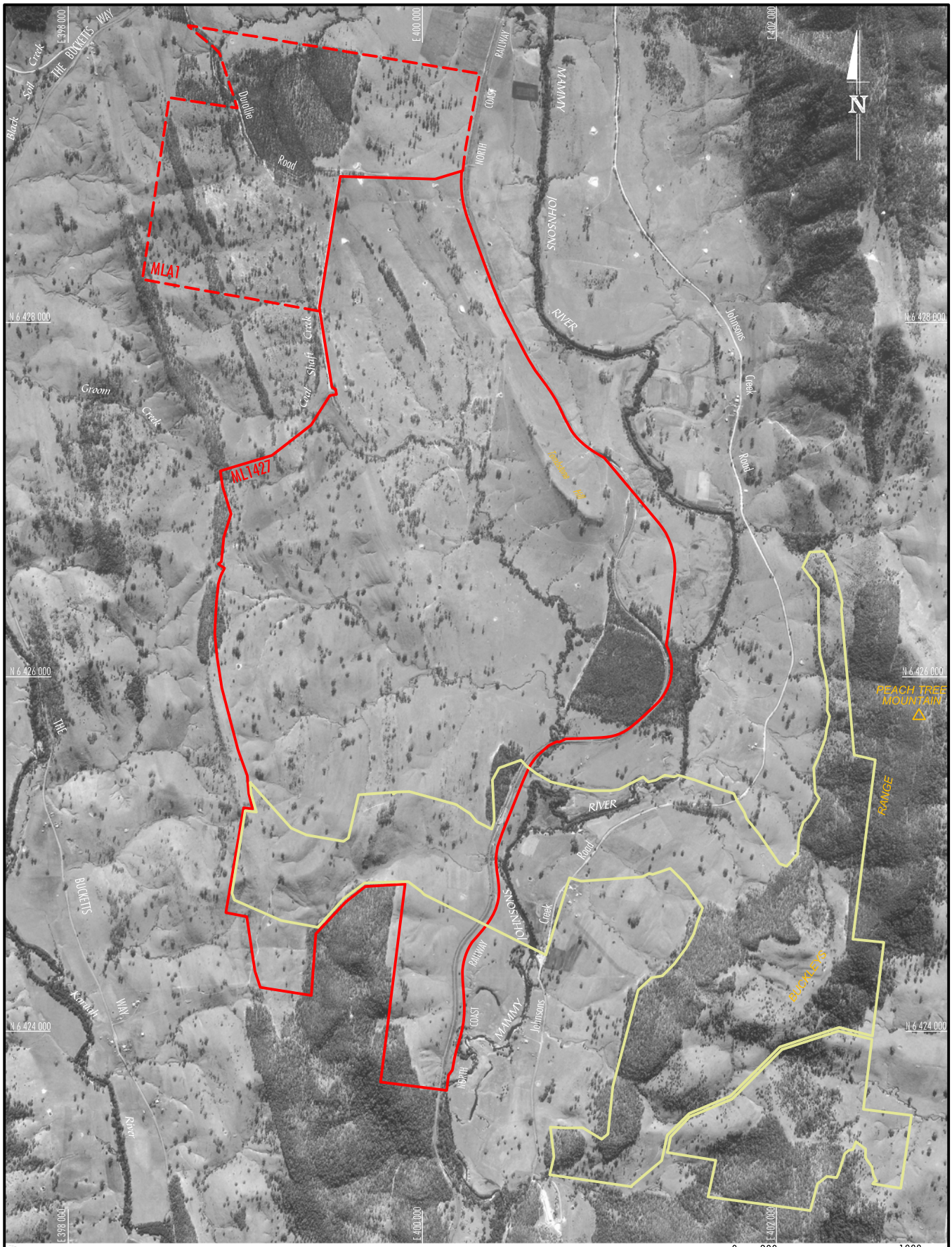
- Secondary Grassland;
- Secondary Grassland with Regrowth Open Woodland/Forest;
- Regrowth Open Forest; and
- Water Sources (dams/creeks).

The dominant habitat type in the Project area is secondary grassland (with or without scattered regrowth trees) (Figure E-5) and relatively small discontinuous secondary woodland and forest remnants. Larger areas of regrowth woodland-forest remnants also form part of the contemporary habitats. Tree regeneration is mostly occurring at forest-formation density. Regrowth trees tend to be tall and straight without obvious hollow formation. The estimated age of regrowth trees varied between 10 and 50 years. Observed tree health was generally good with no signs of tree dieback. No evidence of past fires was noted.

No major rock formations are present in the Project area but areas of scattered rock are present and mainly confined to regrowth areas. No potential subterranean bat roosts (e.g. caves, culvert or disused mine shafts) were recorded in the Project area.

The Project area consists of a number of minor sub-catchments all draining to the Mammy Johnsons River. Landform ranges from near planar, undulating to areas of modestly steep country. A number of man-made dams are present. Infrastructure such as roads, rail lines, powerlines, fence lines and pipelines within the Project area may decrease habitat connectivity for some species.

Up to seven habitat layers are present within the regrowth formations: bare soil, litter, scattered rock, sticks/logs, herb-grass layer, shrub, a mid-storey tree layer with an occasional stag tree and the dominant woodland-forest upperstorey tree layer. Canopy formations, where present, are more-or less continuous, with an occasional emergent tree present.



Source: Department of Lands - Aerial Photography flown June 1980 and DCPL (2009)

LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- Duralie Extension Project Offset Area

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

FIGURE E-7

Historic Aerial Photograph - 1980

DURALIE COAL

CENWEST ENVIRONMENTAL SERVICES AND RESOURCE STRATEGIES

GCL-06-07 App_F&F_111D

The four broad fauna habitat types identified within the Project area are described in detail below.

Secondary Grassland

The Project area is predominantly comprised of the Secondary Grassland fauna habitat type (Figure E-5). This broad fauna habitat type is associated with the derived grassland vegetation unit described in Section 3.1.1.

The Secondary Grasslands are landscapes that were/are managed to optimise grazing. These areas form a mosaic with the Secondary Grasslands with Regrowth Open Woodland/Forest and the Regrowth Open Forest fauna habitat types.

The Secondary Grasslands are dominated by grasses and herbs, predominantly native but with some exotic species present, which create a more-or-less continuous ground cover across the landscape.

The Secondary Grasslands appear to be maintained by active grazing and where such grazing is significantly reduced or eliminated, early woodland/forest succession is apparent.

These grasslands provide suitable habitat for a range of wholly or partly grassland-dependent native bird species and grazing mammals. The areas adjacent to drainage lines are also suitable for a range of frog and small reptile species. Relatively few reptile species would utilise the grassland habitats other than as movement corridors for larger species in search of prey or in dispersal mode.

Internal and external habitat connectivity is relatively high for grassland-dependent species since this habitat merges with Secondary Grassland with Regrowth Open Woodland/Forest and Regrowth Open Forest. Although, the internal and external connectivity of this habitat is relatively poor for forest dependant species.

The dominant habitat layers present are litter and herb-grass with very little rock or log present (Attachment EB). Occasional scald or bare ground patches are also present.

Previous logging aside, the major anthropogenic disturbance event is grazing. This habitat type was generally judged to be of some conservation value to particular suites of native vertebrate fauna (Attachment EB). Under a grazing management regime, this habitat type is more-or-less in equilibrium (i.e. maintained as grassland) but if grazing is discontinued for any length of time, successional changes will often create a Secondary Grassland with Regrowth Open Woodland/Forest, very likely dependent on the elapse of time since initial clearing and/or proximity to adjacent woodland and forest. Under long-term grazing conditions it appears that conditions may change to favour dominance by native and other grasses that are characteristic of degraded grasslands, such as Blady and Whiskey Grasses. The dominance of such species is likely to lessen the habitat value of this habitat type for native vertebrate species.

Secondary Grassland with Regrowth Open Woodland/Forest

The Secondary Grassland with Regrowth Open Woodland/Forest broad fauna habitat type is similar to the Secondary Grassland broad fauna habitat type (described above) and is part of a habitat continuum (Figure E-5). This broad fauna habitat type is distinguished by the presence of either scattered regrowth trees or clumps of scattered trees sometimes presenting as small regrowth woodland/forest remnants. This broad fauna habitat type is associated with the Red Gum Grassy Woodland (Vegetation Community 3) and Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 1) vegetation communities described in Section E3.1.1.

The dominant trees species are variable but always represent one or more tree species from the pre-existing vegetation communities. It is likely that a range of environmental conditions enabled the scattered trees or tree remnant patches to be retained in the landscape, (e.g. changed grazing pressure, a temporary change in land use or the deliberate retention of some trees for the provision of shade for cattle). The great majority of trees in this habitat type are regrowth, are hollow impoverished and range in height from 20 to 30 m, with mean diameters ranging from 40 to 100 centimetres (cm), with the median diameter approximately 40 cm (Attachment EB). Tree canopies within patches are more-or-less even and continuous and usually in forest formation.

Within remnant formations there is more habitat variability than within the surrounding secondary grasslands with up to nine structural layers being present. However the understorey bears little resemblance to the likely pre-European plant assemblage and in most cases is associated with some weed invasion. Tree regrowth is almost always in forest formation with trees often being less than 5 m apart (i.e. about 400 stems/hectare [ha]).

Secondary Grassland with Regrowth Open Woodland/Forest has the potential to provide habitat for a greater number of native vertebrate species than the Secondary Grasslands. However, this habitat type has few mature trees and tends to be very sub-optimal in regards to hollow density. The estimated age of regrowth trees varies from 10 to 50 years.

The winter-flowering Eucalypts, Spotted Gum (*Corymbia maculata*) and Narrow-leaved Ironbark (*Eucalyptus crebra*) are present in the Secondary Grassland with Regrowth Open Woodland/Forest broad fauna habitat type (after Attachment EA).

This habitat type was generally judged to be of some conservation value to particular suites of native vertebrate fauna. Under a grazing management regime this habitat type is more-or-less in equilibrium (i.e. maintained as grassland with scattered trees or tree remnant regrowth patches). However, if grazing is discontinued for any length of time, successional changes will likely enable the secondary grasslands component to be invaded by regrowth woodland or forest, very likely dependent on the elapse of time since initial clearing and/or proximity to adjacent woodland and forest.

Regrowth Open Forest

The Regrowth Open Forest is more common in the northern half of the Project area (Figure E-5) and represents natural vegetation succession either following original land clearing or more likely after the collapse of the dairy industry in the Gloucester area and subsequent cessation of grazing. This broad fauna habitat type is associated with all of the vegetation communities in the Project area described in Section 3.1.1 and listed in Table E-6.

There is a varied range of dominant tree species present including Spotted Gum (*Corymbia maculata*), Mahogany (e.g. *E. acmenoides*), Red Ironbark (*E. fibrosa*) and Grey Ironbark (*E. siderophloia*). Some remnants appeared to be ecotonal with representative species present from more than one pre-European vegetation community. The winter-flowering Eucalypts, Spotted Gum (*Corymbia maculata*), Narrow-leaved Ironbark (*E. crebra*), Thin-leaved Stringybark (*E. eugenioides*), Red Ironbark (*E. fibrosa*) and White Stringybark (*E. globoidea*) are present in the Regrowth Open Forest broad fauna habitat type (after Attachment EA). *Allocasuarina* trees (Forest oak [*Allocasuarina torulosa*] and *Allocasuarina littoralis*) are also present.

Trees varied in height from approximately 10 to 30 m and mean diameter varied from approximately 45 to 150 cm. Tree density varied from woodland to forest formation and in the latter case exhibited a continuous canopy, the cause of light shading on the forest floor.

Up to seven habitat layers are present within the dominant formations: bare soil, litter, rock, sticks/logs, herbs, grasses, shrub, a mid-storey tree layer and an upper storey layer with an occasional stag tree and the dominant woodland-forest species. Shrub layers can vary from those that tolerate wetter conditions such as *Lomandra* spp. to those that prefer drier conditions. Occasional scald or bare ground patches may be present.

The internal habitat connectivity is relatively high for woodland and forest dependent species due to the moderately dense regrowth, though the external habitat connectivity is relatively low for woodland and forest dependent species given the level of fragmentation producing the surrounding secondary grasslands with scattered tree cover and remnant regrowth woodland/forest clumps.

The major anthropogenic disturbance events are grazing and past logging. This habitat type was generally judged to be of some conservation values for particular suites of native vertebrate fauna. However hollow-dependant species are unlikely to thrive in this habitat type, since it is hollow depauperate. Under appropriate management conditions, it is very likely that the bulk of such remnants would likely, after a suitable time, exhibit many of the values of the pre-European vegetation communities from which they were derived.

Water Sources (Dams/Creeks)

There are a number of small farm dams (around 0.25 megalitres [ML] in volume) scattered across the Project area together with larger infrastructure dams up to 15 to 20 ML that have been constructed for mining purposes. These were situated on early order streams with variable and relatively small catchment areas.

The drainage lines in the Project area are ephemeral (including the unnamed drainage lines in the north of the Project area), most without well defined flood plains or tree dominated riparian strips. The regrowth forest broad habitat types described above occur immediately adjacent to some drainage lines. Their presence provides the habitat qualities described above and very likely increases the species diversity within the Project area.

Most farm dams in the Project area and surrounds feature a range of native aquatic plants including fringing reed beds, water lilies, sedge type plants and emergent water plants. Streams and early order drainage lines appear stable and have a high level of across channel cover.

Coal Shaft Creek predominantly occurs to the west of the Project area, although the northern portion of the creek occurs within the Project area (Figure E-2).

Water Source habitats (flowing and non flowing systems) within the Project area provide important additional or complementary habitat and resources for a wide number of species including amphibia, reptiles, birds and mammals. Their combined conservation rating was assessed as being of some conservation value but some disturbance was evident.

E3.2.2 Additional Vertebrate Fauna Habitat Types in the Project Area Surrounds

Some additional habitats were observed in the Project area surrounds. These included riparian forest, and water sources (e.g. wetland areas, farm dams and streams/rivers). These are discussed below.

Riparian Forest

The Riparian Forest is a narrow band 10 to 20 m wide along either side of the Mammy Johnsons River (Figure E-5) (Attachment EB).

The Riparian Forest is around 15 m high with emergent eucalypts to 35 m. Technically, the riparian structure varied from low closed forest to a tall moist forest. The shrub diversity was moderate and the ground cover around 50% below the forest canopy.

This broad fauna habitat type is associated with the Riparian Closed Forest (Vegetation Community 6) described in Section 3.1.2. The typical canopy composition was dominated by Weeping Lilly Pilly (*Waterhousea floribunda*), Water Gum (*Tristaniopsis laurina*) and River Oak (*Casuarina cunninghamii*). The common emergents were Sydney Blue Gum (*Eucalyptus saligna*) and Cabbage Gum (*E. amplifolia* subsp. *amplifolia*) in the more swampy areas. Habitat layers generally present include bare soil, rock, litter, sticks/logs, herbs, shrub, mid-storey trees, upper-storey trees and emergent trees.

The mid stratum was diverse and the ground and river bank stratum consisted of a range of native and exotic plants. Tree hollows were uncommon in the upper strata. Weed succession is a major problem. Nevertheless, the Riparian Forest was assessed as having moderate conservation value but with significant levels of disturbance present. The conservation trend was more difficult to assess but was judged to be able to be improved through targeted management strategies or to further degrade over time due primarily to ongoing exotic weed invasion.

This habitat type is important for a range of amphibia, a limited numbers of reptiles, birds and arboreal mammals.

Water Sources (Wetland Areas/Farm Dams/ Streams/ Rivers)

There are a number of small farm dams (around 0.25 ML in volume) scattered across the immediate surrounds of the Project area. These were situated on early order streams with variable and relatively small catchment areas. The creek and drainage lines are ephemeral, without well defined flood plains or tree dominated riparian strips, although some may once have been spring fed. The Riparian Forest habitat described above is located immediately adjacent to the creeks and drainage lines. The presence of water sources adds to the habitat qualities described above and very likely increases the species diversity within the Project area surrounds.

The Freshwater Wetland EEC occurs on the floodplains of the Mammy Johnsons River (Figure E-6a). During the site inspection it was evident that in the more gently sloping parts of the catchment, some of these streams and drainage lines were once part of a complex series of swampy meadow formations that have degraded to incised or partly incised streams, very likely due to past grazing pressures. These would very likely have once been dominated by reed beds and a range of riparian wetland plants. Most dams in the immediate surrounds have a range of native aquatic plants ranging from fringing reed beds, water lilies, sedge type plants and emergent water plants. Streams and early order drainage lines appear stable and have a high level of across channel cover.

Together, these water (flowing and non-flowing systems) associated habitats within the immediate surrounds provide important additional or complementary habitat and resources for a wide number of species including amphibia, reptiles, birds and mammals. Their combined conservation rating was assessed as having some conservation value but with varying degrees of disturbance evident.

E3.2.3 Vertebrate Fauna Species Composition

A total of 197 native vertebrate species have been located within the Project area and surrounds during the fauna surveys from 1996 to 2009, comprising of 18 amphibians, 14 reptiles, 128 birds and 37 mammals (Attachment EE).

Table E-9 summarises the fauna species composition recorded in the wider region (i.e. AMBS, 1995 and DECCW, 2009b) and the Project area and surrounds (ERM Mitchell McCotter, 1996b; Fly-by-night Bat Surveys, 1996; Woodward-Clyde, 1996c; Paul Weber Consulting Services, 1996; Debus, 1995; Attachment EA).

Table E-9
Vertebrate Fauna Species Composition Recorded in the Project Area and Surrounds

	Regional Fauna Surveys (AMBS, 1995)	Atlas of NSW 1:100,000 Map Sheet (Dungog – 9233) (DECCW, 2009b)	Fauna Surveys Conducted at the Duralie Mine Site for the EIS (DCPL, 1996)					Attachment EA
			ERM Mitchell McCotter (1996b)	Bats Fly-by-night Bat Surveys (1996)	Woodward-Clyde (1996c)	Herp Paul Webber Consulting Services (1996)	Birds Debus (1995)	
Amphibians	32	33	4	N/A	0	11	N/A	17
Reptiles	58	45	4	N/A	0	7	N/A	10
Birds	264	194	47	N/A	2	5	75	97
Mammals	46	78	12	8	29	11	N/A	28
Total Native Fauna Species	384	332	63	8	26	29	75	148
Total Introduced Fauna Species	16	18	4	0	5	5	0	4
Total Fauna Species	400	350	67	8	31	34	75	152

As to be expected, the fauna studies conducted for the Duralie Coal EIS (i.e. ERM Mitchell McCotter, 1996b; Fly-By-Night Bat Surveys, 1996; Woodward-Clyde, 1996c; Paul Weber Consulting Services, 1996) and the Project fauna surveys (Attachment EA) recorded a subset of the fauna species which have been observed in the wider region (Table E-9).

Notably, EcoBiological (Attachment EA, 2009b) recorded many more native species than the earlier studies (Table E-9). This is due in part to the study area covered by EcoBiological (Attachment EA) being larger (approximately 1,009 ha in size) and covering more habitats, and also to the increase in regeneration habitat since 1996.

For more context, 50 fauna species have been recorded within Monkerai Nature Reserve which is located approximately 7 km to the south-west of the Project, and covers an area of approximately 865 ha (DECCW, undated a; NPWS, 2008), and 118 fauna species have been recorded within the Ghin-doo-ee National Park which is located approximately 11 km to the east of the Project and covers an area of 4,819 ha (DECCW, undated b).

E3.2.4 Threatened Fauna Species in the Project Area and/or Surrounds

A total of 18 threatened fauna species listed under the TSC Act and/or EPBC Act have been recorded in the Project area and/or surrounds (Table E-10) including one amphibian, one reptile, nine birds, and seven mammals. Of these, four birds and four mammals have been recorded in the additional disturbance areas associated with the Project, namely the Swift Parrot, Brown Treecreeper (eastern subspecies), Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale, Squirrel Glider, Eastern Bentwing-bat and Eastern Freetail-bat.

No threatened fauna species listed under the FM Act have been recorded in the Project area and/or immediate surrounds.

Table E-10
Threatened Fauna Species Recorded in the Project Area and/or Surrounds

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Amphibians				
Mixophyes iteratus	Giant Barred Frog	E	E	The Giant Barred Frog was seen and heard by EcoBiological at twelve locations along the Mammy Johnsons River, south-east of ML 1427 outside of the Project area (Figure E-8) (Attachment EA). A total of 23 individuals were recorded comprising of six females which were sighted, five males which were sighted (two of which were caught), with a further 11 males heard calling and one juvenile which was caught and identified. EcoBiological (2009b) also recorded the Giant Barred Frog along the Mammy Johnsons River 3 km north-east and 3.5 km north-east of the Project area. At these respective locations, approximately seven males and two females were recorded. The Ecobiological (2009b) records are not shown on Figure E-8.
Reptiles				
Hoplocephalus stephensii	Stephens' Banded Snake	V	-	A record of the Stephens' Banded Snake from 1995 occurs in the BioNet database (NSW Government, 2009) near the Mammy Johnsons River, east of ML 1427 and outside of the Project area. This BioNet database record is not shown on Figure E-8.
Birds				
Ptilinopus regina	Rose-crowned Fruit-Dove	V	-	Woodward-Clyde (1996c) recorded the call of the Rose-crowned Fruit-Dove from Riparian Forest habitat along Mammy Johnsons River, east of the existing DCM and outside of the Project area (Figure E-8).
Lathamus discolor	Swift Parrot	E	E	A single Swift Parrot was sighted by EcoBiological in the north of the Project area (Attachment EA) (Figure E-8).
Tyto tenebricosa	Sooty Owl	V	-	A call of the Sooty Owl was recorded from Riparian Forest habitat along the Mammy Johnsons River, east of the existing DCM by Paul Webber Consulting Services (1996) during a herpetological survey in 1995 (Figure E-8).
Ninox strenua	Powerful Owl	V	-	Woodward-Clyde (1996c) sighted and heard the call of the Powerful Owl at two locations along Coal Shaft Creek, within the approved mine area and approved Coal Shaft Creek Diversion area prior to vegetation clearance (Figure E-8).
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	Eight individuals of this species were sighted by EcoBiological (2009b) approximately 1.4 km to the east of the Project area, on Buckleys Range. Secondary evidence of the species (in the form of crushed *Allocasuarina* cones) was observed to the east and south-east of the Project along Buckleys Range.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	This species was heard by EcoBiological (2009b) flying overhead 0.8 km to the east of the Project area, on the Buckleys Range (Figure E-8). This species was also recorded by EcoBiological (2009b) approximately 10 km north of the Project.
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	-	EcoBiological sighted two individuals of the Brown Treecreeper (eastern subspecies) at one location in the north of the Project area (Attachment EA) (Figure E-8).
Pyrrholaemus sagittata	Speckled Warbler	V	-	Groups of up to three Speckled Warblers were recorded at three locations by EcoBiological in the north of the Project area (Figure E-8) and one location in the approximate extent of existing/approved surface disturbance. A single Speckled Warbler was also recorded by EcoBiological (2009b) 0.9 km to the east on the footslopes of Buckleys Range.

Table E-10 (Continued)
Threatened Fauna Species Recorded in the Project Area and/or Surrounds

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Birds (Continued)				
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	A group of six Grey-crowned Babblers (eastern subspecies) was recorded by EcoBiological (2009b) at one location in the north of the Project area (Attachment EA) (Figure E-8).
Mammals				
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	The Brush-tailed Phascogale was first recorded in the area by Woodward-Clyde (1996c), when an individual was observed foraging on the ground amongst a stand of Paperbarks along a tributary to Coal Shaft Creek and another observed from a hollow along a central portion of Coal Shaft Creek. During a pre-clearance survey of the approved mine, Place Planning and Design (2003) trapped one adult female Brush-tailed Phascogale with three young, in a small Elliot A trap in July 2003. This record is not shown on Figure E-8. During recent surveys, EcoBiological (2009b) sighted one Brush-tailed Phascogale along Mammy Johnsons River outside of the Project area and captured one individual to the west of the Project area (Attachment EA) (Figure E-8).
Planigale maculate	Common Planigale	V	-	Place Planning and Design (2003) trapped a single Common Planigale in a small Elliot A trap during a pre-clearance survey of the approved mine area, conducted in August 2003. This record is not shown on Figure E-8.
Phascolarctos cinereus	Koala	V	-	Koala scats and traces were identified at the same location in a forested portion of ML 1427 during previous fauna surveys (Woodward-Clyde, 1996c; ERM Mitchell McCotter, 1999b) and EcoBiological recorded the Koala west of the Project area (Attachment EA) (Figure E-8).
Petaurus norfolcensis	Squirrel Glider	V	-	The Squirrel Glider was first recorded in the area by Place Planning and Design (2003) during a pre-clearance survey of the approved mine area, conducted in August 2003. One Squirrel Glider was seen during spotlighting, one was captured in an Elliot B trap and one was observed leaving a tree during tree felling (Place Planning and Design, 2003). DCPL (2007a) also observed a Squirrel Glider during a targeted tree clearance associated with the construction of a communications transmission in July 2007. These records are not shown on Figure E-8. During recent surveys, EcoBiological recorded the Squirrel Glider at three locations (Attachment EA). A total of 14 captures were made in traps, with various others sighted during spotlighting, comprising: • four individuals were captured and several sighted in the north of the Project area; • six individuals were captured and several sighted outside of the Project area to the west; and • two individuals were captured and several sighted in the approved mine area, prior to vegetation clearance. EcoBiological (2009b) also captured a single Squirrel Glider approximately 1 km east of the Project area in an Elliot B Tree trap (Figure E-8).

Table E-10 (Continued)
Threatened Fauna Species Recorded in the Project Area and/or Surrounds

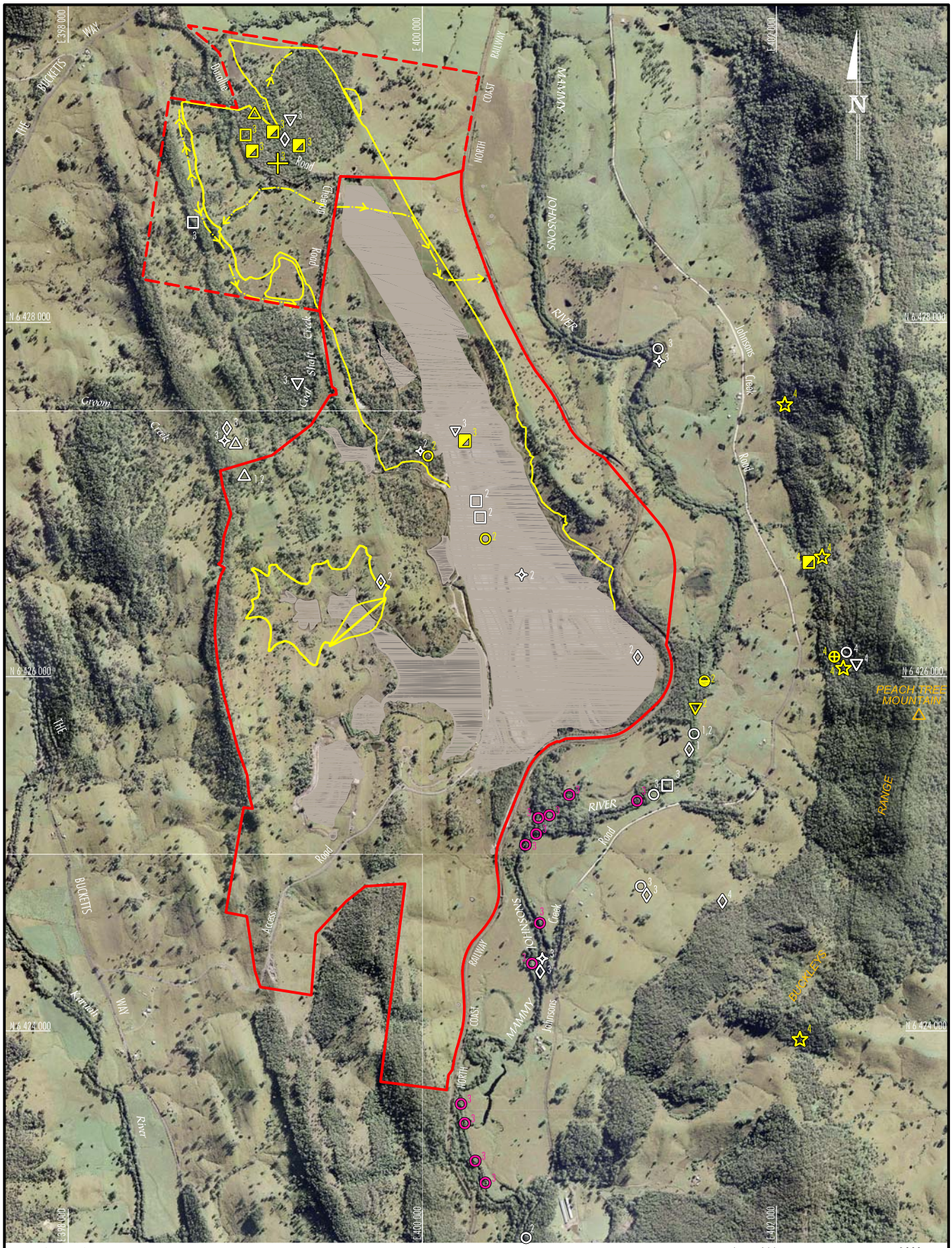
Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Mammals (Continued)				
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Calls of the Eastern Freetail-bat were tentatively recorded along Coal Shaft Creek by Woodward-Clyde (1996c). More recently, EcoBiological (Attachment EA) recorded calls of the Eastern Freetail-bat at locations near the Mammy Johnsons River, east and south-east of ML 1427 outside of the Project area (Attachment EA).
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	ERM Mitchell McCotter (1996b) heard calls of the Eastern Bentwing-bat along the Mammy Johnsons River (Figure E-8). Three additional Eastern Bentwing-bats were recorded by ERM Mitchell McCotter, however, these are not shown on Figure E-8 as the co-ordinates were not provided by ERM Mitchell McCotter. The calls of the Eastern Bentwing-bat species were recorded during the Woodward-Clyde (1996c) survey (Figure E-8). Woodward-Clyde recorded the Eastern Bentwing-bat at four sites in the subject area, however, two of these records are not shown on Figure E-8 as the co-ordinates were not provided by Woodward-Clyde. More recently, EcoBiological (Attachment EA and 2009b) recorded the Eastern Bentwing-bat in the north of the Project area and outside the Project area to the west, south and east (Figure E-8).
Myotis macropus	Large-footed Myotis	V	-	Woodward-Clyde (1996b) identified the call of the Large-footed Myotis within the riparian vegetation along the Mammy Johnsons River and captured the species using harp traps at two locations on the Mammy Johnsons River. ERM Mitchell McCotter (1996c) recorded the Large-footed Myotis along the Mammy Johnsons River. More recently, the Large-footed Myotis was recorded by EcoBiological (Attachment EA and 2009b) along the Mammy Johnsons River, within the Riparian Forest vegetation type (Attachment EA), on river flats to the east of Mammy Johnsons River and on Buckleys Range (Figure E-8) (EcoBiological, 2009b).

[1] Threatened Species status under the TSC Act and EPBC Act (current as at October 2009):

E Endangered.

V Vulnerable.

M Migratory (EPBC Act).



Threatened Fauna

- Giant Barred Frog
- Rose-crowned Fruit-Dove
- Glossy Black-Cockatoo
- Gang-gang Cockatoo
- Swift Parrot
- Sooty Owl
- Powerful Owl
- Brown Treecreeper
- Speckled Warbler
- Grey-crowned Babbler
- Brush-tailed Phascogale
- Koala
- Squirrel Glider
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Large-footed Myotis

1. *ERM Mitchell McCotter (1996b)*
2. *Woodward-Clyde (1996c)*
3. *EcoBiological (2009a)*
4. *EcoBiological (2009b)*

LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- Approximate Extent of Existing/Approved Surface Disturbance
- Approximate Extent of Additional Project Surface Disturbance

0 200 1000

Metres

GRID DATUM: MGA 94 ZONE 56

Source: AAHatch- Aerial Photography flown April 2009 and DCPL (2009)

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

FIGURE E-8

Threatened Fauna Species

DUNDAS COAL

CENWEST ENVIRONMENTAL SERVICES AND RESOURCE STRATEGIES

E3.2.5 Threatened Fauna Populations

No threatened fauna populations listed under the TSC Act are relevant to the Project area. Two threatened fauna populations occur in the Karuah Manning CMA sub-region in which the Project area occurs, namely:

- Emu population in the NSW North Coast Bioregion and Port Stephens LGA; and
- Koala population in the Hawks Nest and Tea Gardens area.

Neither of these threatened fauna populations occur near the Project area.

The *Great Lakes Local Environment Plan, 1996* (Great Lakes LEP) provides environmental zoning for the Squirrel Glider at Myall River Downs west of Tea Gardens, approximately 40 km south of the Project area (Great Lakes Council, 2009). The Squirrel Glider habitat at Myall River Downs is very different to the habitat in the Project area as Myall River Downs is dominated by mature and old growth Red Bloodwood with Swamp Mahogany, *Angophora costa* and *Banksia serrata* (Austeco Environmental Consultants, 2003). At Myall River Downs, the Squirrel Glider population is thought to be dependant on the Red Bloodwood sap at times of the year other food resources (e.g. nectar) are not available.

E3.2.6 Migratory Species

The Project area provides limited habitat for migratory species. Table E-11 presents the migratory species listed under the EPBC Act that have been recorded in the Project area and surrounds.

Table E-11
Migratory Species Recorded in the Project Area and/or Surrounds

Scientific Name	Common Name	Located in Surveys
Hirundapus caudacutus	White-throated Needletail	1
Merops ornatus	Rainbow Bee-eater	2
Rhipidura rufifrons	Rufous Fantail	1, 3
Monarcha melanopsis	Black-faced Monarch	1, 3

[1] Debus (1995).
[2] Attachment EA.
[3] Ecobiological (2009b)

The White-throated Needletail was recorded within a large forest block during the 1995 bird surveys conducted at DCM by Debus (1995).

EcoBiological (Attachment EA) recorded the Rainbow Bee-eater during the recent surveys of the Project area.

The Rufous Fantail was recorded during bird surveys undertaken by Debus (1995) and during a survey of the GCL owned properties located east and north-east of the DCM (EcoBiological, 2009b).

The Black-faced Monarch was recorded by Debus (1995) during the initial surveys of the then proposed DCM. This species was located along Coal Shaft Creek in the centre of the Project area, as well as east of the Project area in a rainforest strip along Mammy Johnsons River. The Black-faced Monarch was also recorded by EcoBiological (2009b) on GCL owned properties located east and north-east of the DCM.

As to be expected, many other migratory species recorded in the wider region (DECCW, 2009b; Birds Australia, 2009; DEWHA, 2009b) have the potential to be recorded in the Project area or surrounds, but given the occurrence of only limited habitat, the Project is not likely to impact the migratory species.

E3.2.7 Introduced Fauna Species in the Project Area and Surrounds

A total of nine introduced terrestrial fauna species have been recorded in the Project area and/or surrounds as listed in Table E-12.

Table E-12
Introduced Fauna Species Recorded in the Project Area and/or Surrounds

Scientific Name	Common Name	Reference
Birds		
Streptopelia chinensis	Spotted Turtle-Dove	1
Mammals		
Rattus rattus	Black Rat	2, 3
Canis lupus dingo	Dingo	4
Canis lupus familiaris	Dog	4
Vulpes vulpes	Red Fox	1, 2, 4, 5, 6
Felis catus	Feral Cat	5
Lepus capensis	Brown Hare	1, 2, 4, 5, 6
Oryctolagus cuniculus	European Rabbit	1, 2, 4, 5, 6
Bos Taurus	European Cattle	5

1 ERM Mitchell McCotter (1996b).
2 Attachment EA.
3 Place Planning and Design (2003).
4 Woodward-Clyde (1996c).
5 Paul Webber Consulting (1996).
6 Ecobiological (2009b).

EcoBiological (Attachment EA) report that the estimated relative abundance of the Black Rat and Red Fox was uncommon, while the Brown Hare and European Rabbit were abundant and common, respectively. Though, Red Fox and Dingo are commonly sighted in the general area (CHPL pers. comm., 2009). The relative abundance of the remaining introduced terrestrial fauna species has not been reported, but given the occasional records it is likely that these species are uncommon in the Project area.

E4 EVALUATION OF POTENTIAL IMPACTS ON FLORA AND FAUNA

The following sections identify the magnitude, extent and significance of potential Project impacts on threatened species, populations and ecological communities, and their habitats, in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005).

E4.1 NATIVE VEGETATION/HABITAT CLEARANCE

Habitat removal and modification resulting from the Project would result in impacts that are listed as Key Threatening Processes under the TSC Act. These are:

- Clearing of native vegetation.
- Removal of dead wood and dead trees.
- Bushrock removal.
- Loss of hollow-bearing trees.
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.

Degradation of native riparian vegetation along NSW watercourses is also a relevant Key Threatening Process under the FM Act and land clearance is also a Threatening Process under the EPBC Act.

These Key Threatening Processes are discussed below.

Clearing of Native Vegetation/Habitat

The additional surface disturbance associated with the Project would involve the clearance of approximately 87 ha of native vegetation communities, approximately 109 ha of secondary grasslands and approximately 11 ha of cropping land. The native vegetation communities which would be cleared comprise (Figure E-6a):

- approximately 61 ha of Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 1);
- approximately 2 ha of Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 2a);
- approximately 20 ha of Red Gum Grassy Woodland (Vegetation Community 3);
- approximately 3 ha of Grey Gum – Red Gum – Apple Riparian Forest (Vegetation Community 4); and
- approximately 1 ha of Stringybark - Paperbark Forest (Vegetation Community 7).

The areas of vegetation communities described above are not a single continuous area but rather multiple patches, the largest of which (approximately 45 ha) occurs in the north of the Project area (Figure E-6a). The indicative Project schedule shows the mining of this area in Year 7 of the mine life.

The vegetation communities to be cleared (Vegetation Communities 1 to 4 and 7) are already moderately cleared vegetation communities in the Hunter/Central Rivers CMA region.

The DECCW Vegetation Types Database (DECCW, 2009e) indicates that 65% of the pre-European extent of the equivalent Vegetation Type to Vegetation Communities 1 and 2a, as assigned by EcoBiological (Attachment EA) (i.e. Spotted Gum – Grey Ironbark Forest Dry Open Forest of the Lower Foothills of the Barrington Tops, North Coast) remains in the CMA region.

The DECCW Vegetation Types Database (DECCW, 2009e) indicates that 55% of the pre-European extent of the equivalent Vegetation Type to Vegetation Communities 3 and 4, as assigned by EcoBiological (Attachment EA) (i.e. Grey Box – Forest Red Gum – Grey Ironbark Open Forest of the Hinterland Ranges of the North Coast) remains in the CMA region.

The DECCW Vegetation Types Database (DECCW, 2009e) indicates that 50% of the pre-European extent of the equivalent Vegetation Type to Vegetation Community 7, as assigned by EcoBiological (Attachment EA) (i.e. Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin) remains in the CMA region.

The vegetation clearance for the Project equates to the clearance of the following broad fauna habitat types (Figure E-5):

- approximately 72 ha of Secondary Grassland;
- approximately 28 ha of Secondary Grassland with Regrowth Open Woodland/Forest; and
- approximately 96 ha of Regrowth Open Forest.

The cumulative flora and fauna impacts resulting from the Project primarily relate to the proposed disturbance which is additional to the 48 ha of forest vegetation formations and 171 ha of derived grassland which has been (or is approved to be) removed for the DCM in the existing approved mining area (DCPL, 1996).

Measures to reduce the direct, indirect and cumulative impacts of the Project in relation to the clearance of vegetation/habitat are provided in Section E5. These include the *Vegetation Clearance Protocol* (DCPL, 2002), rehabilitation of mine landforms with species characteristic of the vegetation communities cleared for the proposed Project. Section E6 provides an offset for the Project which provides long-term management and security of a significant area of land which:

- would increase the area of vegetation/habitat in the medium to long-term;
- would conserve and/or enhance similar vegetation communities/fauna habitats as is located in the Project area;
- is suitably located area to likely benefit flora and fauna populations (biodiversity values) impacted by the Project; and
- would enhance the connectivity of existing habitat areas via linkages with the Mammy Johnsons River and rehabilitated final Project landforms.

Removal of Dead Wood and Dead Trees

Dead wood in the form of ground logs and fallen branches is relatively uncommon in the Project area since the vegetation is predominantly regrowth and as a result less prone to fallen branches. Logs that do occur are predominantly too small to contain hollows suitable for ground-dwelling mammals. However, they are likely to be important to a range of reptile species. Scattered log and fallen branches are also associated with scattered tree groupings and isolated trees within the Secondary Grassland. Dead standing trees (stags) are generally uncommon across the range of habitats but nevertheless are present in small numbers. Clearing in areas where dead wood and dead trees are located would result in their loss. The loss of hollows associated with dead trees is described below.

Bushrock Removal

Bushrock removal is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation (DECCW, 2009f).

No major rock formations or continuous rock formations are present in the Project area but areas of scattered rock are present and are mainly confined to regrowth areas. While bush rocks generally provide a flora and fauna habitat resource, no threatened species which potentially occur within the Project area (Section E2.2.8) are likely to utilise the bush rocks present. Clearing in the Project area would result in bushrock removal, although it is considered to be a relatively minor impact.

Loss of Hollow-bearing Trees

Tree hollows are known to occur primarily in old growth eucalypts trees and it has been found that the presence, abundance and size of hollows is positively correlated with tree trunk diameter/ tree age (DECCW, 2009f). Large hollows may only occur in trees which are 100 to 150 years, or greater, in age (DEC, 2004a).

The majority of the trees in the Project area are regrowth trees which tend to be tall and straight without obvious hollow formation. The estimated age of regrowth trees varied between 10 to 50 years. Hollow-dependant fauna recorded in the Project area (not necessarily utilising hollows) include the Galah, various parrots, Brush-tailed Phascogale, Sugar Glider, Squirrel Glider, Common Ringtail Possum and various bat species (Attachment EE).

Relatively few old growth trees are present and clearing in these areas would result in the loss of hollow-bearing trees. The potential impacts on threatened fauna species are assessed in Section E4.15, while measures to collect suitable hollows during vegetation clearance for use in rehabilitation are described in Section E5.

Alteration to the Natural Flow Regimes of Rivers and Streams and their Floodplains and Wetlands and Degradation of Native Riparian Vegetation along NSW Watercourses

The *Alteration to the Natural Flow Regimes of Rivers and Streams and their Floodplains and Wetlands* is a Key Threatening Process listed under the TSC Act and degradation of native riparian vegetation along NSW watercourses is also a relevant Key Threatening Process under the FM Act.

The Project would directly impact and modify the catchment area of Coal Shaft Creek and a few unnamed drainage lines, but is very unlikely to have a measureable impact on the Mammy Johnsons River as discussed below.

Coal Shaft Creek

A number of existing runoff water control structures are present at the DCM including the MWD Diversions, Coal Shaft Creek Diversion, Eastern Diversion, flood control embankments to prevent inundation of open pit/infrastructure areas and a series of temporary northern diversion dams currently used to capture runoff from the small drainage line to the north of the Weismantel Extension open pit extent as mining progresses, which divert water (via pumping) to the Coal Shaft Creek Diversion (Figure E-2). At the DCM, an existing diversion channel allows for the flow of up-catchment runoff reporting to Coal Shaft Creek to traverse ML 1427 and avoid the mining areas (Figure E-2).

As part of the Project, the northern portion of the Coal Shaft Creek would need to be re-aligned as it occurs within the Project area (Figure E-2). The Project would also involve re-working the lower section of the existing Coal Shaft Creek Diversion channel. Only minor habitat is provided by the section of Coal Shaft Creek which would be impacted by the Project.

Unnamed Drainage Lines

Unnamed drainage lines of the Mammy Johnsons River occur in the north of the Project area and a length of the drainage lines and the upper catchment would be removed as part of the Project. The drainage lines are ephemeral, generally without well defined flood plains or tree dominated riparian strips. Only minor habitat is provided by the unnamed drainage lines which would be impacted by the Project.

Mammy Johnsons River

The Project would not involve the release of mine water to the Mammy Johnsons River, rather mine water disposal would be via irrigation as further described in Section E4.2.

The *Duralie Coal Mine Irrigation Management Plan* (DCPL, 2008b) includes a first flush protocol. The first flush protocol is designed to collect initial (or "first flush") rainfall runoff from irrigation areas which drain to Coal Shaft Creek or Mammy Johnsons River following prolonged dry spells, if this runoff contains high salinity as a result of salt build-up in irrigated soils. In implementing the first flush protocol, water runoff from the irrigation areas would be directed to the MWD.

The continued irrigation (including implementation of the first flush protocol) for the Project and associated impacts was assessed by Gilbert & Associates (2009) (Appendix A of the EA), who concluded that the continued irrigation (including implementation of the first flush protocol) would not result in the Project having a significant effect on the Mammy Johnsons River. Therefore, the continued irrigation (including implementation of the first flush protocol) is not likely to significantly impact any flora or fauna species associated with the Mammy Johnsons River.

Potential groundwater impacts on Mammy Johnsons River are discussed in Section E4.3.

E4.2 POTENTIAL IMPACTS FROM IRRIGATION

As described in Section E1, the Project would include both continued disposal of excess water through irrigation and development of new irrigation areas. Figure E-3 shows the approximate extent of the existing/approved irrigation areas as well as the proposed additional irrigation areas. Irrigation water would also be used on revegetated mine landforms.

Irrigation would be applied at times of soil moisture deficit in accordance with the *Duralie Coal Mine Irrigation Management Plan* (DCPL, 2008b). When soil moisture exceeds relevant deficit conditions (as determined by monitoring) due to rainfall, irrigation operations would be suspended until the soil moisture deficit is re-established.

The current approved irrigation is managed under the existing *Duralie Coal Mine Irrigation Management Plan* (DCPL, 2008b). Agricultural Water Management (2009) has conducted a review of the irrigation water quality at the DCM and concluded:

- the irrigation water has a medium water salinity rating (based on electrical conductivity [EC]) and is therefore suitable for moderately tolerant crops (DEC, 2004b);

- sodium and chloride concentrations in the irrigation water would not harm moderately tolerlant and hardier species;
- calcium concentrations in the irrigation water are sufficient to balance the bicarbonate concentrations and no water quality or soil amendments are required to ameliorate potential soil structure impacts;
- the sodium adsorption ratio of the irrigation water is less than the critical threshold of six where three is a risk to the soil structure through sodicity effects (DEC, 2004b); and
- the irrigated soils are expected to remain in the low salinity class.

As a precaution, the existing *Duralie Coal Mine Irrigation Management Plan* (DCPL, 2008b) includes a first flush protocol as discussed in Section E4.1. The first flush protocol is designed to collect initial (or "first flush") rainfall runoff from irrigation areas which drain to Coal Shaft Creek or Mammy Johnsons River following prolonged dry spells, when this runoff would be expected to contain some salt loads as a result of irrigation.

The additional proposed irrigation areas outside of the approximate extent of additional surface disturbance areas are predominantly located in secondary grasslands (approximately 111 ha). The Project would also involve the irrigation of approximately 28 ha of vegetation communities located outside of the approximate extent of additional surface disturbance areas, comprising of (Figure E-6b):

- approximately 9 ha of Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 1);
- approximately 9 ha of Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 2a); and
- approximately 10 ha of Red Gum Grassy Woodland (Vegetation Community 3).

Vegetation communities within the approximate extent of additional surface disturbance areas would also be irrigated prior to vegetation clearance (Figure E-3).

The irrigation water quality would be as outlined above, i.e. medium water salinity rating and is therefore suitable for moderately tolerant crops (Agriculture Water Management, 2009). Given this, irrigation of native vegetation would optimise available water to the above three communities at times of soil moisture deficit. The irrigation is expected to lead to increased plant productivity in all components of the particular community. Hence it is expected that supplementary irrigation of the selected regrowth vegetation communities would promote optimal regrowth within the currently fragmented patches during periods when otherwise there would be a rainfall deficit. In essence the supplementary irrigation targeting regrowth of native woodland/forest communities seeks to mimic natural conditions in an ongoing wet period. As such, the use of irrigation in the rehabilitation programme is likely to increase the success of revegetation works.

It is possible that irrigation could result in an increase of introduced flora species, including noxious weeds, and possibly additional weed species not now present in the Project area. However, measures are provided to reduce introduced flora species as discussed in Sections E4.5 and E5.

Pasture improvement (e.g. planting pasture species) as described in the existing *Duralie Coal Mine Irrigation Management Plan* (DCPL, 2008b) would not be undertaken in the additional irrigation areas for the Project.

E4.3 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater Dependent Ecosystems

Groundwater dependant ecosystems are ecosystems that have their species composition and their natural ecological processes determined by groundwater (Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ] and Australia and New Zealand Environment and Conservation Council [ANZECC], 1996 in NSW Department of Land and Water Conservation [DLWC], 2004).

The Groundwater Assessment conducted for the Project by Heritage Computing (2009) (Appendix B of the EA) predicted that groundwater levels would be drawn down during operations and post-closure due to various mining activities.

Considering the results of the Groundwater Assessment (Appendix B of the EA), the potential impacts on groundwater dependant ecosystems have been evaluated, including consideration of the NSW State Groundwater Dependent Ecosystems Policy (DLWC, 2004).

The predicted area of groundwater drawdown is considered in Appendix B of the EA to be moderately confined by the geology in the Project area. A brief description of the regional geology is provided in Section E1.4.2. Groundwater resources are located mainly within the sedimentary rock groundwater systems of the Gloucester basin. Groundwater in this system generally flows in a south-easterly direction with water depths to 20 m below the surface along ridgelines and near the ground surface in the west of the Project area (near Coal Shaft Creek) and along the Mammy Johnsons River (Appendix B of the EA).

Although the groundwater is near the surface along Coal Shaft Creek, the creek is ephemeral and the vegetation which occurs is not characteristic of a groundwater dependant ecosystem. It is more likely that the Mammy Johnsons River is a groundwater dependant ecosystem due to the occurrence of species such as Water Gum (*Tristaniopsis laurina*) and the likely connectivity between the permanent surface water and groundwater.

The Project involves the modification to Coal Shaft Creek, a minor tributary to the Mammy Johnsons River, and unnamed drainage lines to the north of the Project area, however the vegetation along these creek systems are not unlikely to be groundwater dependant.

The Surface Water Assessment (Appendix A of the EA) and Groundwater Assessment (Appendix B of the EA) for the Project concluded that the Project is not likely to have a significant impact on the Mammy Johnsons River.

Considering the above, the Project is not likely to impact any terrestrial vegetation or wetlands which may be dependant on groundwater.

The EARs for the Project refer to the *Policy and Guidelines for Fish Friendly Waterway Crossings* (DPI-Fisheries, 2009a). The Project does not involve the construction of waterway crossings so this policy and guideline is not relevant.

E4.4 LOSS OF HABITAT CONNECTIVITY

Connectivity is the *linkages of habitats … communities and ecological processes at multiple spatial and temporal scales* (Noss, 1991 in Lindenmayer and Burgman, 2005). Landscapes which retain more connections between remnant habitats are assumed to be more likely to maintain populations of species (Lindenmayer and Burgman, 2005).

The possible wildlife corridors in the Project area and surrounds (based on physical connectivity of trees) are shown on Figure E-5. Connectivity is species-specific because it depends on a number of life history factors of the species (including dispersal behaviour and mode of movement) and their interaction with landscape patterns (Lindenmayer and Burgman, 2005). Indeed, not all species use corridors and the suitability of a corridor may depend on several factors including the ecology of the species and the physical attributes of the corridor (Lindenmayer and Burgman, 2005). For example, the connectivity requirement for arboreal mammal habitat has been recently studied by a number of authors (e.g. van der Ree *et al.,* 2001, 2003, 2006; Gibbons *et al.,* 2002; Gibbons and Boak, 2008).

Many authors have shown that isolated trees and clumps of trees in cleared paddocks can also be utilised by arboreal mammals as 'stepping stones' in the landscape.

The Project would result in the short-term reduction of physical habitat connectivity, though the Project is unlikely to lead to the isolation of habitat or result in a substantial additional reduction in habitat connectivity within the surrounding landscape as the disturbance areas are located adjacent to the existing DCM.

The offset area for the Project and the rehabilitation concepts aim to increase the connectivity of habitat in the medium to long-term as described in Section E6.

E4.5 INTRODUCED FLORA

A total of 57 introduced flora species have been recorded in the Project area and surrounds, including five noxious weed species (Section E3.1.7).

Relevant Key Threatening Processes (NSW Scientific Committee, 1999a; 2003a; 2006a; 2006b) listed under the TSC Act which relate to introduced flora are:

- *Invasion of Native Plant Communities by Bitou bush and Boneseed*;
- *Invasion of Native Plant Communities by Exotic Perennial Grasses;*
- *Invasion and Establishment of Exotic Vines and Scramblers;* and
- *Invasion, Establishment and Spread of Lantana camara*.

One exotic vine, Blackberry (*Rubus fruticosus* agg. sp.) was recorded within the Project area (Attachment ED). The Blackberry was recorded opportunistically by EcoBiological (Attachment EA) in Vegetation Community 6, though a location or description of the infestation was not reported by EcoBiological. Vegetation Community 6 occurs outside the Project area along the Mammy Johnsons River. The species was also previously recorded by ERM Mitchell McCotter (1996a).

The Bitou Bush was recorded opportunistically by EcoBiological (Attachment EA) in Vegetation Community 7, though a location or description of the infestation was not reported by EcoBiological. A portion of Vegetation Community 7 occurs in the Project disturbance area (Figure E-6a).

Lantana was recorded by EcoBiological (Attachment EA), on the ridgeline located in the south-west of MLA 1. During the habitat assessment (Section E2.2.7), Lantana was found to be common along the unnamed drainage line in the north of the Project area.

Many perennial exotic grasses are already established in the area, either as weeds or pasture grasses (Attachment ED). These would have been introduced many times in the past by domestic stock and/or farm vehicles.

The proposed disturbance and irrigation associated with the Project has the potential to act as a catalyst for weed incursion and, if management measures are not in place, proliferation of weeds can occur. The Project is not considered likely to significantly increase the potential for weed incursion, given the weed control measures outlined in the various DCPL management plans (Section C5), which would continue to be implemented.

E4.6 INTRODUCED FAUNA

Relevant Key Threatening Processes (NSW Scientific Committee, 2000a; 2002; 2004) listed under the TSC Act which relate to introduced fauna are:

- *Predation by the Feral Cat (Felis catus);*
- *Competition and Grazing by the Feral European Rabbit (Oryctolagus cuniculus)*; and
- *Predation by the European Red Fox (Vulpes vulpes)*.

These Key Threatening Processes may be relevant to the Project as the European Rabbit, European Red Fox and Feral Cat have been recorded during surveys undertaken in the Project area and activities associated with the Project may provide increased refuge and scavenging resources (e.g. discarded food scraps) for these species, unless appropriately managed.

Appropriate management of potential refuge and scavenging resources would likely decrease introduced fauna in response to targeted control measures. Measures to avoid and mitigate potential impacts caused by introduced fauna are provided in Section E5.

E4.7 FAUNA AND NOISE

A number of recent literature reviews have been conducted on the effects of noise on wildlife (Radle, 2007; Kaseloo, 2005; Institute for Environmental Monitoring and Research, 2001). Noise can potentially adversely impact certain fauna species, although studies on the effect of noise on wildlife have shown very variable responses to potential impacts. Numerous studies indicate that many fauna species (including poultry) adapt to human activities and readily habituate to noise (e.g. Algers, 1978 in Richard Heggie Associates, 1997; Allaire, 1978; Ames, 1978; Busnel, 1978; Lynch and Speake, 1978; Shaw, 1978; Streeter *et al.*, 1979; Poole, 1982 in Richard Heggie Associates, 1997).

Similar to the existing DCM, noise emissions associated with the Project would originate predominantly from mobile equipment, processing plant and coal handling. In addition, the mining method requires the drilling and blasting of overburden.

Noise mitigation and management measures would be implemented as part of the Project as outlined in Section E5. Noise is unlikely to significantly impact any fauna species.

E4.8 DUST AND VEGETATION

Studies have shown that excessive dust generation can impact on the health and viability of surrounding vegetation. Dust can affect vegetation by inhibiting physiological processes such as photosynthesis, respiration and transpiration, and allow penetration of phytotoxic gaseous pollutants (Eller, 1977; Farmer, 1993).

Similar to the existing DCM, dust emissions associated with the Project would originate predominantly from the haulage of materials (i.e. coal and waste rock), wind blown emissions (particularly from waste rock dumps) and blasting. Measures to avoid and mitigate impacts from dust are provided in Section E5. Dust is unlikely to significantly impact any flora species.

E4.9 FAUNA AND ARTIFICIAL LIGHTING

Artificial lighting for the Project has the potential to affect the behavioural patterns of some fauna species. For example, some bird and bat species are attracted to insects that swarm around artificial lights. As a consequence of this, these bird and bat species could then become vulnerable to predation by larger predators which may lead to changes in population structure and community composition.

Artificial lighting is unlikely to significantly impact any fauna species, given the existing artificial lighting impacts from the DCM are unlikely to significantly increase as a result of the Project.

E4.10 VEHICULAR TRAFFIC MOVEMENTS

Vehicular traffic movements associated with the construction and operation of the Project have the potential to increase the mortality of some fauna species.

It is considered unlikely that the vehicular traffic movements required for the Project would significantly impact fauna given the location of the proposed traffic movements and the measures to avoid and mitigate potential impacts described in Section E5 (e.g. speed limits).

E4.11 BUSHFIRE RISK

Ecological Consequences of High Frequency Fire is listed as a Key Threatening Process under the TSC Act (NSW Scientific Committee, 2000b). The risk of high frequency fire as a result of the Project is considered to be relatively low given the relatively high rainfall in the area, grazing management and management measures described in Section E5, supported by the observed lack of evidence of past fire.

E4.12 HUMAN-CAUSED CLIMATE CHANGE

Human-caused Climate Change is listed as a Key Threatening Process under the TSC Act (DECCW, 2009a). This potential impact is addressed in Section 4 in the Main Report of the EA.

E4.13 CHYTRID FUNGUS

Infection of frogs by amphibian chytrid causing the disease Chytridiomycosis is listed as a Key Threatening Process under the TSC Act and EPBC Act.

A water-borne fungal pathogen *Batrachochytrium dendrobatidis*, commonly known as the amphibian or frog chytrid fungus, is responsible for the disease Chytridiomycosis (Berger *et al*., 1999). Infection occurs through water-borne zoospores released from an infected amphibian in water (NPWS, 2001a). Collection and handling of frogs and inadvertent transport of infected material between frog habitats may also promote the disease's spread (NSW Scientific Committee, 2003b).

To reduce the likelihood of spreading infection, personnel conducting amphibian surveys (e.g. associated with the rehabilitation/offset area) would observe appropriate hygiene protocols in accordance with the NPWS (2001a) *Hygiene Protocol for the Control of Disease in Frogs*. These measures would be documented in the revised Rehabilitation Management Plan and Offset Management Plan.

E4.14 THREATENED FLORA SPECIES

No threatened flora species are likely to be affected by the Project. The flora species that are considered to potentially occur in the Project area or surrounds (Table E-4) are discussed below.

Trailing Woodruff (Asperula asthenes)

The Trailing Woodruff (*Asperula asthenes*) is a small perennial herb (DECCW, 2009f). It is known from damp sites, often along river banks, between Bulahdelah and Kempsey, NSW (DECCW, 2009f).

No potential habitat for this species has been located in the Project area. Potential habitat for this species occurs along the Mammy Johnsons River and associated floodplains which would not be adversely impacted by the Project.

Slaty Red Gum (Eucalyptus glaucina)

The Slaty Red Gum (*Eucalyptus glaucina*) is a tree which typically grows to 16 m (Pellow, *et al.,* 2009) but can be up to 30 m in height (DECCW, 2009f). This species is found only in the North Coast IBRA region from near Casino (where it can be locally common), and further south, from Taree to Broke (DECCW, 2009f). This Red Gum grows in grassy woodland and dry eucalypt forest (DECCW, 2009a). The soils are typically deep and moderately fertile (DECCW, 2009f). Flowers are produced between August and December (DECCW, 2009f).

This tree has not been recorded in the Project area during multiple targeted surveys, and given its known range is unlikely to occur in the Project area.

Guthrie's Grevillea (Grevillea guthrieana)

Guthrie's Grevillea is known to occur in the north coast of NSW, at Booral near Bulahdelah and on the Carrai Plateau, south-west of Kempsey (DEC, 2005a). The Guthrie's Grevillea grows along creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil (DEC, 2005a). The species flowers in spring (Royal Botanic Gardens & Domain Trust, 1999).

This distinctive flowering shrub has not been recorded in the Project area or surrounds during multiple targeted surveys, and given its known range, is unlikely to occur in the Project area.

Magenta Lilly Pilly (Syzygium paniculatum)

The Magenta Lilly Pilly (*Syzygium paniculatum*) is a rainforest tree which grows to 8 m in height (DECCW, 2009f). It is found in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest (DECCW, 2009f).

Payne (1991, 1997) has studied the biology and ecology of the Magenta Lilly Pilly among the Central Coast populations (NPWS, 2001b). This species occurs on sandy soil (Pellow *et al.,* 2009). On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest (DECCW, 2009f), while on the central coast the Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (DECCW, 2009f). Plants produce white flower-clusters at the end of each branch, between November and February (DECCW, 2009f).

This distinctive lillypilly tree has not been recorded in the Project area or surrounds during multiple targeted surveys and is unlikely to occur in the Project area.

White-flowered Wax Plant (Cynanchum elegans)

The White-flowered Wax Plant is restricted to eastern NSW from Brunswick Heads on the north coast to Gerroa in the Illawarra region and has been recorded as far west as Merriwa in the upper Hunter River valley (DEC, 2005b).

The White-flowered Wax Plant typically occurs on the edge of dry rainforest vegetation (DEC, 2005b). Other associated vegetation types include littoral rainforest; Coastal Tea-tree (*Leptospermum laevigatum*); Coastal Banksia (*Banksia integrifolia* subsp. *integrifolia*) coastal scrub; Forest Red Gum (*Eucalyptus tereticornis*) aligned open forest and woodland; Spotted Gum (*Eucalyptus maculata*) aligned open forest and woodland; and Bracelet Honeymyrtle (*Melaleuca armillaris*) scrub to open scrub (DEC, 2005b).

The White-flowered Wax Plant flowers between August and May, with a peak in November. Seeds are wind dispersed and seed production is variable and unreliable (DEC, 2005b). It is considered to be unlikely that a soil seed bank for this species exists and plants are capable of suckering from rootstock in response to occasional slashing or grazing (DEC, 2005b).

This species has not been recorded in the Project area or surrounds during multiple targeted surveys, and is unlikely to occur

E4.15 THREATENED FAUNA SPECIES

Section E2.2.8 and Table E-4 provide a list of threatened fauna species that are either known to occur or considered to potentially occur in the Project area or immediate surrounds. This list of threatened fauna species was further refined to include only those likely to be affected by the Project (Table E-13). This list is conservative and includes species which may be subject to only minor removal of known habitat as further described in Sections E4.15.1 to E4.15.7.

Table E-13
Threatened Fauna Species, or their Habitat, Likely to be Affected by the Project

Scientific Name	Common Name	Conservation Status	
		TSC Act[1]	EPBC Act[2]
Birds			
Lathamus discolor	Swift Parrot	E	E
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	-
Pyrrholaemus sagittata	Speckled Warbler	V	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-
Mammals			
Phascogale tapoatafa	Brush-tailed Phascogale	V	-
Petaurus norfolcensis	Squirrel Glider	V	-
Mormopterus norfolkensis	Eastern Freetail-bat	V	-
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-
Myotis macropus	Large-footed Myotis	V	-

[1] Threatened Species status under the TSC Act.

[2] Threatened Species status under the EPBC Act.

V Vulnerable.

E Endangered.

In accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005), the effect of the Project on current disturbance regimes applicable to threatened species has been considered. It is considered unlikely that the Project would result in a significant change in the current disturbance regimes (e.g. frequency of fires – Section E4.11) given the management measures proposed (e.g. fire management – Section E5). The Project would impact on surface water flow regimes in the Project area, particularly Coal Shaft Creek and a few unnamed drainage lines, but would not have a measureable impact on the Mammy Johnsons River.

In accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005), the effect of the Project on connectivity of habitat for threatened species has been assessed. The potential impacts of the Project on loss of habitat connectivity are evaluated in Section E4.4.

The Project would not affect any critical habitat. No critical fauna habitat occurs within the vicinity of the Project area as designated by the Register of Critical Habitat held by the Commonwealth Minister of the Environment, Heritage and Arts (DEWHA, 2009c), Register of Critical Habitat held by the Director-General of the DECCW (DECCW, 2009g), the Register of Critical Habitat held by the Director-General of the DPI-Fisheries (DPI-Fisheries, 2009b) or identified within the Great Lakes LEP.

The potential impacts from the Project on the threatened fauna species listed in Table E-13 are evaluated in the following sections in consideration of the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). The potential impacts of the Project on other threatened fauna species listed in Table E-4 are discussed in Section E4.15.8.

E4.15.1 Swift Parrot

The potential impacts from the existing DCM on the Swift Parrot (*Lathamus discolor*) were previously assessed by Woodward-Clyde (1996c) and it was concluded that the DCM would not significantly impact the Swift Parrot.

In 2009, a single Swift Parrot was sighted by EcoBiological in the north of the Project area (Attachment EA) (Figure E-8). The closest BioNet record of the Swift Parrot to the Project area is located 38 km south-west (NSW Government, 2009). The record in the Project area was likely to be an opportunistic sighting of a migratory, nomadic or vagrant bird utilising foraging resources in the Project area.

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Swift Parrot breeds in Tasmania and typically migrates to mainland Australia between March and October (Swift Parrot Recovery Team, 2001; DEC, 2005c).

The Swift Parrot breeds from September to January (DEC, 2005c). It nests in hollows in old growth trees across a range of eucalypt species (Swift Parrot Recovery Team, 2001).

This species occurs where there is profuse flowering of eucalypts or where there are abundant lerp (from sap-sucking bugs) infestations (DEC, 2005c). Favored feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*) (DEC, 2005c). Commonly used lerp infested trees include Grey Box (*E. microcarpa*), Grey Box (*E. moluccana*) and Blackbutt (*E. pilularis*) (DEC, 2005c).

Migration and dispersal events occur within the species' non-breeding winter range, and the final destination of birds is thought to be dependant on local food resources (Swift Parrot Recovery Team, 2001). The re-use of nest sites depends on the availability of food in the area and nests are not necessarily re-used in successive years (Swift Parrot Recovery Team, 2001).

Threats relevant to the Swift Parrot include:

- *… habitat loss through clearing for agriculture, and urban and industrial development* (DECCW, 2009f)*;*
- *Collisions with wire netting fences, windows and cars, during the breeding season and winter migration …* (DECCW, 2009f); and
- firewood collection (Brown, 1989 in Garnett and Crowley, 2000).

The Swift Parrot only breeds in Tasmania. Some potential foraging and roosting resources for the Swift Parrot occur within the Project area (i.e. winter flowing Eucalypts, e.g. Spotted Gum [*Corymbia maculata*], Narrow-leaved Ironbark [*Eucalyptus crebra*], Thin-leaved Stringybark [*Eucalyptus eugenioides*], Red Ironbark [*Eucalyptus fibrosa*] and White Stringybark [*Eucalyptus globoidea*]) and would be removed as part of the Project.

Vehicular movement associated with the Project also have a very limited potential to adversely impact non-breeding individuals of this species.

Although some suitable foraging habitat would be removed as part of the Project, the Project would not significantly affect the lifecycle of this species given:

- the Project area is located within the over-wintering and underutilised range of the Swift Parrot albeit likely to be a very minor component of the Swift Parrot's habitat;
- the species does not breed in the Project area as breeding occurs only in Tasmania;
- the species' mobility (i.e. the Swift Parrot is migratory) would enable the Swift Parrot to relocate easily to alternative habitats within its winter feeding range if needs be;
- the localised nature of the Project disturbance areas together with the very infrequent use of existing habitat by the Swift Parrot within the Project area is likely to result in a relatively minor impact on the species foraging resources, if at all;
- there remains significant and widespread potential and underutilised feeding and roosting resources for the species in the wider area (Figure E-9); and
- the species is likely to be absent from the Project area and the immediate surrounds during the breeding season and to be absent or in very low numbers in the non breeding season, and very likely never attaining resident status.

Further, a referral under the EPBC Act has been prepared in consideration of the *Significant Impact Guidelines – Matters of National Environmental Significance* (DEH, 2006), which concludes that the Project is unlikely to significantly impact the Swift Parrot.

Notwithstanding, a number of measures have been developed to minimise potential impacts on this species including the following:

- Continuation of the *Duralie Coal Mine Vegetation Clearance Protocol*, which includes management of threatened species (DCPL, 2002) (Section E5).
- Continuation of the on-site control of introduced animal fauna, fire management and weed control (Section E5).
- Rehabilitation of Project disturbance areas with native grass, shrub and tree species characteristic of the vegetation communities cleared (Section E5).
- Long-term conservation and enhancement of potential habitat resources for the Swift Parrot within the offset area as described in Section E6.

Conclusion

The Project is unlikely to adversely or significantly impact the lifecycle of the Swift Parrot.

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2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat requirements for this species are outlined above. In the Project area, winter flowing Eucalypts, e.g. Spotted Gum (*Corymbia maculata*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Thin-leaved Stringybark (*E. eugenioides*), Red Ironbark (*E. fibrosa*) and White Stringybark (*E.globoidea*) represent potential food sources for the Swift Parrot. These trees are scattered throughout the proposed disturbance area which is quantified in Section E4.1.

The foraging and roosting habitat present in the Project area is a very minor component of the Swift Parrot's habitat. Based on the available data, the Swift Parrot record in the Project area is likely that of a migrating or dispersing lone bird, or possibly a nomadic sighting, and suggests that the species is unlikely to have resident status within the Project area. Hence the Swift Parrot's limited but potential resources in the Project area are rarely used and underutised.

Conclusion

The proposed Project is very unlikely to significantly affect the habitat of the Swift Parrot or the Swift Parrot population.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Swift Parrot breeds in Tasmania and typically migrates or disperses to south-eastern Australia from Victoria (VIC) to the eastern parts of South Australia (SA), south-eastern QLD and the coast and south-west slopes of NSW (DEC, 2005c).

Conclusion

The Project area is located within the known winter range distribution of the Swift Parrot. The Project area does not represent a distributional limit for this species.

E4.15.2 Brown Treecreeper (Eastern Subspecies)

EcoBiological sighted two individuals of the Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) at one location in the north of the Project area (Attachment EA) (Figure E-8).

The recent sighting by EcoBiological (Attachment EA) is the only record of the species in the Project area or surrounds. The Brown Treecreeper (eastern subspecies) is usually a communal bird and found in groups of eight to 12 birds (DECCW, 2009f) and while the species is predicted to occur in the Karuah Manning CMA subregion (in which the Project area is located), it is not known to occur in the CMA subregion (DECCW, 2009h). The closest BioNet record of this species is located approximately 90 km west of the Project area (NSW Government, 2009). The species does not appear to be a resident within the Project Area. It could not be determined if the sighting represented a bonded pair or a dispersal/migratory movement.

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Brown Treecreeper (eastern subspecies) inhabits Eucalypt woodlands and dry open forest of the inland plains and slopes of the Great Dividing Range, mainly in woodlands dominated by stringybarks or other rough-barked Eucalypts, usually with an open grassy understorey (DEC, 2005d). It is less commonly found in similar woodland habitats on the coastal ranges and plains, and is usually not found in woodlands with a dense shrub layer (DEC, 2005d). An important habitat component for foraging is fallen timber (DEC, 2005d).

The Brown Treecreeper (eastern subspecies) breeds between July and February (DEC, 2005d). Hollows in standing dead or live trees and tree stumps are essential for nesting (DEC, 2005d), although nests have been observed in fence posts (NSW Scientific Committee, 2001a).

The species forages in trees and on the ground for insects, although nectar from Mugga Ironbark (*E. sideroxylon*) and paperbarks, sap from an unidentified eucalypt, lizards and food scraps are also eaten (DEC, 2005d).

The Brown Treecreeper (eastern subspecies) is generally observed in pairs or groups of eight to 12 birds and is considered to be sedentary (DEC, 2005d). The species breeds in pairs or co-operatively in territories which range in size from 1.1 to 10.7 ha (DEC, 2005d). Each group is composed of a breeding pair with retained male offspring and, rarely, retained female offspring (DEC, 2005d).

This sub-species is predominantly sedentary, though some birds may disperse locally after breeding (DECCW, 2009f).

The main threats relevant to the Brown Treecreeper (eastern subspecies), include (DECCW, 2009f):

- *Historical loss of woodland, forest and mallee habitats as a result of agriculture, forestry, mining and residential development.*
- *Fragmentation of woodland and forest remnants which isolates populations and causes local extinctions.*
- *Ongoing degradation of habitat, particularly the loss of tree hollows and fallen timber from firewood collection and overgrazing.*
- *Lack of regeneration of eucalypt overstorey in woodland due to overgrazing and too-frequent fires.*
- *Loss of ground litter from compaction and overgrazing.*
- *Inappropriate forestry management practices.*

The Project would result in the removal of the vegetation in which this species was recorded. However, the Project is unlikely to significantly affect the lifecycle of this species given:

- the very limited records of the Brown Treecreeper (eastern subspecies) in the Project area suggest that the species is not resident within the Project area;
- it is unlikely that a viable population of the Brown Treecreeper (eastern subspecies) is extant within the Project area given the already fragmented nature of the habitat (i.e. the largest remnant is approximately 45 ha) and the Brown Treecreeper (eastern subspecies) appears unable to maintain viable populations in remnants less then 200 ha (Barrett *et al.,* 1994 in NSW Scientific Committee, 2001a); and
- much of the extant regrowth woodland and forest habitats within the Project area are suboptimal to the needs of the Brown Treecreeper (eastern subspecies) since tree densities are too high and ground feeding niche space too limited.

Notwithstanding, a number of measures have been developed to minimise potential impacts on this species including the following:

- Continuation of the *Duralie Coal Mine Vegetation Clearance Protocol*, which includes management of threatened species (DCPL, 2002) (Section E5).
- Continuation of the on-site control of introduced feral fauna, fire management and weed control (Section E5).
- Rehabilitation of Project disturbance areas with native grass, shrub and tree species characteristic of the vegetation communities cleared (Section E5).
- Long-term conservation and enhancement of potential habitat for the Brown Treecreeper (eastern subspecies) within the offset area as described in Section E6.

Conclusion

The Project is very unlikely to adversely impact the lifecycle of the Brown Treecreeper (eastern subspecies).

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat requirements for this species are outlined above. The area of the habitat patch in which the Brown Treecreeper (eastern subspecies) was recorded is 45 ha and constitutes a regrowth woodland/forest patch.

The Brown Treecreeper (eastern subspecies) appears unable to maintain viable populations in remnants less then 200 ha and its abundance decreases as remnant area decreases (Barrett *et*. al., 1994 in NSW Scientific Committee, 2001a). In locations where the species is found, habitat fragmentation can lead to a skewed sex ratio in Brown Treecreeper (eastern subspecies) populations because female birds are unable to disperse to isolated remnants (Walters *et al*., 1999).

There does not appear to be a resident population of the Brown Treecreeper (eastern subspecies) within the Project area and much of the extant regrowth woodland and forest habitats within the Project area are sub-optimal to the needs of the Brown Treecreeper (eastern subspecies) since tree densities are too high and ground feeding niche space too limited.

Conclusion

The Project is very unlikely to significantly impact the habitat of the Brown Treecreeper (eastern subspecies).

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Brown Treecreeper (eastern subspecies) is distributed throughout central NSW on the western side of the Great Dividing Range (NSW Scientific Committee, 2001a). Scattered populations also exist on the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney and in parts of the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee, 2001a).

The Project area is located east of the previously known records of the Brown Treecreeper (eastern subspecies) (after NSW Government, 2009) in this region. There does not appear to be a resident population of the Brown Tree creeper within the Project area. Much of the extant regrowth woodland and forest habitats within the Project area are sub-optimal to the needs of the Brown Treecreeper (eastern subspecies), since tree densities are too high and ground feeding niche space too limited.

However the Project area does not appear to be a distributional limit for this species, nor is the Project likely to adversely impact the Brown Treecreeper (eastern subspecies), were a resident population found to be present.

Conclusion

The Brown Treecreeper (eastern subspecies) is not at a statewide distributional limit nor is the Project likely to adversely impact this species.

E4.15.3 Speckled Warbler

Groups of up to three Speckled Warblers (*Pyrrholaemus sagittatus*) were recorded at three locations by EcoBiological in the north of the Project area (Attachment EA) (Figure E-8). The Speckled Warbler was also observed in an area approved for surface disturbance (Figure E-8) (Attachment EA).

A single Speckled Warbler was recorded by EcoBiological (2009b) approximately 0.9 km to the east on the footslopes of Buckleys Range and additional records of this species are known in the local area, approximately 2 km north and near Craven, approximately 8 km to the north (NSW Government, 2009).

These data suggest that it is likely that a resident population of Speckled Warbler utilises habitat in the Project area and surrounds.

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Speckled Warbler inhabits a wide range of *Eucalyptus* dominated communities that have a tussocky grassy understorey with a sparse shrub layer, often on rocky ridges or in gullies (DEC, 2005e).

The Speckled Warbler typically breeds between August and January (Pizzey and Knight, 1999). The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, or placed in a low shrub or tree trunk, often among fallen branches and other litter (DECCW, 2009f). A side entrance allows the bird to walk directly inside (DEC, 2005e).

The diet of the Speckled Warbler consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees (DEC, 2005e).

Speckled Warbler pairs are sedentary and occupy a breeding territory of about 10 ha, with a slightly larger home-range when not breeding (DEC, 2005e). Large, relatively undisturbed remnants are required for the species to persist in an area (DECCW, 2009f). Research on the ecology of this species suggests that a minimum of 30 to 40 ha of suitable habitat preferably linked to other remnant patches is required to facilitate juvenile dispersal, genetic exchange and winter flocking behaviour (Gardner, 2004).

Threats to this species include (DEC, 2005e):

- susceptibility … *to catastrophic events and localised extinction* (due to fragmented nature of the populations and their small size).
- *Clearance of remnant grassy woodland habitat for paddock management reasons and for firewood.*
- *Poor regeneration of grassy woodland habitats.*
- *Modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, heavy grazing and compaction by stock and frequent fire.*
- *Habitat is lost and further fragmented as land is being cleared for residential and agricultural developments. In particular, nest predation increases significantly, to nest failure rates of over 80%, in isolated fragments.*
- *Nest failure due to predation by native and non-native birds, cats, dogs and foxes particularly in fragmented and degraded habitats.*

The Project would result in the removal of 96 ha of regrowth forest/woodland, some being potential breeding and foraging resources for the Speckled Warbler. The Speckled Warbler was recorded within the Project area in a vegetation patch of approximately 45 ha in area. This loss of woodland/forest could possibly cause a small number of the local population to relocate within the Project area or elsewhere. However, the Project is unlikely to significantly affect the lifecycle of this species given:

- the available potential habitat of the Speckled Warbler within the Project area and the immediate surrounds appears to be very much under-utilised by the species;
- the localised nature of the Project disturbance areas (which are adjacent to the existing DCM) compared with habitat availability elsewhere in the local area (Figure E-9); and
- the existing records of the species in the immediate surrounds of the Project area (i.e. approximately 0.9 km to the east [EcoBiological, 2009b], approximately 2 km north, approximately 8 km to the north [NSW Government, 2009]).

Notwithstanding, a number of measures have been developed to minimise potential impacts on this species including the following:

- Continuation of the *Duralie Coal Mine Vegetation Clearance Protocol*, which includes management of threatened species (DCPL, 2002) (Section E5).
- Continuation of the on-site control of introduced feral fauna, fire management and weed control (Section E5).
- Rehabilitation of Project disturbance areas with native grass, shrub and tree species characteristic of the vegetation communities cleared (Section E5).
- Long-term conservation and enhancement of known habitat for the Speckled Warbler within the offset area as described in Section E6.

Conclusion

The Project would remove some potential habitat of the Speckled Warbler. However the existing available Speckled Warbler habitat and resources within the Project area appear to be significantly under-utilised by this species. Hence, the Project is likely to marginally adversely impact the lifecycle of the Speckled Warbler if at all.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Large areas of relatively undisturbed habitat is required for the Speckled Warbler to persist in the landscape (DEC, 2005e). The Speckled Warbler is usually not located in areas where habitat fragments are less than 100 ha (NSW Scientific Committee, 2001b). However there appears to be a viable population of the Speckled Warbler within the Project area despite the internal fragmentation and its regrowth nature.

The Regrowth Open Forest habitat type available within the Project area provides potential habitat for the Speckled Warbler, albeit significantly underutilised by this species (Figure E-5).

The Project would involve the removal of 96 ha of Regrowth Open Forest which occurs in various patches across the Project area. The largest continuous treed area which would be removed, approximately 45 ha in area, occurs in the north of the Project area (Figure E-5).

Conclusion

Some known and potential Speckled Warbler habitat would be removed by the Project. The configuration of the remnant woodland/forest to be removed appears to be sub-optimal for the species needs both in terms of remnant patch area and inter-remnant connectivity. The Project is unlikely to significantly affect the habitat of the Speckled Warbler.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Speckled Warbler has a patchy distribution throughout south-eastern QLD, the eastern half of NSW and into VIC, as far west as the Grampians (DEC, 2005e). The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast (DEC, 2005e).

Conclusion

The Project is located within the known distribution range of the Speckled Warbler. The Project area does not represent a distributional limit for this species.

E4.15.4 Grey-crowned Babbler (Eastern Subspecies)

A group of six Grey-crowned Babblers (eastern subspecies) (*Pomatostomus temporalis temporalis*) was recorded by EcoBiological in the north of the Project area (Attachment EA) (Figure E-8). It could not be determined if this species is wholly resident within the Project area or whether a component part of its territory is within the Project area. However, it is likely that a viable colony of the Grey-crowned Babbler (eastern subspecies), albeit small is either extant within the Project area or within the immediate surrounds.

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Grey-crowned Babbler (eastern subspecies) inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (DECCW, 2009f). This species lives and breeds in a co-ordinated communal group which may include up to 12 individuals (DECCW, 2009f). These extended family parties are essential for both the co-operative feeding of young and predator avoidance (King, 1980 in Garnett and Crowley, 2000).

The Grey-crowned Babbler (eastern subspecies) typically breeds between July and February (DEC, 2005f). The species live in family groups that consist of a breeding pair and young from previous breeding seasons (DEC, 2005f). Conspicuous, dome-shaped nests are constructed from sticks and are maintained year round and used for roosting at night (DEC, 2005f). Nests are typically located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts (DEC, 2005f). Approximately two to three eggs are laid and incubated by the female (DEC, 2005f).

The Grey-crowned Babbler (eastern subspecies) feeds on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, where they dig and probe amongst leaf litter and tussock grasses (DEC, 2005f).

Threats relevant to the Grey-crowned Babbler (eastern subspecies) include (DEC, 2005f):

- *Clearing of woodland remnants.*
- *Heavy grazing and removal of coarse, woody debris within woodland remnants.*
- *Nest predation by species such as ravens and butcherbirds may be an issue in some regions where populations are small and fragmented.*

The Project is unlikely to significantly affect the lifecycle of this species given:

- only one colony of this species has been observed in the north of the Project area;
- the Project would involve the removal of 28 ha of Secondary Grassland with Regrowth Open Woodland/Forest which occurs in various patches across the Project area (Figure E-5); and
- the localised nature of the Project disturbance areas (which are adjacent to the existing DCM) compared with habitat availability elsewhere in the local area (Figure E-9).

Notwithstanding, a number of measures have been developed to minimise potential impacts on this species including the following:

- Continuation of the *Duralie Coal Mine Vegetation Clearance Protocol*, which includes management of threatened species (DCPL, 2002) (Section E5).
- Continuation of the on-site control of introduced feral fauna, fire management and weed control (Section E5).
- Rehabilitation of Project disturbance areas with native grass, shrub and tree species characteristic of the vegetation communities cleared (Section E5).
- Long-term conservation and enhancement of potential habitat for the Grey-crowned Babbler (eastern subspecies) within the offset area as described in Section E6.

Conclusion

The project is unlikely to significantly impact on the lifecycle of the Grey-crowned Babbler (eastern subspecies).

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat requirements for this species are outlined above. The Secondary Grassland with Regrowth Open Woodland/Forest (Figure E-5) provide potential habitat for the Grey-crowned Babbler (eastern subspecies). The Project would involve the removal of 28 ha of Secondary Grassland with Regrowth Open Woodland/Forest which also occurs in various patches across the Project area (Figure E-5) as well as in the immediate surrounds.

Conclusion

The Project is unlikely to have a significant impact on the habitat of the Grey-crowned Babbler (eastern subspecies).

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

In NSW, the Grey-crowned Babbler (eastern subspecies) occurs on the western slopes of the Great Dividing Range, the western plains and woodlands in the Hunter Valley and in several locations on the north coast of NSW (DEC, 2009f).

Conclusion

The Project area is located within the known distribution of the Grey-crowned Babbler (eastern subspecies) and the Project area does not represent a distributional limit for this species.

E4.15.5 Brush-tailed Phascogale

The Brush-tailed Phascogale was first recorded in the DCM area by Woodward-Clyde (1996c), when a single specimen was observed foraging on the ground amongst a stand of Paperbarks along a tributary to Coal Shaft Creek (Woodward-Clyde, 1996c). A single specimen was also observed from a hollow along a central portion of Coal Shaft Creek (Woodward-Clyde, 1996c). The potential impacts from the existing DCM on the Brush-tailed Phascogale were previously assessed by Woodward-Clyde (1996c) and it was concluded that the DCM would not significantly impact the Brush-tailed Phascogale.

Since 1996, one adult female Brush-tailed Phascogale with three young was recorded during a pre-clearance survey of the approved mine in July 2003 (Place Planning and Design, 2003). During recent surveys, EcoBiological sighted one Brush-tailed Phascogale along Mammy Johnsons River, immediately east but outside of the Project area and captured one individual to the west of the Project area (Attachment EA) (Figure E-8).

The records indicate that it is likely that a resident and viable population of Brush-tailed Phascogale utilises habitat in the Project area and surrounds.

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Brush-tailed Phascogale prefers dry schlerophyll open forests with a sparse ground cover of herbs, grasses, shrubs or leaf litter (DEC, 2005g). However it also inhabits heath, swamps, rainforest and wet sclerophyll forest. The Brush-tailed Phascogale mates between May and July (DEC, 2005g). Females live up to three years but generally only produce one litter.

Nursery nests are built in large tree hollows with entrances 25 to 40 mm wide and many hollows may be used over a short time (DEC, 2005g). The presence of a high density of old growth trees supporting hollows is an essential component of this species' habitat requirements (van der Ree *et al.,* 2006; Soderquist, 1998). Van der Ree *et al.,* (2006) observed that Brush-tailed Phascogale prefer larger trees (average diameter of >80 cm DBH).

The Brush-tailed Phascogale is a nocturnal species which feeds mainly on arthropods, however other invertebrates vertebrates, nectar and small vertebrates are also eaten (DEC, 2005g). This species is thought to prefer foraging in rough-barked trees greater than 25 cm in diameter (DEC, 2005g).

Females have home ranges of 20 to 60 ha, while males establish overlapping home ranges of more than 100 ha (DEC, 2005g). Individuals are known to move 300 m over open land, though prefer forested corridors linking habitat areas (Woodward Clyde, 1996c).

Van der Ree *et al.* (2006) studied the nest-tree selection by the Brush-tailed Phascogale in a highly fragmented agricultural landscape in south-east Australia, using radio tracking. The study found that scattered clumps of trees and individual trees in a predominantly cleared landscape were used by the species and suitable trees that were evenly distributed across the landscape were more beneficial than clumped trees (van der Ree *et al.,* 2006).

Threats relevant to the Brush-tailed Phascogale include (DEC, 2005g):

- *Loss and fragmentation of habitat.*
- *Loss of hollow-bearing trees.*
- *Predation by foxes and cats.*
- *Competition for nesting hollows with the introduced honeybee.*

It is likely that a resident and viable population of Brush-tailed Phascogale utilises habitat in the Project area and surrounds. The Project would result in the removal of 96 ha of regrowth forest/woodland, some being potential breeding and foraging resources for Brush-tailed Phascogale. This loss of woodland/forest could possibly cause a likely small number of the local population to relocate from within the Project area to elsewhere. The Project would result in the loss and further fragmentation of potential habitat resources for the Brush-tailed Phascogale. While the forest and woodland vegetation formations within the Project area are predominantly regrowth, there are low numbers of scattered hollow-bearing trees/stags (Attachment EA) which this species could potentially utilise for nesting. Some components of the regrowth woodland/forest vegetation in the Project area also provide suitable foraging resources for this species.

It is unlikely that the Project would significantly affect the lifecycle of this species given:

- the relatively low numbers of scattered hollow-bearing trees/stags which would be removed by the Project;
- the localised nature of the Project disturbance areas and wider occurrence of potential habitat (Figure E-9); and

- the likely very low density and the nature of the distribution of the Brush-tailed Phascogale across the Project area.

Notwithstanding, a number of measures have been developed to minimise potential impacts on this species including the following:

- Continuation of the *Duralie Coal Mine Vegetation Clearance Protocol*, which includes management of threatened species (DCPL, 2002) (Section E5).
- Continuation of the on-site control of introduced feral fauna, fire management and weed control (Section E5).
- Rehabilitation of Project disturbance areas with native grass, shrub and tree species characteristic of the vegetation communities cleared (Section E5).
- Long-term conservation and enhancement of known habitat for the Brush-tailed Phascogale within the offset area as described in Section E6.

Conclusion

The Project is unlikely to have a significant impact on the life cyle of the Brush-tailed Phascogale.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat requirements for this species are outlined above. As described in Section E3.2.1, almost all of the pre-European forest and woodland in the Project area has been extensively cleared and/or logged at least once and in some cases very likely twice. Mostly tree re-generation is occurring at forest-formation density. Regrowth trees tend to be tall and straight and without obvious hollow formation. The estimated age of regrowth trees varied between 10 to 50 years.

The Brush-tailed Phascogale is a hollow-dependant species and the presence of a high density of old growth trees supporting hollows is an essential component of this species habitat requirements (Soderquist, 1998; van der Ree *et al.,* 2006). In the Project area, low numbers of scattered hollow-bearing trees/stags occur in the Secondary Grassland with Regrowth Open Woodland/Forest and Regrowth Open Forest broad habitat types (Figure E-5). However, the density of hollows is sub-optimal for hollow-dependant species.

It is likely that a resident and viable population of Brush-tailed Phascogale utilises habitat in the Project area and surrounds. The Project would result in the removal of 96 ha of regrowth forest/woodland, some being potential breeding and foraging resources for Brush-tailed Phascogale. This loss of woodland/forest could possibly cause a likely small number of the local population to relocate within the Project area or elsewhere. The Project would result in the loss and further fragmentation of potential habitat resources for the Brush-tailed Phascogale. While the forest and woodland vegetation formations within the Project area are predominantly regrowth, there are low numbers of scattered hollow-bearing trees/stags (Attachment EA) which this species could potentially utilise for nesting. Some components of the regrowth woodland/forest vegetation in the Project area also provide suitable foraging resources for this species.

Conclusions

The project is unlikely to significantly affect the existing habitat of the Brush-tailed Phascogale.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Brush-tailed Phascogale has a patchy distribution around the coast of Australia and in NSW, the species appears to be most abundant in forests on the Great Dividing Range in the north-east and south-east (DEC, 2005g).

Conclusion

The Project area is located within the known distribution of the Brush-tailed Phascogale and the Project area does not represent a distributional limit for this species.

E4.15.6 Squirrel Glider

The Squirrel Glider was not recorded during the fauna surveys conducted within ML 1427 (Sections E2.2.1 and E2.2.8). However the potential impacts from the existing DCM on the Squirrel Glider (*Petaurus norfolcensis*) were assessed by Woodward-Clyde (1996c) and it was concluded that the DCM would not significantly impact the Squirrel Glider.

The Squirrel Glider was first recorded in the area by Place Planning and Design (2003) during a pre-clearance survey of the approved mine area, conducted in August 2003. A single Squirrel Glider was seen during spotlighting, another was captured in an Elliot B trap and another seen leaving a tree during tree felling (Place Planning and Design, 2003). DCPL (2007b) also observed a Squirrel Glider during a targeted tree clearance associated with the construction of a communications transmission in July 2007.

During recent surveys, EcoBiological recorded the Squirrel Glider at three locations (Attachment EA) as follows:

- four captures and two sightings in the north of the Project area;
- six captures and three sightings outside of the Project area to the west; and
- one capture and two sightings in the approved mine area, prior to vegetation clearance.

EcoBiological (2009b) also captured a single Squirrel Glider approximately 1 km east of the Project area on Buckley's Range. Additional records of the Squirrel Glider occur within 10 km of the Project area, to the north near Wards River and near The Glen Nature Reserve (NSW Government, 2009) (Figure E-4).

It is possible that the same Squirrel Glider was recorded on more than one occasion during the surveys by EcoBiological. However the data indicate that a resident and viable population of Squirrel Glider is located within the Project area and the immediate surrounds.

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Squirrel Glider inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas (DEC, 2005h).

The Squirrel Glider requires tree hollows, refuge and nesting habitat (DEC, 2005h). A number of studies have found a strong relationship between the prevalence of trees with hollows in an area of forest or woodland, and the presence and abundance of gliders (Lindenmayer, 2002). The Squirrel Glider lives in family groups containing a single adult male, one or more adult females and offspring (DEC, 2005h).

The estimated home range area for this species varies from 2 to 13 ha, with densities from 0.4 to 3 individuals per ha (Quin, 1993; Traill and Coates, 1993; Suckling, 1998).

Squirrel Glider mating usually occurs in June or July (Van Dyck and Strahan, 2008). The Squirrel Glider gives birth to two young between May and December (DECCW, 2009f). Roosts are bowl-shaped and lined with leaves (DECCW, 2009f) and are usually located in hollows with a tight fitting entrance. Beyer *et al.* (2008) found that dead trees were highly favoured and suggested that this might be because they provide superior hollows to live tree dens. Beyer *et al.* (2008) also noted that any tree with an adequate hollow could be used by this species

The diet of the Squirrel Glider varies seasonally and consists of acacia gum, eucalypt sap, nectar, honeydew, manna, invertebrates and pollen (DEC, 2005h). Squirrel Gliders appear to prefer stands of mixed forest that contain a shrub or acacia understorey (DEC, 2005h).

The estimated home range area for this species varies from 0.65 to 8.55 ha (Quin, 1995 in NPWS, 1999b). The home range is likely to vary according to habitat quality and resource availability (NPWS, 1999b).

Squirrel Gliders are typically restricted to woodland and/or forested areas (after Rowston *et al*., 2002). However it is possible that a population could utilise nearby scattered trees, since the Squirrel Glider can glide more than 50 m in one move (NPWS, 1999b) and are known to come to ground level and to even move between trees along the ground (D. Goldney, personal observation).

Squirrel Gliders are known to utilise smaller isolated remnants (Beyer *et al*., 2008) and narrow corridors of linear remnant vegetation (van der Ree, 2002).

Primary threats to the Squirrel Glider include (DEC, 2005h):

- *Loss and fragmentation of habitat.*
- *Loss of hollow-bearing trees.*
- *Loss of flowering understorey and midstorey shrubs in forests.*
- *Individuals being caught in barbed wire fences while gliding*.

The data indicate that a resident and viable population of Squirrel Glider is located within the Project area and the immediate surrounds. The Project would result in the removal of 96 ha of regrowth forest/woodland, some being potential breeding and foraging resources for eth Squirrel Glider. This loss of woodland/forest could possibly cause a likely small number of the local population to relocate within the Project area or elsewhere. The Project would result in the loss and further fragmentation of potential habitat resources for the Squirrel Glider. While the forest and woodland vegetation formations within the Project area are predominantly regrowth, there are low numbers of scattered hollow-bearing trees/stags (Attachment EA) which this species could potentially utilise for nesting. Some components of the regrowth woodland/forest vegetation in the Project area also provide suitable foraging resources for this species.

The Project is unlikely to significantly affect the lifecycle of this species within the Project area given:

- the relatively low numbers of scattered hollow-bearing trees/stags which would be removed for the Project;
- the localised nature of the Project disturbance areas, which are adjacent to the existing DCM;
- the likely widespread nature of the viable population of the Squirel Glider within the immediate surrounds of the Project (Figure E-8); and
- the capacity of the Squirrel Glider to relocate if necessary following clearing.

Notwithstanding, a number of measures have been developed to minimise potential impacts on this species including the following:

- Continuation of the Duralie Coal Mine Vegetation Clearance Protocol, which includes management of threatened species (DCPL, 2002) (Section E5).
- Continuation of the on-site control of introduced feral fauna, fire management and weed control (Section E5).
- Rehabilitation of Project disturbance areas with native grass, shrub and tree species characteristic of the vegetation communities cleared (Section E5).
- Long-term conservation and enhancement of known habitat for the Squirrel Glider within the offset area as described in Section E6.

Conclusions

The Project is unlikely to significantly impact the lifecycle of the Squirrel Glider.

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat requirements for this species are outlined above. As described in Section E3.2.1, almost all of the pre-European forest and woodland in the Project area has been extensively cleared and/or logged. Mostly tree re-generation is occurring at forest-formation density. Regrowth trees tend to be tall and straight and without obvious hollow formation. The estimated age of regrowth trees varies between 10–50 years.

The Squirrel Glider is a hollow-dependant species (Lindenmayer, 2002). In the Project area, low numbers of scattered hollow-bearing trees/stags occur in the Secondary Grassland with Regrowth Open Woodland/Forest and Regrowth Open Forest broad habitat types (Figure E-5). However, the density of hollows is sub-optimal for hollow-dependant species.

The Project would result in the removal of 96 ha of regrowth forest/woodland, some being potential breeding and foraging resources for the Squirrel Glider. This loss of woodland/forest could possibly cause a likely small number of individuals form the local population to relocate within the Project area or elsewhere. The Project would result in the loss and further fragmentation of potential habitat resources for the Squirrel Glider. While the forest and woodland vegetation formations within the Project area are predominantly regrowth, there are low numbers of scattered hollow-bearing trees/stags (Attachment EA) which this species could potentially utilise for nesting. Some components of the regrowth woodland/forest vegetation in the Project area also provide suitable foraging resources for this species.

Despite the considerable vegetation regrowth that has occurred within ML1427 and MLA 1, the existing Squirrel Glider habitat in the Project area and immediate surrounds is highly fragmented. It is considered that there is likely to be enough connection (by way of linear vegetation and scattered trees) to facilitate movement of the Squirrel Glider, and not isolate individuals. The Project would result in some further fragmentation of this species habitat in the north of the Project area from clearance of Regrowth Open Forest, which may limit Squirrel Glider movement across MLA 1 in the short-term (Figure E-5).

The composition of the Squirrel Glider foraging resources in the Project area are similar to those that occur in the surrounds.

The regrowth vegetation would provide more suitable habitat resources for the Squirrel Glider in the future when the trees form hollows and habitat is better connected across the landscape.

Conclusions

Some extant sub-optimal habitat of the Squirrel Glider would be removed by the project but it is unlikely that the habitat of the species would be significantly impacted to the extent that a viable population would be at risk of local extinction.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Squirrel Glider is widely, though sparsely, distributed in eastern Australia, from northern QLD to western VIC (DEC, 2005h).

Conclusion

The Project area is located within the known distribution of the Squirrel Glider and does not represent a distributional limit for this species.

E4.15.7 Bat Fauna

The following three threatened bat species have been recorded within the Project area or surrounds during previous surveys:

- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*); and
- Large-footed Myotis (*Myotis macropus*).

All three were recorded for the Duralie Coal EIS (Woodward-Clyde, 1996c). More recently the calls of these three species were recorded in 2008 and 2009, by EcoBiological (Attachment EA).

The Eastern Bentwing-bat and Eastern Freetail-bat were recorded in the Project area, while the Large-footed Myotis was recorded along the Mammy Johnsons River, south-east of ML 1427 and outside of the Project area (Attachment EA). The potential impacts of the Project on these bat species are assessed below.

1. How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The Eastern Freetail-bat is generally found in dry sclerophyll forest and woodland east of the Great Dividing Range (DEC, 2005i). This species roosts mainly in tree hollows, but will also roost under bark or in man-made structures (DEC, 2005i). The Eastern Freetail-bat is solitary and insectivorous (DEC, 2005i). The Large-footed Myotis generally roosts in groups of approximately 10 to 15 individuals close to water in caves, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage (DEC, 2005j). The Large-footed Myotis is intimately associated with waterways, typically larger permanent waterways in the lower catchment areas (Anderson *et al.,* 2006). This species forages over streams and pools, catching insects and small fish by raking their feet across the water surface (DEC, 2005j). In NSW, females have one young per year usually between November and December (DEC, 2005j).

Threats relevant to the Eastern Freetail-bat and Large-footed Myotis include (DECCW, 2009a):

- *Loss of hollow-bearing trees.*
- *Loss of foraging habitat.*
- *Application of pesticides in or adjacent to foraging areas.*

Reduction in stream water quality affecting food resources is also a recognised threat to the Large-footed Myotis.

The Project would result in loss and fragmentation of limited potential habitat resources for the Eastern Freetail-bat and Large-footed Myotis and likely displace individuals/groups utilising habitat in the Project area. Vegetation within the Project area is predominantly regrowth and hence there are low numbers of scattered hollow-bearing trees/stags (Attachment EA) which these species may utilise for roosting. The Project would result in the removal of 96 ha of regrowth forest/woodland. This loss of woodland/forest could possibly cause an unknown number of individuals from the local population to relocate within the Project area or elsewhere. The Project would also result in further fragmentation of potential habitat. While the forest and woodland vegetation formations within the Project area are predominantly regrowth, there are low numbers of scattered hollow-bearing trees/stags (Attachment EA) which these species could potentially utilise for roosting. Some components of the regrowth woodland/forest vegetation in the Project area also provide suitable foraging resources for this species.

Hence the Project would is unlikely to significantly affect the lifecycle of these species given:

- the relatively low numbers of the scattered hollow-bearing trees/stags which would be removed for the Project;
- the localised nature of the Project disturbance areas, which are adjacent to the existing DCM; and
- the availability of additional habitat resources of varying quality for these species in the wider area (e.g. along the Mammy Johnsons River and ranges). The Eastern Freetail-bat has previously been recorded along the Mammy Johnsons River, south-east of ML 1427 outside of the Project area (Attachment EA).

Caves are the primary habitat for the Eastern Bentwing-bat, although the species may also use derelict mines, stormwater tunnels, buildings and other man-man structures (DEC, 2005k). The Eastern Bentwing-bat forms discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young (DEC, 2005k). Maternity caves have specific temperature and humidity regimes. At other times throughout the year, Eastern Bentwing-bat populations disperse within approximately 300 km range of maternity caves (DEC, 2005k). Breeding/roosting colonies range in size from approximately 100 to 150,000 individuals (DEC, 2005k). The species hunts in forested areas, catching moths and other flying insects above the tree tops.

No suitable primary habitat for the Eastern Bentwing-bat exists within the Project area (e.g. caves, derelict mines, etc.). However, the Project would result in the loss and fragmentation of potential foraging habitat for the Eastern Bentwing-bat.

The Project would not significantly affect the lifecycle of this species given:

- the lack of potential primary habitat within the Project area; and
- the localised nature of the Project disturbance areas, which are adjacent to the existing DCM.

Notwithstanding the above, a number of measures have been developed to minimise potential impacts on these bat species including the following:

- Continuation of the *Duralie Coal Mine Vegetation Clearance Protocol*, which includes management of threatened species (DCPL, 2002) (Section E5).
- Continuation of the on-site control of introduced feral fauna and fire management (Section E5).
- Rehabilitation of Project disturbance areas with native grass, shrub and tree species characteristic of the vegetation communities cleared (Section E5).
- Long-term conservation and enhancement of known habitat for these species within the offset area as described in Section E6. The Eastern Bentwing-bat and Large-footed Myotis were recorded during the survey of the offset area (EcoBiological, 2009b).

Conclusion

The Project is unlikely to significantly impact the lifecycle of the Eastern Freetail-bat, Eastern Bentwing-bat and the Large-footed Myotis

2. How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The habitat requirements for these species are outlined above. As described in Section E3.2.1, almost all of the pre-European forest and woodland in the Project area has been extensively cleared and/or logged. Regrowth trees tend to be tall and straight and without obvious hollow formation. The estimated age of regrowth trees varied between 10 to 50 years.

The Eastern Freetail-bat and (albeit to a lesser extent) the Large-footed Myotis are hollow-dependant species. In the Project area, low numbers of scattered hollow-bearing trees/stags occur in the Secondary Grassland with Regrowth Open Woodland/Forest and Regrowth Open Forest broad habitat types (Figure E-5). However, the density of hollows is sub-optimal for hollow-dependant species.

The regrowth vegetation would provide more suitable habitat resources for the Eastern Freetail-bat and the Large-footed Myotis in the future when the trees form hollows.

As described above, no suitable primary habitat for the Eastern Bentwing-bat exists within the Project area (e.g. caves, derelict mines, etc.).

Conclusion

The Project is unlikely to significantly impact the habitat of the Eastern Freetail-bat, Eastern Bentwing-bat and the Large-footed Myotis.

3. Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Eastern Freetail-bat, Eastern Bentwing-bat and Large-footed Myotis are found along the east coast of NSW (DEC, 2005i, 2005j, 2005k).

Conclusion

The Project is located within the known distributions of these species and the Project area does not represent a distributional limit for these species.

E4.15.8 Other Fauna Species

This section provides justification for concluding that the following threatened fauna species are unlikely to be affected by the Project.

Stuttering Frog (Mixophyes balbus)

The Stuttering Frog (*Mixophyes balbus*) has not been recorded in the Project area or surrounds. The closest record of this species is approximately 15 km to the south-east of the Project area (NSW Government, 2009).

The Stuttering Frog is distributed from far northern NSW, along the Great Dividing Range, to north-east VIC (NPWS, 2000b). The Stuttering Frog is found in cool rainforest, moist eucalypt forest and occasionally along creeks in dry eucalypt forest (DECCW, 2009f). The Stuttering Frog breeds only in shallow, flowing streams (NPWS, 2000b).

The Project is unlikely to adversely impact the Stuttering Frog given that it was not located within the Project area, nor were there nearby records or potential breeding areas for this species (e.g. Mammy Johnsons River).

Giant Barred Frog (Mixophyes iteratus)

The Giant Barred Frog (*Mixophyes iteratus*) was seen and heard by EcoBiological (Attachment EA) at twelve locations along the Mammy Johnsons River, south-east of the Project area (Figure E-8) (Attachment EA). A total of 23 individuals were recorded including six sighted females, five sighted or captured males, one captured juvenile, and a further 11 males heard calling.

EcoBiological (2009b) also recorded the Giant Barred Frog along the Mammy Johnsons River approximately 3 km and 3.5 km north-east of the Project area. At these respective locations, approximately seven females and two males were recorded. An additional 21 records of the Giant Barred Frog occur in the State Forest database, from 2001, along Mill Creek less than 5 km east of the Project (NSW Government, 2009).

The distribution of the Giant Barred Frog extends across the eastern coast and ranges from south-eastern QLD to the Hawkesbury River in NSW (DECCW, 2009f). North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold for this species (DECCW, 2009f).

The Giant Barred Frog occurs along shallow rocky streams in rainforest, wet sclerophyll forest and farmland between 100 and 1,000 m (Hines and South-east QLD Threatened Frogs Recovery Team, 2002) or deep, slow moving streams with steep banks in lowland areas (Hines and South-east QLD Threatened Frogs Recovery Team, 2002).

The species is associated with permanent flowing drainages and is not known to utilise still water areas (NSW Scientific Committee, 1999b). The Giant Barred Frog breeds from late spring to summer, generally around shallow, flowing rocky permanent streams (DECCW, 2009f; Lemckert and Brassil, 2000). Females lay eggs onto the moist creek backs or rocks above water level, from where tadpoles drop into the water when hatched (DECCW, 2009f).

The Giant Barred Frog feeds primarily on large insects and spiders (NPWS, 2000b).

When not breeding, this species will disperse away from streams (DECCW, 2009f). Lemckert and Brassil (2000) undertook a four year study on the movements and habitat use of the Giant Barred Frog in the Coffs Harbour/Dorrigo area (NSW) using radio tracking. The study found that these frogs stayed within a 20 m band either side of the four streams monitored. Hence, Lemckert and Brassil (2000) concluded that a 30 m buffer around streams used by the Giant Barred Frog (as adopted by the logging industry), is likely to protect the area of streamside habitat used by the frog.

The Project is not likely to adversely impact the Giant Barred Frog within the Project area as it was not located there nor was suitable habitat found within the Project area. However a viable population of the Giant Barred Frog was located on Mammy Johnsons River south of the Project area. However the Project is very unlikely to result in a measurable impact on the Mammy Johnsons River (Figure E-6a) nor is the Giant Barred Frog likely to utilise any fauna habitat resources that would be removed for the Project.

Green and Golden Bell Frog (Litoria aurea)

The Green and Golden Bell Frog (*Litoria aurea*) has not been recorded in the Project area or surrounds. The closest record of this species is located 23 km to the south-west of the Project area (NSW Government, 2009).

Records of this species extend from near Brunswick Heads on the NSW north coast, southwards along the coast to VIC and east to Gippsland and occupy mostly coastal areas (DECCW, 2009f). Some records extend inland to Bathurst (where it is now locally extinct), Tumut and the Australian Capital Territory (ACT) region.

The Green and Golden Bell Frog inhabits marshes, dams and stream sides and appears to prefer those waterbodies where bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.) grow (DECCW, 2009f). Populations of the Green and Golden Bell Frog, especially in the Greater Sydney region, exist in highly disturbed areas such as disused industrial sites, landfill areas and cleared land (DECCW, 2009f). The Green and Golden Bell Frog also occasionally inhabit farm dams and ornamental ponds (Robinson, 1998).

Some potential habitat for the Green and Golden Bell Frog occurs in the Project area (e.g. farm dams) and in the wider area. However the Project is unlikely to adversely impact the Green and Golden Bell Frog given the lack of records within the Project area and along the Mammy Johnsons River.

Booroolong Frog (Litoria booroolongensis)

The Booroolong Frog (*Litoria booroolongensis*) has not been recorded in the Project area or in the immediate surrounds. The closest record of this species is located approximately 44 km to the north of the Project area (NSW Government, 2009).

In NSW, the Booroolong Frog is found predominantly along the western flowing streams of the Great Dividing Range, and it is considered to be rare throughout most of the remaining range (DECCW, 2009f).

The Booroolong Frog inhabits permanent streams and shelters within ferns, sedges or grasses fringing the streams (DECCW, 2009f). NPWS (2000b) indicates that the Booroolong Frog is typically found on or under boulders or debris in and beside the rocky beds of mountain streams and on grassy borders adjacent to slow moving streams.

Since the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Booroolong Frog.

Green-thighed Frog (Litoria brevipalmata)

The Green-thighed Frog (*Litoria brevipalmata*) has not been recorded in the Project area or the immediate surrounds. The closest record of this species is located approximately 13.5 km east south-east of the Project area (NSW Government, 2009).

The Green-thighed Frog is limited to isolated localities along the coast and ranges from the NSW central coast to south-east QLD (NPWS, 2000b). The Green-thighed Frog occurs in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain (NPWS, 2000b). The Green-thighed Frog breeds following heavy rainfall in late spring and summer, with frogs aggregating around grassy semi-permanent ponds and flood-prone grassy areas (NPWS, 2000b).

While there is some potential habitat for this species in the Project area, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Green-thighed Frog.

Pale-headed Snake (Hoplocephalus bitorquatus)

The Pale-headed Snake (*Hoplocephalus bitorquatus*) has not been recorded in the Project area or the immediate surrounds. The Pale-headed Snake is a medium-sized tree-dwelling snake which has a patchy distribution from north-eastern NSW to north QLD. In NSW, the species is found on both sides of the Great Dividing Range, where it mainly occurs in dry eucalypt forests and woodlands and occasionally in rainforest or moist eucalypt forest (NPWS, 2000b).

This species is not known or predicted to occur in the same CMA sub-region as the Project (DECCW, 2009f). Nor has the species been located on-site or in the immediate surrounds in spite of the various surveys. Given that the species has not been located in the Project area or in the immediate surrounds, the Project is not likely to adversely impact the Pale-headed Snake.

Stephens' Banded Snake (Hoplocephalus stephensii)

A record of the Stephens' Banded Snake from 1995 occurs in the DECCW database (2009b) near the Mammy Johnsons River, east of ML 1427 and outside of the Project area. However the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys.

The Stephens' Banded Snake is a medium-sized partly tree-dwelling snake which is found on the coast and ranges from Gosford to southern QLD (NPWS, 2000b). The species is found in rainforest and eucalypt forests and rocky areas up to 950 m. The Stephens' Banded Snake shelters between loose bark and tree trunks, amongst vines, or in hollow trunks, limbs, rock crevices or under slabs during the day (NPWS, 2000b). At night, it hunts frogs, lizards, birds and small animals.

While there is some potential habitat for this species in the Project area, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact Stephens' Banded Snake.

Freckled Duck (Stictonetta naevosa)

The Freckled Duck (*Stictonetta naevosa*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 51 km south south-west of the Project area (NSW Government, 2009).

The Freckled Duck is generally found in south-eastern and south-western Australia, although the species may occur elsewhere as a vagrant (DEC, 2005l). The Freckled Duck is nomadic between ephemeral inland wetlands, although during the driest years, they congregate on permanent wetlands (Garnett and Crowley, 2000).

The Freckled Duck inhabits permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree (DEC, 2005l). The Freckled Duck forages at wetland edges or by dabbling in shallow water (Morcombe, 2004).

Very limited habitat for the Freckled Duck occurs within the Project area and also some potential habitat occurs in the immediate surrounds (e.g. along the Mammy Johnsons River), though this habitat would not be impacted by the Project.

While there is some potential habitat for this species in the Project area, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Freckled Duck.

Blue-billed Duck (Oxyura australis)

The Blue-billed Duck (*Oxyura australis*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 51 km south of the Project area (NSW Government, 2009).

Blue-billed Ducks roost usually on open water or in a small, concealed bay (Marchant and Higgins, 1990). Blue-billed Ducks disperse to well-vegetated freshwater swamps and lakes to breed (Slater *et al*., 1986). Young Blue-billed Ducks (yearlings and sub-adults) in particular are regionally and seasonally nomadic where they migrate each year from the natal swamps of inland NSW to non-breeding areas on the Murray River system and coastal lakes of VIC and SA (Frith, 1977; Serventy, 1985).

This species is not known or predicted to occur in the same CMA sub-region as the Project (DECCW, 2009f). While there is very limited potential habitat for this species in the Project area, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Blue-billed Duck.

Black-necked Stork (Ephippiorhynchus asiaticus)

The Black-necked Stork (*Ephippiorhynchus asiaticus*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 12.5 km north of the Project area (NSW Government, 2009).

The Black-necked Stork is widespread in northern Australia and sparse in coastal eastern Australia from QLD to southern NSW (NPWS, 2000b). The species is found in swamps, mangroves, mudflats, dry floodplains and irrigated land (NPWS, 2000b).

Very limited habitat for the Black-necked Stork occurs within the Project area and in the immediate surrounds (e.g. along the Mammy Johnsons River). While there is very limited potential habitat for this species in the Project area, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Black-necked Stork.

Australasian Bittern (Botaurus poiciloptilus)

The Australasian Bittern (*Botaurus poiciloptilus*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 38 km to the south-west of the Project area (NSW Government, 2009).

The Australasian Bittern is found from southern QLD to Tasmania and south-eastern SA, including most of NSW and VIC (NPWS, 1999c). The species has been observed along the NSW coast, in wetlands of the Murrumbidgee and Lachlan Rivers and in the Murray-Darling Basin (NPWS, 1999c).

The Australasian Bittern forages in shallows or hunts in deeper water from bent-over reeds or other platforms (Morcombe, 2004). The species appears to be sedentary in permanent habitat but may move short distances during winter and in response to years with high rainfall (Marchant and Higgins, 1990).

No habitat for the Australasian Bittern occurs within the Project area although some potential habitat occurs in the surrounds (e.g. along the Mammy Johnsons River). Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Australian Bittern.

Grey Falcon (Falco hypoleucos)

The Grey Falcon (*Falco hypoleucos*) has not been recorded in the Project area or surrounds. The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range (DEC, 2005m). Breeding is now generally confined to the arid portions of the species' range (DEC, 2005m).

The Grey Falcon inhabits flat, mainly treeless or lightly timbered plains with open drier vegetation types, including Acacia/low shrubland, Spinifex and tussock grasslands, as well as Eucalypt-lined watercourses (Ayers *et al*., 1996). This species also inhabits wooded watercourses (DECCW, 2009f). The Grey Falcon utilises old nests of other birds of prey and ravens, usually high in a living Eucalypt near water or a watercourse (DECCW, 2009f).

This species is not known or predicted to occur in the same CMA sub-region as the Project (DECCW, 2009f). Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Grey Falcon.

Osprey (Pandion haliaetus)

The Osprey (*Pandion haliaetus*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 4.5 km east north-east of the Project area (NSW Government, 2009).

The Osprey occurs along the entire coast of Australia. In NSW, the Osprey's breeding population is confined to the north and central coasts, from the QLD border south to Gosford, although single birds can occur further south to VIC and occasionally on large inland rivers (NPWS, 2000b). Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Osprey.

Square-tailed Kite (Lophoictinia isura)

The Square-tailed Kite (*Lophoictinia isura*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 55 km to the east of the Project area (NSW Government, 2009).

The Square-tailed Kite favours timbered habitats including dry woodlands and open forests, with a particular preference for timbered watercourses (DECCW, 2009f). In NSW, scattered records indicate the species is a regular resident in the north, north-east and along the major west-flowing river systems and is a summer breeding migrant to the south-east (DECCW, 2009f). Resident pairs have a large hunting range of at least 100 square kilometres (km^2) (NPWS, 2000b). Marchant and Higgins (1993) describe the species as migratory across much of its distribution.

Limited potential habitat for the Square-tailed Kite occurs in the Project area. Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Square-tailed Kite

Bush Stone-curlew (Burhinus grallarius)

The Bush Stone-curlew (*Burhinus grallarius*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 29 km east north-east of the Project area (NSW Government, 2009).

In NSW, Bush Stone-curlews occur in lowland grassy woodland and open forest, much of which has been cleared for agriculture and urban development (Johnson and Baker-Gabb, 1994). In general, habitat occurs in open woodlands with few, if any, shrubs, and short, sparse grasses of less than 15 cm in height, with scattered fallen timber, leaf litter and bare ground present. In general, Bush Stone-curlews are found in lower elevation grassy woodlands on the coast (DEC, 2005n).

This species is mainly sedentary although is known to be locally dispersive outside breeding periods (NPWS, 1999d). Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Bush Stone-curlew.

Wompoo Fruit-Dove (Ptilinopus magnificus)

The Wompoo Fruit-Dove (*Ptilinopus magnificus*) has not been recorded in the Project area or the immediate surrounds. The closest record of this species is located approximately 9.5 km north of the Project area (NSW Government, 2009).

The Wompoo Fruit-Dove is found along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula (NPWS, 2000b). The Wompoo Fruit-Dove occurs in rainforests, low elevation moist eucalypt and brushbox forests. The species is most often seen in mature forests, but are also found in remnant or regenerating rainforest (NPWS, 2000b). The Wompoo Fruit-Dove feeds on a diverse range of tree and vine fruits and are locally nomadic following ripening fruits.

Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Wompoo Fruit-Dove. Some suitable habitat for this species occurs along the Mammy Johnsons River.

Superb Fruit-Dove (Ptilinopus superbus)

The Superb Fruit-Dove (*Ptilinopus superbus*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 51 km south-east of the Project area (NSW Government, 2009).

The Superb Fruit-Dove is widely distributed along the east coast of Australia from Cape York to north-eastern NSW north of the Richmond River, and is also occasionally recorded as a vagrant further south along the NSW coast to the VIC border (NPWS, 2000b).

The Superb Fruit-Dove occurs mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful (NPWS, 2000b). The species is thought to be locally nomadic, following ripening fruits, and also migratory between the northern and southern parts of its range

Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Superb Fruit-Dove. Some suitable habitat occurs outside the Project area along the Mammy Johnsons River.

Rose-crowned Fruit-Dove (Ptilinopus regina)

Woodward-Clyde (1996c) recorded the call of the Rose-crowned Fruit-Dove (*Ptilinopus regina*) from Riparian Forest habitat along Mammy Johnsons River, east of the existing DCM and outside of the Project area (Figure E-8). The potential impacts from the existing DCM on the Rose-crowned Fruit-Dove was previously assessed by Woodward-Clyde (1996c) who concluded that the DCM would not significantly impact the Rose-crowned Fruit-Dove. This species was not recorded by EcoBiological (Attachment EA).

The species is known from the coast and ranges of eastern NSW and QLD, from Newcastle to Cape York, with vagrants occasionally recorded further south to VIC (DEC, 2005o). The multiple records of this species near the Project area indicate that a resident, local population of Rose-crowned Fruit-Dove may utilise habitat along the Mammy Johnsons River outside of the Project area.

The Rose-crowned Fruit-dove occurs mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful (DEC, 2005o).

The Rose-crowned Fruit-Dove breeds in rainforests with dense vine growth. The nest is a frail loosely woven cup of twigs and tendrils (Australian Museum, 2009b).

Rose-crowned Fruit-Doves feed in the canopy of rainforest, singly or in pairs or in small parties mainly in the morning or late afternoon (Australian Museum, 2009b). Rose-crowned Fruit-doves feed entirely on fruit from vines, shrubs, large trees and palms, and are thought to be locally nomadic as they follow the ripening of fruits (DEC, 2005o).

Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Rose-crowned Fruit-dove. Some suitable habitat occurs outside the Project area along the Mammy Johnsons River.

Glossy Black-Cockatoo (Calyptorhynchus lathami)

Eight individuals of this species were sighted by EcoBiological (2009b) approximately 1.4 km to the east of the Project area, on the Buckleys Range. Secondary evidence of the species (in the form of crushed Allocasuarina cones) was also observed south of this particular sighting.

The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central QLD coast to East Gippsland in VIC, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina (DECCW, 2009f).

The Glossy Black-Cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1,000 m where stands of She-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur (DECCW, 2009f).

Very limited resources are available for this species within the Project area. Given that the species has not been located on-site in spite of the various surveys, the Project is not likely to adversely impact the Glossy Black-Cockatoo

Gang-gang Cockatoo (Callocephalon fimbriatum)

This species was heard by EcoBiological (2009b) flying overhead approximately 0.8 km to the east of the Project area, on the Buckleys Range, and approximately 10 km north of the Project area.

The Gang-gang Cockatoo occurs from southern VIC throughout south-eastern and central-eastern NSW (DEC, 2005p). Within NSW, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes.

During the summer months, the Gang-gang Cockatoo is generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (DEC, 2005p). In winter, the Gang-gang Cockatoo tends to move to lower altitude areas, typically in drier, more open eucalypt forests and woodlands (particularly box-ironbark assemblages) and urban areas (DEC, 2005p). The Gang-gang Cockatoo favours old growth vegetation for nesting and roosting (DEC, 2005p).

This species undertakes nomadic as well as seasonal movements (NSW Scientific Committee, 2005; Pizzey and Knight, 2006). Limited resources are available for this species within the Project area. However given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Gang-gang Cockatoo.

Turquoise Parrot (Neophema pulchella)

The Turquoise Parrot (*Neophema pulchella*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 20 km east of the Project area (NSW Government, 2009).

The Turquoise Parrot is distributed from southern QLD through to northern VIC and occurs on the coastal plains to the western slopes of the Great Dividing Range (DEC, 2005q).

The Turquoise Parrot inhabits edges of Eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland (DECCW, 2009f). The species favours open grassy woodland with dead trees and forested hills with Yellow Box (*Eucalyptus melliodora*), Blakely's Red Gum (*E. blakelyi*) and White Box (*E. albens*). The Turquoise Parrot is partly nomadic (Ayers *et al.,* 1996).

Limited resources are available for this species within the Project area. However given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Turquoise Parrot

Sooty Owl (Tyto tenebricosa)

A call of the Sooty Owl was recorded from Riparian Forest habitat along the Mammy Johnsons River, east of the existing DCM by Paul Webber Consulting Services (1996) during a herpetological survey in 1995 (Figure E-8). This species was not recorded during recent surveys (Attachment EA; EcoBiological, 2009b).

The Sooty Owl inhabits rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests (DECCW, 2009f). The Sooty Owl is thought to pair permanently and hold the same territory (approximately 200 to 800 ha) each year.

This species is a specialised inhabitant of the interior of extensive wet forest (Debus, 1994). The Sooty Owl roosts by day in one of a number of set perches (e.g. a deep hollow, on the stems of a giant fig or a crevice under a bank or cliff) and hunts through the forest and along its edge for prey.

Limited resources are available for this species within the Project area. However given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Sooty Owl. Some suitable habitat occurs outside the Project area along the Mammy Johnsons River.

Masked Owl (Tyto novaehollandiae)

The Masked Owl (*Tyto novaehollandiae*) has not been recorded in the Project area. An active nest of the Masked Owl was reported in Woodward-Clyde (1996c) from along the Bucketts Way between Stroud Road and Stroud in a large tree in a cleared paddock with smaller scattered trees. The closest record of this species in BioNet is located approximately 18 km west of the Project area (NSW Government, 2009). The DECCW has advised that multiple records (1996 to 1999) occur within 5 km of the proposed offset area (DECWW, pers. comm., December 2009).

The main distribution of the Masked Owl is along the coast of NSW extending to the western plains (DECCW, 2009a). However, this species is sparsely distributed through sub-coastal mainland Australia and inland of the Great Dividing Range (Schodde and Mason, 1980; Smith *et al.,* 1995; Higgins, 1998 in Garnett and Crowley, 2000). The Masked Owl inhabits forests, woodlands and nearby clearings (Flegg, 2002). This species requires large hollows in which to nest.

Limited resources are available for this species within the Project area as the majority of the Project area is regrowth. However, given that the species has not been located in the Project area or in the immediate surrounds, in spite of the various surveys, the Project is not likely to adversely impact the Masked Owl.

Grass Owl (Tyto capensis)

The Grass Owl (*Tyto capensis*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 22 km south south-east of the Project area (NSW Government, 2009).

The Grass Owl is a small ground-dwelling owl which has been recorded occasionally in all mainland states of Australia but appears to be more commonly recorded in northern and north-east Australia (NPWS, 2000b). In NSW, the Grass Owl is more likely to be found in the north-east. Grass Owls are possibly nomadic, their movements linked to the incidence of rodents (NPWS, 2000b). The Grass Owl is found in areas of tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath and cane grass, or sedges on flood plains (NPWS, 2000b).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Sooty Owl.

Powerful Owl (Ninox strenua)

Woodward-Clyde (1996c) heard the call of one Powerful Owl (*Ninox strenua*) at two locations along Coal Shaft Creek, within the approved mine area and approved Coal Shaft Creek Diversion area prior to vegetation clearance. This species was not recorded during recent surveys (Attachment EA; EcoBiological, 2009b).

In NSW, the Powerful Owl is widely distributed throughout the eastern forests from the coast inland to tablelands (DECCW, 2009f). Powerful Owls typically nest in large tree hollows (at least 0.5 m deep), contained within large eucalypts (80 to 240 cm DBH) that are at least 150 years old (DECCW, 2009f).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Sooty Owl. Some suitable habitat occurs outside the Project area along the Mammy Johnsons River.

Barking Owl (Ninox connivens)

The Barking Owl (*Ninox connivens*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 22 km east north-east of the Project area (NSW Government, 2009).

The Barking Owl generally inhabits open forest and woodland areas on gentle terrain (DECCW, 2009a), avoiding high altitudes and dense, wet escarpment forests (Debus, 1997). This species is rarely recorded in coastal and escarpment forests, or in the far west (DECCW, 2009a).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Barking Owl.

Black-chinned Honeyeater (eastern subspecies) (Melithreptus gularis gularis)

The Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*) has not been recorded in the Project area or surrounds. The closest record of this species is located 28 km south-east of the Project area (NSW Government, 2009).

The Black-chinned Honeyeater (eastern subspecies) is found predominately west of the Great Dividing Range in a narrow belt through NSW, extending north into southern QLD, and south into VIC and SA, where it occupies Eucalypt woodlands within an approximate annual rainfall range of 400 to 700 mm (Blakers *et al.*, 1984). In NSW, the Black-chinned Honeyeater (eastern subspecies) is mainly found in woodlands containing Box-Ironbark woodland associations and River Red Gum (Garnett and Crowley, 2000; NSW Scientific Committee, 2001c).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Black-chinned Honeyeater (eastern subspecies)

Regent Honeyeater (Anthochaera phrygia)

The Regent Honeyeater (*Anthochaera phrygia*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 38 km to the south-west of the Project area (NSW Government, 2009).

The Regent Honeyeater occurs in a wide variety of habitats, including Swamp Mahogany forest, Spotted Gum, riverine She-oak woodlands, remnant stands of timber, roadside reserves and travelling stock routes (DECCW, 2009a).

The Regent Honeyeater is regarded as a single population (DEC, 2005r). The birds are migratory, shifting generally northwards in autumn and winter and returning south to breed in spring. There are only a small number of known breeding sites for the Regent Honeyeater in NSW, the most important being in the Capertee Valley, although other important breeding areas are situated in Warrumbungle National Park, Pilliga Nature Reserve, Barraban district, the central coast around Gosford, and the Hunter Valley (DEC, 2005r).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Regent Honeyeater

Hooded Robin (south-eastern form) (Melanodryas cucullata cucullata)

The Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 29 km south-east of the Project area (NSW Government, 2009).

The Hooded Robin occurs from Brisbane to Adelaide, throughout most of inland NSW, with the exception of the north-west (DEC, 2005s). The Hooded Robin (south-eastern form) inhabits a wide range of Eucalypt woodlands, mallee, Acacia scrubland and open forests (Garnett and Crowley, 2000). This species appears unable to survive in remnants smaller than 100 to 200 ha (NSW Scientific Committee, 2001d).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Hooded Robin (south-eastern form).

Olive Whistler (Pachycephala olivacea)

The Olive Whistler (*Pachycephala olivacea*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 23.5 km west north-west of the Project area (NSW Government, 2009).

The Olive Whistler inhabits the wet forests on the ranges of the east coast (DEC, 2005t). The Olive Whistler has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to VIC (DEC, 2005t). In the south it is found inland to the Snowy Mountains and the Brindabella Range

This species is not known or predicted to occur in the same CMA sub-region as the Project (DECCW, 2009a). Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Olive Whistler.

Diamond Firetail (Stagonopleura guttata)

The Diamond Firetail (*Stagonopleura guttata*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 47.5 km south-west of the Project area (NSW Government, 2009). The DECCW has advised that a record from 1980 occurs 2.6 km north-west of the proposed offset area (DECCW, pers. comm., December 2009).

The Diamond Firetail is widely distributed in NSW and is also found in the ACT, QLD, VIC and SA (DEC, 2005u). Within NSW, most records are concentrated in the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina (DEC, 2005u).

The Diamond Firetail is generally found in grassy eucalypt woodlands, but also occurs in open forest, mallee, natural temperate grassland and secondary grassland derived from other communities (DEC, 2005u). The Diamond Firetail is thought to be sedentary, although some populations move locally (DEC, 2005u).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Diamond Firetail.

Spotted-tailed Quoll (Dasyurus maculatea)

The Spotted-tailed Quoll (*Dasyurus maculatea*) has not been recorded in the Project area or surrounds. Numerous records occur in the surrounding area (5 to 10 km) from the Project area, the closest record of this species is located approximately 3.5 km north-west of the Project area (NSW Government, 2009).

The Spotted-tailed Quoll occurs in a range of habitats that include sclerophyll forests and woodlands, rainforests and coastal heathlands (NPWS, 1999e). This species has also been observed in treeless areas including grazing lands, open country and rocky outcrops but they do require large areas of relatively intact vegetation for foraging as well as hollow logs, tree hollows, rock outcrops and caves to use as den sites (NPWS, 1999e). This species is primarily solitary and nocturnal, although it may forage during the day (NPWS, 1999e).

Dead wood in the form of ground logs and fallen branches are relatively uncommon in the Project area since the vegetation is predominantly regrowth and as a result less prone to fallen branches. Logs that do occur are predominantly too small to contain hollows suitable for ground-dwelling mammals. Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Spotted-tailed Quoll.

Common Planigale (Planigale maculata)

Place Planning and Design (2003) trapped a single Common Planigale in a small Elliot A trap during a pre-clearance survey of the approved mine area, conducted in August 2003. This species was not recorded by EcoBiological (Attachment EA) in the Project area, despite suitable survey effort.

The Common Planigale is found in coastal north-eastern NSW, coastal eastern QLD and Arnhem Land (NPWS, 2000b). The species' southern distribution limit is on the NSW lower north coast. The Project area is located to the south of the distribution of this species, with the closest record from Barrington Tops in 1976 (after NSW Government, 2009).

The Common Planigale inhabits rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water (DECCW, 2009a). The Common Planigale is active at night and during the day, the species shelters in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. They are fierce carnivorous hunters and agile climbers, preying on insects and small vertebrates (DECCW, 2009a).

The Common Planigale breeds from October to January and the female builds a nest lined with grass, eucalypt leaves or shredded bark (NPWS, 2000b). The habitat in which this species was recorded (Place Planning and Design, 2003) has already been removed by the approved DCM. Limited resources are now available for this species within the Project area. However, given that the species has not been located on-site since 2003 in spite of the various surveys, the Project is not likely to adversely impact the Common Planigale. Some suitable habitat occurs outside the Project area along the Mammy Johnsons River and in the Buckley Range.

Notwithstanding the above, the Project would involve continuation of the *Duralie Coal Mine Vegetation Clearance Protocol* which includes pre-clearance surveys (DCPL, 2002) (Section E5).

Koala (Phascolarctos cinereus)

Koala scats and traces have been identified at the same general location during three previous fauna surveys (Woodward-Clyde, 1996c; ERM Mitchell McCotter, 1996b; Attachment EA) (Figure E-8). ERM Mitchell McCotter (1996b) recorded evidence of past Koala activity in the narrow strip of open forest on the ridgelines in the north of the DCM site (i.e. numerous scats at the base of Grey Gums [*Eucalyptus punctata, E. canaliculata*]). ERM Mitchell McCotter (1996) also recorded one Koala in the forest areas near Pepper's Mountain to the south of the DCM area. The potential habitat for the Koala is assessed in accordance with *NSW State Environmental Planning Policy No. 44 (Koala Habitat Protection)* (SEPP 44) in Section E4.18.

Yellow-bellied Glider (Petaurus australis)

The Yellow-bellied Glider (*Petaurus australis*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 8 km east of the Project area (NSW Government, 2009).

The Yellow-bellied Glider is found from southern QLD to VIC, from the east coast to the western slopes of the Great Dividing Range (DEC, 2005v). Within its range, the Yellow-bellied Glider is restricted to tall, mature forests in regions of high rainfall (NPWS, 1999f). This species favours productive, tall open sclerophyll forests with mature trees, which provide shelter and nesting hollows and year round forage resources (NPWS, 1999f). Essential elements of habitat include sap-site trees, winter flowering eucalypts, mature trees suitable for den sites and a mosaic of forest types (Tanton, 1994).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Yellow-bellied Glider. Some suitable habitat occurs outside the Project area along the Mammy Johnsons River.

Parma Wallaby (Macropus parma)

The Parma Wallaby (*Macropus parma*) has not been recorded in the Project area or surrounds. The closest record of this species is located approximately 3.5 km south of the Project area (NSW Government, 2009).

The Parma Wallaby was once distributed from north-eastern NSW to the Bega area in the south-east, however their range is now confined to the coast and ranges of central and northern NSW (NPWS, 2000b).

The Parma Wallaby is found in moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest (NPWS, 2000b). This species typically feeds at night on grasses and herbs in more open eucalypt forest and nearby grassy areas (NPWS, 2000b). During the day, the Parma Wallaby is known to shelter at the edges of rainforest.

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Parma Wallaby. Some suitable habitat occurs outside the Project area along Buckleys Range.

Grey-headed Flying-fox (Pteropus poliocephalus)

The Grey-headed Flying-fox (*Pteropus poliocephalus*) has not been recorded in the Project area or surrounds.

The Grey-headed Flying Fox inhabits rainforests, open forests, closed and open woodlands, *Melaleuca* swamps, *Banksia* woodlands, as well as mangroves (Churchill, 1998; Duncan *et al*., 1999). The Grey-headed Flying Fox is distributed in coastal south-eastern Australia, from VIC to Miriam Vale in QLD and inland to the western slopes (Hall and Richards, 2000). Roost sites of the Grey-headed Flying Fox (known as camps) are commonly formed in gullies, typically not far from water and usually in vegetation with a dense canopy (Tidemann, 1998).

The Grey-headed Flying Fox responds to changes in the amount and location of available food by migrating in irregular patterns (Eby, 2000). Migration patterns vary between years in association with the changing location of flowering trees (Eby, 2000).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Grey-headed Flying-fox. Some suitable habitat occurs outside the Project area along the Mammy Johnsons River. Notwithstanding the above, the Project would involve continuation of the *Duralie Coal Mine Vegetation Clearance Protocol* which includes pre-clearance surveys (DCPL, 2002) (Section E5).

Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris)

The Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) was recorded approximately 20 km north of the DCM by Greg Richards and Associates (2001).

The Yellow-bellied Sheathtail-bat can be found in a wide range of habitats, including wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert (Churchill, 1998). The Yellow-bellied Sheathtail-bat roosts in tree hollows and has been found to utilise multiple roost sites (Greg Richards and Associates, 2001).

The Yellow-bellied Sheathtail-bat is insectivorous and forages above the tree canopy. A variety of prey items are eaten including long-horned grasshoppers, shield bugs and flying ants. Beetles comprise up to 90% of this species' diet (Churchill, 1998).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Yellow-bellied Sheathtail-bat. Notwithstanding the above, the Project would involve continuation of the *Duralie Coal Mine Vegetation Clearance Protocol* which includes pre-clearance surveys (DCPL, 2002) (Section E5).

Golden-tipped Bat (Kerivoula papuensis)

The Golden-tipped Bat (*Kerivoula papuensis*) has not been recorded in the Project area or surrounds.

The Golden-tipped Bat is patchily distributed within eastern QLD and eastern NSW south to Bega (NPWS, 2000b). The Golden-tipped Bat inhabits tangled rainforest understorey and moist forest, although it has also been recorded in dry forest (NPWS, 2000b). The diet of the Golden-tipped Bat appears to be very specialised, consisting mainly of orb weaving spiders. The species is not known to roost in caves, but have been recorded in tree hollows and disused bird nests (NPWS, 2000b).

Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Golden-tipped Bat. Furthermore the Project area lacks primary roosting habitat (i.e. caves).

Little Bentwing-bat (Miniopterus australis)

The Little Bentwing-bat (*Miniopterus australis*) has not been recorded in the Project area or surrounds.

The Little Bentwing-bat is distributed in north-eastern NSW and eastern QLD (NPWS, 2000b). The species inhabits moist eucalypt forest, rainforest or dense coastal banksia scrub. The Little Bentwing-bat roosts in caves, tunnels and sometimes tree hollows during the day, and at night forages for small insects beneath the canopy of densely vegetated habitats (NPWS, 2000b). This species frequently shares roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters (NPWS, 2000b).

Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Little Bentwing-bat. Furthermore the Project area lacks primary roosting habitat (i.e. caves).

Large-eared Pied Bat (Chalinolobus dwyeri)

The Large-eared Pied Bat (*Chalinolobus dwyeri*) has not been recorded in the Project area or surrounds.

The Large-eared Pied Bat roosts in caves, mine tunnels and the abandoned mud nests of Fairy Martins (Hoye and Dwyer, 1998; Schulz, 1998). Females give birth in November and young are independent by late February (Hoye and Dwyer, 1998). Young leave the cave soon after, while the females remain another month before abandoning the roost in late March for winter (Churchill, 1998). This species is thought to spend the coldest months in hibernation (Hoye and Dwyer, 1998). The Large-eared Pied Bat forages for small flying insects below the forest canopy (Hoye and Dwyer, 1998; Churchill, 1998).

Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Large-eared Pied Bat. Furthermore the Project area lacks primary roosting habitat (i.e. caves).

Eastern False Pipistrelle (Falsistrellus tasmaniensis)

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) has not been recorded in the Project area or the immediate surrounds.

The Eastern False Pipistrelle predominantly roosts in tree hollows, as well as abandoned buildings (Parnaby, 1983), and there is also one record from the Jenolan Caves. The Eastern False Pipistrelle has been recorded travelling 12 km from foraging areas to roosting sites (Churchill, 1998). Given the size and shape of the wings of this species, it is likely that Eastern False Pipistrelles are highly mobile (Phillips, 1995). During winter, some populations of the Eastern False Pipistrelle may migrate from highland to coastal areas, while others may hibernate (Parnaby, 1983).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Eastern False Pipistrelle. Notwithstanding the above, the Project would involve continuation of the *Duralie Coal Mine Vegetation Clearance Protocol* which includes pre-clearance surveys (DCPL, 2002) (Section E5).

Greater Broad-nosed Bat (Scoteanax rueppellii)

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) has not been recorded in the Project area or in the immediate surrounds.

The Greater Broad-nosed Bat is thought to be highly mobile with a large foraging range (Phillips, 1998). This species flies slowly at a height of approximately 3 to 6 m (Hoye and Richards, 1995). Natural and human-made openings are used as movement corridors in the more congested environments of the wetter forests (Hoye and Richards, 1995). This species roosts in tree hollows, however may occasionally be found in buildings (Churchill, 1998).

Limited resources are available for this species within the Project area. However, given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Greater Broad-nosed Bat. Notwithstanding the above, the Project would involve continuation of the *Duralie Coal Mine Vegetation Clearance Protocol* which includes pre-clearance surveys (DCPL, 2002) (Section E5).

Eastern Cave Bat (Vespadelus troughtoni)

The Eastern Cave Bat (*Vespadelus troughtoni*) has not been recorded in the Project area or surrounds. The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW (DECCW, 2009a). The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT (DECCW, 2009a).

The Eastern Cave Bat is a cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. It has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. The species is occasionally found along cliff-lines in wet eucalypt forest and rainforest. Little is understood of its feeding or breeding requirements or behaviour.

Given that the species has not been located in the Project area or in the immediate surrounds in spite of the various surveys, the Project is not likely to adversely impact the Large-eared Pied Bat. Furthermore the Project area lacks primary roosting habitat (i.e. caves).

E4.16 THREATENED POPULATIONS

As described in Section E3.2.5, no threatened fauna populations listed under the TSC Act are relevant to the Project area.

E4.17 THREATENED ECOLOGICAL COMMUNITIES

No TECs have been recorded in the Project area. Three TECs have been recorded in the surrounds of the Project area, namely, the River-Flat Eucalypt Forest EEC, Freshwater Wetlands on Coastal Floodplains EEC and Lowland Rainforest on Floodplain EEC listed under the TSC Act.

The Project would not adversely impact these communities for reasons described below.

E4.17.1 Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

The Freshwater Wetlands EEC is associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands (NSW Scientific Committee, 2008a). The community typically occurs on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains (NSW Scientific Committee, 2008a).

The Freshwater Wetlands EEC generally occurs below 20 m elevation in the NSW North Coast, Sydney Basin and South East Corner bioregions (NSW Scientific Committee, 2008a). The structure of the community varies from sedgelands and reedlands to herbfields, and woody species of plants are generally scarce (NSW Scientific Committee, 2008a). Typically these wetlands form mosaics with other floodplain communities, and often they include or are associated with ephemeral or semi-permanent standing water (e.g. Goodrick, 1970).

EcoBiological (Attachment EA) mapped the occurrence of Freshwater Wetlands EEC in the surrounds of the Project area (Figure E-6a). It is likely that the wetland areas were once associated with a previous alignment of the Mammy Johnson's River. EcoBiological (Attachment EA) report that the occurrences had key indicator species in rushes, grasses, aquatic plants and forbs.

The Project would not adversely impact the Freshwater Wetlands EEC as it outside of the Project area. The Project would also not adversely affect the current disturbance regimes relevant to the ecological community (e.g. surface water flow), or the connectivity of habitat for the ecological community.

Approximately 0.2 ha of this Freshwater Wetlands EEC occurs in the proposed offset area as mapped by EcoBiological (Attachment EA). This occurrence would be conserved and enhanced as described in Section E6.

E4.17.2 River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

The River-Flat Eucalypt Forest EEC is found on the river flats of the coastal floodplains of NSW (DECCW, 2009a). The community occurs on silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains (NSW Scientific Committee, 2008b). While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include: Forest Red Gum (*Eucalyptus tereticornis*), Cabbage Gum (*E. amplifolia*), Rough-barked Apple (*Angophora floribunda*) and Broad-leaved Apple (*A. subvelutina*).

The River-Flat Eucalypt Forest EEC generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community may vary from tall open forests to woodlands and generally has a tall open tree layer of eucalypts, which may exceed 40 m in height, although partial clearing may have reduced the canopy to scattered trees (NSW Scientific Committee, 2008b; DECCW, 2009a). These forests and woodlands typically form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Goodrick, 1970).

EcoBiological (Attachment EA) consider that Vegetation Community 5 – the Cabbage Gum Floodplain Forest in the Project area, is equivalent to the River-flat Eucalypt Forest EEC, despite the identification guideline indicating that the River-flat Eucalypt Forest EEC typically occurs 40 km south of the Project area (south of Port Stephens) (DECC, 2007b).

The Project would not adversely impact the River-flat Eucalypt Forest EEC. The Project would also not adversely affect the current disturbance regimes relevant to the ecological community (e.g. surface water flow), or the connectivity of the habitat for the ecological community.

Approximately 8 ha of this River-flat Eucalypt Forest EEC occurs in the proposed offset area as mapped by EcoBiological (Attachment EA). This occurrence would be conserved and enhanced as described in Section E6.

E4.17.3 Lowland Rainforest on Floodplain in the NSW North Coast Bioregion

The Lowland Rainforest on Floodplain EEC is, in its undisturbed state, a closed canopy forest characterised by its high species richness and structural complexity (NSW Scientific Committee, 2008c). This community covers less than 1,000 ha in NSW and remaining stands are small and isolated (NSW Scientific Committee, 2008c). NSW Scientific Committee (2008c) describes the occurrence of Floyd (1990) Suballiance 26: *Waterhousea floribunda* as a possible indicator of this community. For this reason, EcoBiological (Attachment EA) consider that Vegetation Community 6 – the Riparian Closed Forest in the Project area, is equivalent to the Lowland Rainforest on Floodplain EEC.

The potential surface water and groundwater impacts of the Project are evaluated in Sections E4.1, E4.2 and E4.3. In essence, DCPL do not propose to have a measurable impact the Mammy Johnsons River as part of the Project, as such the flora and fauna habitat resources provided by the river would not be adversely impacted by the Project.

The Project would not adversely impact the Lowland Rainforest on Floodplain EEC and would not affect the current disturbance regimes relevant to the ecological community (e.g. surface water flow), or the connectivity of the habitat for the ecological community.

The proposed Project offset measures would enhance the connectivity between the Mammy Johnsons River, the extensive remnant vegetation associated with Buckleys Range and the rehabitation of the final Project landforms.

E4.18 KOALA HABITAT

The *National Koala Conservation and Management Strategy 2009-2014* (Consultation Draft), was prepared to provide objectives and actions for Koala conservation in Australia (National Koala Conservation and Management Strategy Steering Committee, 2009). While at a smaller scale, the NSW State *Recovery Plan for the Koala* (DECC, 2008) was prepared to address the conservation requirements of the species across its known range in NSW. The *Recovery Plan for the Koala* (DECC, 2008) identifies actions to be taken to ensure the long-term viability of the koala in nature.

The most important factor influencing koala occurrence is the suite of tree species available (DECC, 2008). The *Recovery Plan for the Koala* (DECC, 2008), identifies regionally-based tree species of fundamental importance to koala survival (DECC, 2008). The Koala food trees of the North-Coast Koala Management Area (the management area in which the Project area is located) are listed in Table E-14.

Table E-14
Koala Food Tree Species in the North Coast Koala Management Area

Scientific Name	Common Name	Scientific Name	Common Name
Primary Food Tree Species			
E. microcorys	Tallowwood	*E. bancroftii*	Orange Gum
E. parramattensis	Parramatta Red Gum	*E. robusta*	Swamp Mahogany
E. tereticornis	Forest Red Gum	*E. amplifolia*	Cabbage Gum
Secondary Food Tree Species			
E. seeana	Narrow-leaved Red Gum	*E. rummeryi*	Steel Box
E. largeana	Craven Grey Box	*E. notabilis*	Mountain Mahogany
E. glaucina	Slaty Red Gum	*E. rudderi*	Rudder's Box
E. biturbinata	Grey Gum	*E. moluccana*	Grey Box
E. propinqua	Small-fruited Grey Gum	*E. quadrangulata*	White-topped Box
E. canaliculata	Large-fruited Grey Gum	*E. melliodora*	Yellow Box
E. resinifera	Red Mahogany		
Stringybarks/Supplementary Food Tree Species			
E. tindaliae	Stringybark	*E. cameronii*	Diehard Stringybark
E. agglomerata	Blue-leaved Stringybark	*E. globoidea*	White Stringybark
E. eugeniodes	Thin-leaved Stringybark		

Source: DECC (2008).

The Project area contains Tallowwood (*E. microcorys*), Forest Red Gum (*E. tereticornis*) and Cabbage Gum (*E. amplifolia*) trees which are primary food tree species for the Koala in the North Coast Koala Management Area (Table E-14; Attachments EA and ED). Secondary food tree species present include Red Mahogany (*E. resinifera*) and Grey Box (*E. moluccana*) (Table E-14; Attachments EA and ED).

Although Koalas have not been sighted within the Project area, Koala scats and traces were identified in the west of ML1427 during three previous fauna surveys undertaken as part of the Duralie Coal EIS (Woodward-Clyde, 1996c and ERM Mitchell McCotter). Additional secondary evidence (one pellet) was recorded by EcoBiological (Attachment EA) in a similar area, to the west of the Project area (Figure E-8). The Koala has been recorded in multiple locations in the wider area (NSW Government, 2009), including in The Glen Nature Reserve, Ghin-doo-ee National Park and Barrington Tops National Park (DECCW, 2009c).

These records, together with other data, indicate that the Koala occurs within the Project area and in the immediate surrounds and that potential habitat for Koala exists within the Project area. However, given that the Koala has not been recorded in the Project area (despite targeted surveys) suggests that the Project area is not utilised regularly by this species.

NSW State Environmental Planning Policy No 44—Koala Habitat Protection

The SEPP 44, is an environmental planning instrument which aims to: *encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.*

Potential koala habitat under SEPP 44 means *areas of native vegetation where the trees listed in Schedule 2* (Table E-15) *constitute at least 15% of the total number of trees in the upper or lower strata of the tree component*.

Table E-15
Preferred Food Trees of Koalas in NSW

Scientific Name	Common Name
Eucalyptus punctata	Grey Gum
E. tereticornis	Forest Red Gum
E. robusta	Swamp Mahogany
E. microcorys	Tallowwood
E. viminalis	Ribbon or Manna Gum
E. camaldulensis	River Red Gum
E. haemastoma	Broad-leaved Scribbly Gum
E. signata	Scribbly Gum
E. albens	White Box
E. populnea	Bimble Box or Poplar Box

Source: SEPP 44.

Three tree species listed in Table E-15 were recorded by EcoBiological (Attachment EA) in the Project area, namely, Grey Gum (*Eucalyptus punctata*), Forest Red Gum (*E. tereticornis*) and Tallowwood (*E. microcorys*). Some potential Koala food trees occur in the Project area and surrounds and meet the definition as potential koala habitat as the Forest Red Gum (*E. tereticornis*) is likely to constitute greater than 15 % of the total number of trees in the upper strata of the tree component.

Core koala habitat under SEPP 44 means *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)*.

Conservatively, approximately 20 ha of potential Koala habitat as defined by SEPP 44 would be removed by the Project (equivalent to the Red Gum Grassy Woodland), however, the Project area is not considered to represent core koala habitat considering that the Koala has not been recorded utilising habitat in the Project (despite targeted surveys).

As described in Section E5, the DCM Vegetation Clearance Protocol (DCPL, 2002) has been developed to minimise the impact of vegetation clearance on flora and fauna. Key component of the *Vegetation Clearance Protocol* includes pre-clearance surveys and fauna management measures.

E4.19 OTHER MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Sections E4.14 and E4.15 provide an assessment of the potential impacts of the Project on threatened species listed under the EPBC Act.

No TEC's or populations listed under the EPBC Act occur, or are likely to occur, in the Project area as discussed in Sections E3.1.5, E3.1.6 and E3.2.5.

No World Heritage Properties or National Heritage Places are situated in the Project area or surrounds. The closest World Heritage Property and National Heritage Place to the Project is the Gondwana Rainforests of Australia (Barrington Tops area), situated approximately 17 km to the north-west of the Project.

The closest Ramsar wetland is Myall Lakes, which is situated approximately 37 km south-east of the Project. Myall Lakes is a considerable distance from the area of any potential direct (e.g. vegetation clearance) or indirect (e.g. potential effects on water quality) effect of the Project. The Project area is not located on Commonwealth land.

E4.20 CUMULATIVE IMPACTS

Cumulative impacts are considered to be the total impact on the environment that would result from the incremental impacts of the Project added to other existing impacts. Cumulative impacts include direct and indirect impacts on the environment.

The regional setting of the Project and surrounding land use is described in Section E1.2 and E1.4, respectively. The DCM and the SCM (which is located approximately 20 km to the north of the DCM) are the main mining developments in the area. As previously described, the Project is located in a rural area characterised by cattle grazing on native and improved pastures, along with some poultry farming and other agricultural production. The majority of the Project area has been cleared as part of past rural land use practices and logging. These past and present actions have been considered in the assessment of cumulative impacts.

The cumulative impact assessment has considered the species present (species diversity, abundance and dynamics), patterns of species distribution (the communities and ecosystem present that encompass all species), broad habitat types (the ecological niches for the range of species present), and ecosystem processes.

In relation to past and present mining, it is likely that the range and scale of impacts would be similar to those described for the Project. The main cumulative impacts of the Project are associated with Project impacts described in Sections E4.1 to E4.19.

The area and composition of the vegetation approved to be cleared for the DCM and proposed to be cleared for the Project is described in Section E4.1. The proposed Project disturbance areas are located adjacent to the existing DCM, and as such the terrestrial flora, fauna and their habitats to be impacted by the Project are similar to those which would have been impacted for the existing DCM. It is also likely that the accumulating impacts would increase linearly and proportionally with the area of disturbance. The cumulative impacts described are likely to be fully expressed within a few years of the completion of mining.

The approved impacts associated with the local creeks and drainage lines (e.g. Coal Shaft Creek) are likely to have been greater for the existing DCM, than the potential impacts on these systems as a result of the Project. This is because the lengths of the existing creek diversions at the DCM are more extensive than the additional works required for the Project. Further, the riparian vegetation/habitat which was approved to be disturbed as part of the existing DCM was adjoining the Mammy Johnsons River, where as the vegetation/habitat proposed to be removed for the Project is not adjoining the Mammy Johnsons River.

The proposed impact avoidance, mitigation and offset measures (Sections E5 and E6) of the Project are likely to maintain regional fauna biodiversity in the short-term and to enhance it in the long-term. The enhancement and conservation measures proposed as part of the offset would help maintain (and possibly improve) the flora biodiversity values in the offset area.

E5 IMPACT AVOIDANCE AND MITIGATION MEASURES

The EARs for the Project state that the EA must include a description of the measures that would be implemented to avoid, minimise, mitigate, rehabilitate/remediate, monitor and/or offset the potential impacts of the Project. The following impact avoidance and mitigation measures include those currently in place at the DCM which would potentially be applicable to the Project. The protocols and management plans described below would be revised and/or updated for the Project, as required.

Vegetation Clearance Protocol

The DCM Vegetation Clearance Protocol (DCPL, 2002) has been developed to minimise the impact of vegetation clearance on flora and fauna. The key components of the DCM Vegetation Clearance Protocol include delineation of areas to be cleared of native remnant vegetation, pre-clearance surveys, fauna management measures and vegetation clearance supervision. In addition, habitat resources, such as hollows, would be opportunistically salvaged for placement within rehabilitation areas or other fauna habitat enhancement areas, where practicable.

The DCM Vegetation Clearance Protocol (DCPL, 2002) also contains general long-term flora and fauna management measures, including:

- the placement of nesting boxes in suitable habitat for birds and arboreal mammals;
- the placement of bat boxes in suitable habitat for bats;
- the relocation of habitat features salvaged from felled trees (e.g. hollow branches) in suitable habitat;
- inclusion of hollow-developing tree species in the rehabilitation programmes;
- inclusion of appropriate species in the rehabilitation programme to provide foraging resources; and
- speed limits would be imposed on vehicles using the Project roads and tracks and signposting installed to assist in reducing potential vehicle strike.

Irrigation Management Plan

The DCM Irrigation Management Plan (DCPL, 2008b) details the DCM water management system and irrigation requirements, establishes ameliorative measures for irrigation areas and sets out an irrigation monitoring programme and reporting requirements.

The DCM Irrigation Management Plan (DCPL, 2008b) contains erosion control measures, including temporary exclusion of stock and construction of appropriate silt fences (DCPL, 2008b).

The DCM Irrigation Management Plan (DCPL, 2008b) contains weed control measures including mechanical removal of noxious weeds and/or the application of approved herbicides in authorised areas. Follow-up inspections would be made to check for the effectiveness of the weed control measures (DCPL, 2008b). Weed management at the DCM is further discussed below.

Site Water Management Plan

The DCM Site Water Management Plan (DCPL, 2008c) establishes strategies for the management of site water during the operation of the Project. The key objectives of the on-site water management system are the interception and diversion of runoff from undisturbed and rehabilitated landforms around mining activities and collection, treatment (where necessary) and irrigation of excess mine water over pastures within ML 1427. The DCM Site Water Management Plan (DCPL, 2008c) includes the following:

- Site Water Balance;
- Erosion and Sediment Control Plan;
- Surface Water Management and Monitoring Plan;
- Groundwater Monitoring Program; and
- Surface and Groundwater Response Plan.

Weed Management

The DCM Rehabilitation Management Plan (DCPL, 2007b) and DCM Irrigation Management Plan (DCPL, 2008b) provide measures to control weeds. The weed control measures include:

- identification of weeds via regular site inspections and communication with landholders and regulatory authorities;
- irrigation areas would be managed such that a vegetation cover is maintained as much as possible to suppress the establishment of weeds;
- mechanical removal of identified weeds and/or the application of approved herbicides in authorised areas;
- follow-up site inspections to determine the effectiveness of eradication programs; and
- minimisation of seed transport from the site through the use of the site's vehicle wash bay.

The DCM Rehabilitation Management Plan (DCPL, 2007b) and DCM Irrigation Management Plan (DCPL, 2008b) would be revised to include consideration of the noxious weeds recorded in the Project area and surrounds (Section E3.1.7).

Animal Pest Management and Monitoring

The DCM Rehabilitation Management Plan (DCPL, 2007b) provides measures to control animal pests. The pest control measures include removing available feed and baiting. In addition, the DCM Vegetation Clearance Protocol contains general fauna management measures, including:

- the maintenance of a clean, rubbish-free environment in order to discourage scavenging and reduce the potential for colonisation of these areas by non-endemic fauna (e.g. introduced rodents, predators and birds);
- domestic pets would not be allowed in the Project area; and
- employees and contractors would not be permitted to encourage fauna through feeding.

These measures would be continued for the Project.

Noise Control Measures

A range of noise control measures are implemented at the DCM to minimise noise emissions. These measures would also be applicable to the Project. The DCM Noise Monitoring Plan (DCPL, 2007c) contains mitigation measures to limit noise emissions, including the following:

- avoiding the simultaneous use of significant noise generating equipment wherever possible;
- monitoring weather conditions and where adverse conditions are experienced or predicted operational changes would be made to avoid or reduce noise impacts; and
- regularly maintaining all machinery and plant used on-site and dedicated locomotives and rolling stock used off-site to minimise noise generation.

Dust Control Measures

Current dust mitigation and management measures implemented at the DCM are presented in the DCM Air Quality Monitoring Program (incorporating Air Quality Management (DCPL, 2007d) and include:

- water spraying of haul routes;
- water spraying of coal in trains prior to departure from the DCM to the SCM;
- rehabilitation of waste rock dumps as soon as practicable;
- watering of waste rock dumps with travelling irrigation system;
- where practicable, scheduling of blasting events to avoid poor dispersion conditions (i.e. early morning/late afternoon);
- dust aprons on drill rigs are lowered during drilling. Water injection or dust suppression sprays are used on drilling equipment when dust generation potential is high; and
- water sprays are used on the ROM dump hopper, all coal transfer points between the hopper and the train loading bin, including the rotary breaker.

Bushfire Management

The DCM Rehabilitation Management Plan (DCPL, 2007b) outlines the bushfire management measures in place at the DCM, including:

- Controlled grazing – cattle are grazed on portions of ML 1427 upon which active mining operations are not occurring and appropriate fencing is available. Sustainable stocking levels result in minimal pasture presence and hence low residual fuel loads.
- Hazard reduction burns – in areas where controlled grazing is not possible or appropriate and fuel loads are high, hazard reduction burns may be undertaken.
- Firefighting equipment – it is considered likely that if a bushfire occurred within ML 1427 the local Royal Fire Service (RFS) would be called for assistance. The RFS, if required, could be assisted by mine personnel and mine resources. The mine has a water cart with water canon and fire suppressant foam, trailer mounted fire fighting equipment, dozers, etc.
- Reporting – an annual report on bushfire management is provided to the Great Lakes RFS.

Rehabilitation

The disturbance areas associated with the Project would be rehabilitated and revegetated with native grass, shrub and tree species characteristic of the vegetation communities cleared. The DCM Rehabilitation Management Plan (DCPL, 2007b) presents the rehabilitation objectives and provides a description of the rehabilitation works to be undertaken and the rehabilitation assessment and completion criteria.

The DCM Rehabilitation Management Plan (DCPL, 2007b) also describes actions to be undertaken to improve habitat within rehabilitated areas, including:

- exclusion of cattle from areas where existing vegetation is to be protected;
- recovery (and re-use) of tree hollows from timber felled during clearing work in advance of mining;
- restriction of light vehicles within revegetated areas;
- noxious weed management;
- feral animal control; and
- irrigation to promote revegetation.

Other Fauna Protection and Management Measures

Other fauna protection and management initiatives have been implemented at the DCM. These measures include:

- setting speed limits;
- installing warning signs on roads and tracks in the vicinity of the DCM;
- the maintenance of a clean, rubbish-free area; and
- preparation of procedures which detail how to care for animals found at risk of harm or injured at DCM.

E6 OFFSET MEASURES

The EARs for the Project state that the EA must include a description of the measures that would be implemented to maintain or improve the biodiversity values of the surrounding region in the medium to long-term.

This assessment proposes an offset in consideration of the EARs, relevant Part 3A development guidelines (e.g. DEC and DPI, 2005), DECCW's principles for the use of biodiversity offsets in NSW (DECCW, 2009i) and ecological principles commonly used in the design of reserves for wildlife conservation.

DECCW's principles for the use of biodiversity offsets in NSW are as follows (DECCW, 2009i):

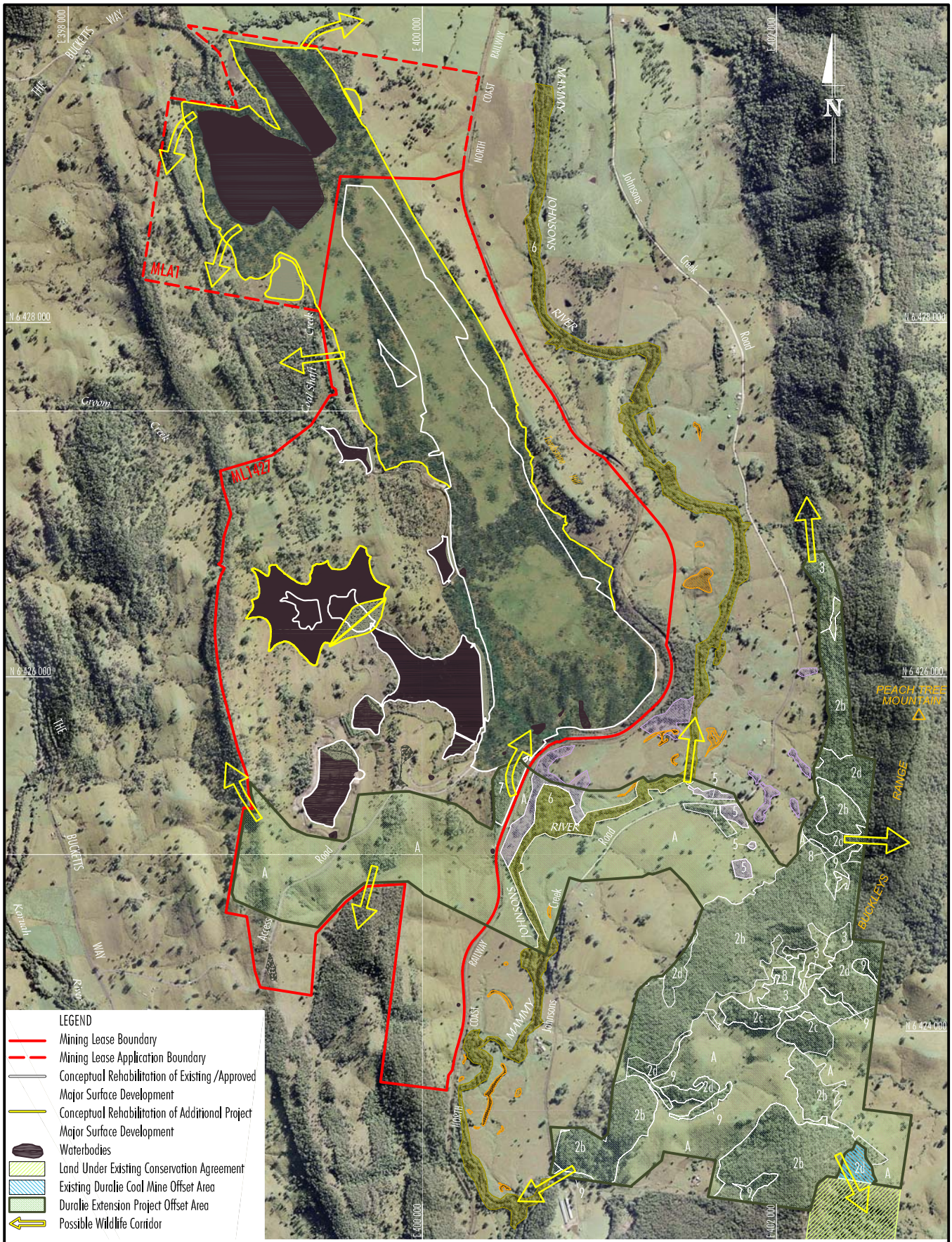
1. Impacts must be avoided first by using prevention and mitigation measures.
2. All regulatory requirements must be met.
3. Offsets must never reward ongoing poor performance.
4. Offsets would complement other government programs.
5. Offsets must be underpinned by sound ecological principles.
6. Offsets should aim to result in a net improvement in biodiversity over time.
7. Offsets must be enduring. They must offset the impact of the development for the period that the impact occurs.
8. Offsets should be agreed prior to the impact occurring.
9. Offsets must be quantifiable. The impacts and benefits must be reliably estimated.
10. Offsets must be targeted.
11. Offsets must be located appropriately.
12. Offsets must be supplementary.
13. Offsets and their actions must be enforceable through Development Consent conditions, licence conditions, conservation agreements or a contract.

The proposed offset area for the Project is described in Section E6.1, the flora and fauna characteristics of the proposed offset area are described in Section E6.2 and the ecological gains of the proposed offset area and a reconciliation of the proposed offset against the DECCW's offset principles is provided in Section E6.3.

E6.1 PROPOSED OFFSET AREA SECURITY AND MANAGEMENT MEASURES

DCPL propose an offset area which is located on freehold GCL/DCPL owned land to the east of the Project area (Figure E-10). GCL currently manages the land for pastoral purposes.

The proposed offset area is located directly adjacent to DCPL's existing offset area which was proposed as part of the DCM June 2009 modification (Figure E-10). DCPL's existing offset area directly adjoins land which has a conservation agreement included in its conditions of tenure (Figure E-10).



LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- Conceptual Rehabilitation of Existing /Approved Major Surface Development
- Conceptual Rehabilitation of Additional Project Major Surface Development
- Waterbodies
- Land Under Existing Conservation Agreement
- Existing Duralie Coal Mine Offset Area
- Duralie Extension Project Offset Area
- Possible Wildlife Corridor

Vegetation Communities

1 Refer to Figue E-6a
2a-2d Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest
3 Red Gum Grassy Woodland
4 Grey Gum – Red Gum – Apple Riparian Forest
5 Cabbage Gum Floodplain Forest - River-flat Eucalypt Forest on Coastal Floodplains Endangered Ecological Community
6 Riparian Closed Forest - Lowland Forest on Floodplain Endangered Ecological Community
7 Stringybark – Paperbark Forest
8 Dry Gully Rainforest
9 Blue Gum Moist Forest
10 Perch Sedgeland
11 Freshwater Wetlands Endangered Ecological Community

Vegetation Map Units

A Derived Grasslands
B Cropping

0 200 1000

Metres

GRID DATUM: MGA 94 ZONE 56

Source: AAHatch- Aerial Photography flown April 2009; DCPL (2009) and Vegetation - Ecobiological (2009a and b)

TERRESTRIAL FLORA AND FAUNA ASSESSMENT

FIGURE E-10

Offset Area

DURALIE COAL

CENWEST ENVIRONMENTAL SERVICES AND RESOURCE STRATEGIES

GCL-06-07 App_F&F_105L

Table E-16 provides a summary of the proposed offset. While approximately 87 ha of natural vegetation communities and 109 ha of derived grassland would be cleared for the Project, it is proposed that significant areas of existing native vegetation communities would be enhanced (some 214 ha) and areas of derived grasslands would be revegetated (some 230 ha).

Table E-16
Summary of the Offset Proposal

Area	Description	Area (ha)*
Enhancement Area	Enhancement of existing areas of native vegetation communities through natural regeneration and management for conservation.	214
Revegetation Area	Re-establishment of woodland in derived grasslands by selective planting and fencing for natural regeneration.	230
	Total Area Conserved (ha)	444

* Approximate areas are based on vegetation mapping provided on Figure E-6a.

The conservation of the proposed offset areas would be secured in perpetuity, and this may occur through a voluntary conservation agreement with the NSW Minister for the Environment. A voluntary conservation agreement provides permanent protection as it is registered on the title of the land.

A management plan would be prepared by suitably qualified persons to facilitate the revegetation and regeneration of native vegetation and habitats within the proposed offset area along with habitat enhancement of existing habitats. It is anticipated that the plan would detail measures including:

- encouraging native regeneration by providing appropriate fencing to exclude grazing from existing treed areas;
- selective revegetation in derived grasslands by appropriate plantings or seeding using local seed sources;
- managing weeds and pests;
- managing fire including mosaic burnings likely needed to optimise species diversity;
- creating signage of the proposed offset area;
- restricting vehicular and people access; and
- monitoring ongoing management performance, habitat quality and diversity, species diversity, landscape resilience and landscape function within the offset, by suitably qualified person(s).

Stock grazing may be used experimentally as a management tool to assist with the regeneration of native vegetation within the derived grassland area.

As stated in Section E5, where practicable, habitat features (e.g. large hollows and some suitable logs) would be salvaged during vegetation clearance activities and relocated to areas where habitat enhancement is required (e.g. in the proposed offset area).

The proposed offset area traverses two roads. Canopy bridges would be installed to facilitate the crossing of arboreal mammals where there is not existing substantial canopy connection.

The proposed offset area would be independently audited at intervals agreed with relevant authorities. The audits would be conducted by a suitably qualified person(s) to:

- assess compliance with the management plan;
- assess the performance of the proposed offset area;
- review the adequacy of the management measures and monitoring programme; and
- recommend actions or measures to improve the performance of the offset, management plan, or monitoring programme.

E6.2 FLORA AND FAUNA CHARACTERISTICS OF THE PROPOSED OFFSET AREA

General Environment

The proposed offset area covers a portion of Buckleys Range and associated footslopes (Figure E-10). Elevations generally range from approximately RL 50 m along the river flats of the Mammy Johnsons River to RL 150 m on Buckleys Range.

The proposed offset area traverses two roads and the North Coast Railway (Figure E-10).

The surface geology of the Buckleys Range and footslopes comprises of Alum Mountain Volcanics, with Quaternary Alluvium associated with the Mammy Johnsons River and related floodplains (Department of Industry and Investment, 2009). In the proposed offset area to the east of the Mammy Johnsons River, the surface geology is more similar to the Project area being comprised of Permian materials.

The foot slopes of the Buckleys Range comprises the Bucketts Road Soil Landscape, which is known as a transferral soil landscape, consisting of deep deposits of eroded colluvial soils formed beneath steep to precipitous sedimentary and volcanic material (Henderson, 2000), in this case, Buckleys Range. The soils in the proposed offset area to the east of the Mammy Johnsons River are derived from sandstone.

The proposed offset area incorporates a section of the Mammy Johnsons River at the confluence of Coal Shaft Creek and adjoins the riparian vegetation along the Mammy Johnsons River at a second location to the south (Figure E-10). Similar to the Project area, the proposed offset area is situated in the Mammy Johnsons River catchment.

While Buckleys Range is mostly heavily vegetated, the lower flootslopes of Buckleys Range have been cleared as part of past rural land use practices and logging (Figure E-10). The area of the vegetation patch associated with Buckleys Range is significantly larger than the patches which would be cleared for the Project. The largest area of continuous vegetation in, and adjoining, the Project area is approximately 45 ha, while the largest area of continuous vegetation in, and adjoining, the proposed offset area is approximately 1,260 ha.

The native vegetation associated with Buckleys Range is a north-south aligned elongated shape. This vegetation patch forms part of an important corridor which runs parallel to the Mammy Johnsons River. The proposed offset would aim to establish a wildlife corridor across the valley from the vegetation on Buckleys Range to the Mammy Johnsons River to the vegetation on the western side of ML 1427 (Figure E-10). The width of the proposed corridor across the valley is between 50 and 100 m wide. The corridor incorporates existing patches of native vegetation and scattered trees.

There are physical differences between the proposed offset and the areas where vegetation would be cleared within Project area. These include: different soil landscapes occurring to the east of the Mammy Johnsons River and the maximum elevation along Buckley Range being higher than the elevation in the Project area. These differences are not considered to diminish the suitability of the proposed offset area. Rather, the proposed offset area is considerably enriched by this added variability.

EcoBiological (2009b) undertook flora and terrestrial vertebrate fauna surveys covering the proposed offset area in August 2008 and January 2009 as described in Section E2.2.4. A summary of the survey techniques utilised are provided in Section E2.2.4. The flora and fauna characteristics of the proposed offset areas are described below.

Flora Characteristics

As described in Section E3.1, the Vegetation Types Database (DECCW, 2009e) contains a standard list of vegetation types used with the BioMetric tool under the *Native Vegetation Act, 2003*, and the NSW Biobanking Credit Calculator under the TSC Act (DECCW, 2009a). Under these schemes, vegetation types, rather than vegetation communities, are the unit of measure for the calculation of offsets.

Table E-17 provides the vegetation types identified by EcoBiological (2009b; Attachment EA) in the Project area and offset area, together with the approximate area to be cleared in the Project area and conserved in the proposed offset area. The vegetation types are shown on Figure E-10.

Table E-17
Vegetation Types which would be Cleared and Conserved by the Project

Vegetation Type	Approximate Area to be Cleared	Approximate Area of Existing Vegetation to be Offset
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	63 ha *(comprising 61 ha of Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest [Vegetation Community 1] and 2 ha of Spotted Gum – Grey Ironbark [Vegetation Community 2a])*	167 ha *(comprising Spotted Gum – Grey Ironbark [Vegetation Community 2b-2d])*
Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast	23 ha *(comprising 20 ha of Red Gum Grassy Woodland [Vegetation Community 3] and 3 ha of Grey Gum – Red Gum - Apple Riparian Forest [Vegetation Community 4)*	12 ha *(comprising 10 ha of Red Gum Grassy Woodland [Vegetation Community 3] and 2 ha of Grey Gum – Red Gum - Apple Riparian Forest [Vegetation Community 4])*
Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin	1 ha *(comprising of Stringybark – Paperbark Forest [Vegetation Community 7])*	4 ha *(comprising of Stringybark – Paperbark Forest [Vegetation Community 7])*
Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands	0	8 ha *(comprising of Cabbage Gum Floodplain Forest [Vegetation Community 5] equivalent to the River-Flat Eucalypt Forest EEC)*
Weeping Lilly Pilly - Water Gum riparian rainforest of the southern North Coast	0	14 ha *(comprising of Riparian Closed Forest [Vegetation Community 6] equivalent to the Lowland Forest on Floodplain EEC)*
Giant Stinging Tree - Fig dry subtropical rainforest of the North Coast and Brigalow Belt South	0	1 ha *(comprising of Dry Gully Rainforest [Vegetation Community 8])*
Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	0	8 ha *(comprising of Blue Gum Moist Forest [Vegetation Community 9])*
Freshwater Wetlands	0	0.2 ha *(comprising of Freshwater Wetlands EEC [Vegetation Community 11])*
Total	**87 ha**	**214.2 ha**

Source: Based on vegetation mapping by EcoBiological (2009b and Attachment EA).

As indicated by Table E-17, similar vegetation types occur within the Project area and the proposed offset area (after EcoBiological, 2009b; Attachment EA). All vegetation types impacted by the Project area are represented in the proposed offset area.

A significantly larger quantity of *Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast* and *Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin* Vegetation Type would be provided in the proposed offset area than would be cleared for the Project (Table E-17).

A smaller area of *Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast* Vegetation Type is contained with the proposed offset area than would be cleared for the Project. Although, it is likely that this vegetation type would regenerate within the derived grasslands in areas surrounding the existing patches of Red Gum Grassy Woodland. Further, the establishment of woodland in derived grasslands would be facilitated by revegetation with appropriate plantings or seeding using local seed sources.

Vegetation Communities 5, 6, 8, 9 and 11 occur within the proposed offset area, but do not occur within the Project area (Table E-17). Descriptions of Vegetation Communities 5, 6 and 11 are provided in Section 3.1.2. Vegetation Communities 5, 6 and 11 have been included in the proposed offset area in recognition of their relatively high conservation value as these communities are TECs, namely, the River-Flat Eucalypt Forest EEC, Lowland Forest on Floodplain EEC and Freshwater Wetlands EEC.

Small patches of Vegetation Communities 8 and 9 (Blue Gum Moist Forest) occur in the proposed offset area as they are surrounded by other vegetation communities. In Vegetation Community 8, the dominant indicator species are Rusty Fig (*Ficus rubiginosa*) and Two-leaved Tuckeroo (*Rhysotoechia bifoliolata* subsp. *bifoliolata*), with scattered Moreton Bay Fig (*F. macrophylla*). In Vegetation Community 9, the dominant indicator species are Sydney Blue Gum (*Eucalyptus saligna*) and Brush Box (*Lophostemon confertus*) with Turpentine (*Syncarpia glomulifera*) and Grey Gum (*E. punctata*) as common associated species.

The Spotted Gum – Grey Ironbark community which occurs in the proposed offset area is relatively diverse. Three variations of Spotted Gum – Grey Ironbark were recorded by EcoBiological in the proposed offset area (Vegetation Communities 2b, 2c and 2d) (Figure E-10). EcoBiological (2009b) describes the dominant overstorey species of Vegetation Community 2b as Spotted Gum (*Corymbia maculata*), Grey Ironbark (*Eucalyptus siderophloia*) and Thick-leaved Mahogany (*E. carnea*), with moderate to dense Forest Oak (*Allocasuarina torulosa*) and a shrub layer consistently having Prickly Shaggy Pea (*Podolobium ilicifolium)* and Narrow–leaved Geebung (*Persoonia linearis)*. EcoBiological (2009b) describes the dominant overstorey species of Vegetation Community 2c as Tallowood (*E. microcorys*) with Spotted Gum (*C. maculata*) at sheltered slopes and minor drainage lines. In Vegetation Community 2c, Forest Oak (*A. torulosa*) dominated the mid stratum where as EcoBiological (2009b) describes the dominant overstorey species of Vegetation Community 2d as almost totally dominated by Forest Oak (*A. torulosa*) with emergent trees Tallowood (*E. microcorys*, *C. gummifera* and *E. carnea*).

Similar to the vegetation in the Project area, the vegetation in the offset area has been subject to intense historic logging. Although, the majority of the regrowth vegetation in the proposed offset area is older than the regrowth in the Project area, evidenced by comparision of the historic air photo (Figure E-7) and the current air photo (Figure E-6a). Many of the existing trees in the proposed offset area have regrown in the later 1800s and early 1900s, with multiple recruitment events evident. Some smaller treed areas were more recent regrowth in the order of 10 to 50 years (Figures E-7 and E-10). The condition of the regrowth is considered very good with minimal weeds present and a diverse understorey. There was evidence of low-medium intensity past fire (e.g. Eucalypt coppicing and blackened bark).

The intensity of stock grazing within the proposed offset area has been light for a number of seasons, with some derived grassland areas supporting young sapling regeneration.

Fauna Characteristics

The broad fauna habitats within the proposed offset area are more diverse than those within the Project area. Broad habitat types present in the offset area include: open forest, closed forest, woodland, Rocky Escarpments, riparian habitat along a length of the Mammy Johnsons River, unnamed creeks and drainage areas, freshwater wetlands, farm dams and secondary grasslands. All broad fauna habitat types impacted by the Project area are represented in the proposed offset area.

The condition of the habitats within the proposed offset area ranges from very good to highly degraded. Agricultural land use is considered to be the greatest existing threat to the habitats in the offset area.

EcoBiological (2009b) recorded a range of vertebrate fauna species during surveys of Buckleys Range and surrounds. There were many similarities between the vertebrate species present within the offset area and the Project area. Vertebrate fauna species in the proposed offset area are represented by terrestrial, aquatic and arboreal amphibians, reptiles, woodland and forest birds and arboreal and ground dwelling mammals.

Table E-18 provides a list of threatened fauna species recorded in the offset area and a description of the record.

Table E-18
Threatened Fauna Species Recorded in the Offset Area

Scientific Name	Common Name	Conservation Status[1]		Description of the Record by EcoBiological (2009b)
		TSC Act	EPBC Act	
Amphibians				
Mixophyes iteratus	Giant Barred Frog	E	E	The Giant Barred Frog was seen and heard by EcoBiological along the Mammy Johnsons River.
Birds				
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	Eight individuals of this species were sighted on the Buckleys Range. Secondary evidence of the species (in the form of crushed Allocasuarina cones) was observed south of the record along the range.
Pyrrholaemus sagittata	Speckled Warbler	V	-	A single Speckled Warbler was recorded on the footslopes of Buckleys Range.
Mammals				
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	One Brush-tailed Phascogale was sighted along Mammy Johnsons River outside of the Project area.
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	EcoBiological recorded calls of the Eastern Freetail-bat at two locations along the Mammy Johnsons River.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	EcoBiological recorded the Eastern Bentwing-bat at two locations outside of the Project area.
Myotis macropus	Large-footed Myotis	V	-	The Large-footed Myotis was recorded by EcoBiological along the Mammy Johnsons River, within the Riparian Closed Forest vegetation type.

[1] Threatened species status under the TSC Act and EPBC Act (current as at October 2009).
E Endangered
V Vulnerable

The proposed offset area provides known habitat for the threatened fauna species listed in Table E-18 evidenced by records of the species. The proposed offset area also contains potential habitat for the Rose-crowned Fruit-Dove, Swift Parrot, Brown Treecreeper (eastern subspecies), Grey-crowned Babbler (eastern subspecies) and Squirrel Glider.

Once established, the proposed corridor across the valley is likely to be utilised by a range of local native fauna, including the Squirrel Glider and Brush-tailed Phascogale.

E6.3 ECOLOGICAL GAINS OF THE PROPOSED OFFSET

The proposed offset area concept has been developed and designed in consideration of the ecological principles commonly used in the design of reserves for wildlife conservation. Factors which were considered include the area, shape, location and spatial pattern/connectivity of the area to be conserved (e.g. Bennett *et al.,* 2000) as well as the location of existing habitat resources and conservation values (e.g. threatened species and ecological communities).

Ecological gains from the proposed offset include (Figure E-10):

- Similar vegetation communities/fauna habitats, compared to the Project area, would be conserved/enhanced in the proposed offset area by security of tenure in perpetuity and exclusion of grazing.
- The proposed offset area is suitably located to benefit flora and fauna populations (biodiversity values) potentially impacted by the Project.
- The proposed offset area is suitably located adjacent to existing conserved areas (i.e. the proposed offset area is located directly adjacent to DCPL's existing offset area which was proposed as part of the DCM June 2009 modification, and DCPL's existing offset area directly adjoins land which has a conservation agreement included in its conditions of tenure).
- The proposed offset area would enhance the local connectivity of existing habitat areas and create linkages to the Mammy Johnsons River and the rehabilitation areas of the final Project landforms.
- Opportunity to enhance the riparian habitat along a length of the Mammy Johnsons River (e.g. increasing the width of the riparian vegetation and implementing weed control measures).
- Conservation and enhancement of approximately 14 ha of the Lowland Rainforest on Floodplain EEC.
- Conservation and enhancement of approximately 8 ha of the River-Flat Eucalypt Forest EEC.
- Conservation and enhancement of approximately 0.2 ha of the Freshwater Wetlands on Coastal Floodplains EEC.
- The proposed offset area contains known habitat for the threatened Giant Barred Frog, Glossy Black Cockatoo, Speckled Warbler, Brush-tailed Phascogale, Eastern Freetail-bat, Eastern Bentwing-bat and Large Footed Myotis, as well as a significant number of protected species.
- The proposed offset area also contains potential habitat for the threatened Rose-crowned Fruit-Dove, Swift Parrot, Brown Treecreeper (eastern subspecies), Grey-crowned Babbler (eastern subspecies) and Squirrel Glider.

The proposed offset measures constitutes a suitable offset against residual flora and fauna impacts associated with the Project, given the anticipated improvement in the flora and fauna habitat value that are planned to eventuate in the proposed offset area in the medium to long-term.

Table E-19 provides a reconciliation of the proposed offset against the DECCW (2009i) offset principles.

Table E-19
Reconciliation of the Proposed Offset against the DECCW Offset Principles

DECCW Offset Principles (DECCW, 2009i)	Description of How the Proposed Offset Adresses the DECCW Offset Principles
Impacts must be avoided first by using prevention and mitigation measures.	Impact avoidance and mitigation measures are provided in Section E5 and include measures such as weed and pest control measures. The offset area is proposed to address remaining impacts (e.g. vegetation/habitat removal).
All regulatory requirements must be met.	DCPL are required to meet all statutory requirements. The offset area is not proposed to substitute other licence/approval requirements.
Offsets must never reward ongoing poor performance.	The proposed conservation area provides an appropriate offset against residual flora and fauna impacts associated with the Project and is not proposed to reward past performance.
Offsets will complement other government programs.	The proposed offset compliments the current reserve system in NSW by providing long-term security and management of a significant area of vegetation/habitat. DCPL recognise the conservation benefit in increasing the area of existing conserved areas. The proposed offset area adjoins DCPL's existing offset area and privately owned land which has a conservation agreement included in its land title.
Offsets must be underpinned by sound ecological principles.	The proposed offset area is underpinned by sound ecological principles such as establishment of corridors to link important habitat areas, increasing the size of existing patches of vegetation/habitat, incorporating known and potential habitat for threatened species (Table E-18) and communities, and revegetation of drainage areas.
Offsets should aim to result in a net improvement in biodiversity over time.	Increased security in perpetuity would be provided for the proposed offset area through rezoning relevant land to reflect conservation purposes. Additional management (Section E6.1) would enhance significant areas of existing native vegetation communities (some 214 ha) and areas of derived grasslands which would be revegetated (some 230 ha). The proposed corridor from Buckleys Range to ML 1427 would link areas of conservation value.
Offsets must be enduring. They must offset the impact of the development for the period that the impact occurs.	The proposed offset area would be secured in perpetuity through rezoning the relevant land to reflect conservation purposes. The security of the proposed offset area would facilitate an ecological gain from the protection from other land use practises (e.g. current grazing).
Offsets should be agreed prior to the impact occurring.	The offset area is proposed as part of the Project. The implementation of the offset area is likely to be a condition of Project approval.
Offsets must be quantifiable. The impacts and benefits must be reliably estimated.	The biodiversity loss from the Project is described throughout this assessment, for example: • the areas of the impact are quantified in Section E4.1; • the types of vegetation communities, habitat and species affected are described in Sections E3 and E4; • connectivity with other areas of habitat/corridors as described in Sections E3.2.1 and E4.4; and • condition of the habitat as described in Section E3.2.1. The proposed offset area is quantified in Tables E-16 and E-17. The implementation of the measures listed in Section E6.1, would enhance habitats in the proposed offset area.
Offsets must be targeted.	The proposed offset area was designed to target: • similar vegetation which would be impacted by the Project (Table E-17); • known occurrences of threatened species (Table E-18); and • areas which would be used to create local corridors to promote local fauna movement (Figure E-10).
Offsets must be located appropriately.	The proposed offset area is located an appropriate distance from the Project as to benefit the local populations of flora and fauna which would be impacted by the Project. The proposed offset area is located in the same CMA sub-region and LGA as the Project.
Offsets must be supplementary.	The implementation of the proposed offset is beyond existing requirements, in that the proposed offset area is not subject to an existing conservation agreement.
Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	Measures to monitor and independently audit the proposed offset area are provided in Section E6.1. The implementation of the offset area is likely to be a condition of Project approval.

E7 KEY THRESHOLDS

Key thresholds are discussed below in relation to the Project in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005).

Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.

Suitable avoidance and mitigation measures are provided for the Project (Section E5). The enhancement and conservation measures proposed as part of the offset (Section E6) would help maintain (and possibly improve) the local biodiversity values.

Whether or not the proposal is likely to reduce the long-term viability of a local population of threatened species, population or ecological community.

The Project is not likely to reduce the long-term viability of a local population of threatened species, population or ecological community.

Whether or not the proposal is likely to accelerate the extinction of a threatened species, population or ecological community or place it at risk of extinction.

The Project would not accelerate the extinction of any threatened flora species, population or ecological community or place it at risk of extinction as none were identified in the disturbance areas of the Project during the flora surveys, or are considered likely to be affected.

The Project would not result in the extinction of any threatened fauna species, or place it at direct risk of extinction. The avoidance and mitigation measures, as well as the enhancement and conservation measures proposed as part of the offset (Section E6) would help maintain the local populations of threatened fauna species.

Whether or not the proposal will adversely affect critical habitat.

No critical fauna habitat occurs within the vicinity of the Project area as designated by the Register of Critical Habitat held by the Commonwealth Minister of the Environment, Heritage and Arts (DEWHA, 2009c), Register of Critical Habitat held by the Director-General of the DECC (DECCW, 2009g), the Register of Critical Habitat held by the Director-General of the DPI-Fisheries (DPI-Fisheries, 2009b) or identified within the Great Lakes LEP. Therefore, the Project would not affect any critical habitat.

E8 CONCLUSIONS

The Project is situated in a valley which is bound by ridgelines to the east (Buckleys Range) and west (Linger and Die Ridge). The wider area is rural which is characterised by cattle grazing on native and improved pastures, along with some poultry farming and other agricultural production. Almost all of the pre-European forest and woodland which occurred in the Project area has been extensively cleared and/or logged at least once and in some cases very likely twice.

Flora

The vegetation community patches in the Project area are mostly regrowth comprising Spotted Gum - Red Ironbark – Thick-leaved Mahogany Forest and Red Gum Grassy Woodland. Tree regeneration is mostly occurring at forest-formation density. The estimated age of regrowth trees varies between 10 to 50 years. Under appropriate management conditions it is very likely that the bulk of such remnants would, after a suitable time, exhibit many of the values of the pre-European vegetation communities from which they were derived.

A total of 305 native flora species have been located within the Project area and the immediate surrounds during the flora surveys from 1996 to 2009. Introduced flora species are moderately diverse in area, most likely due to the high rainfall and past/present agricultural land use. Introduced flora species are more abundant along drainage areas.

No threatened flora species listed under the TSC Act or EPBC Act have been recorded, or are considered likely to occur, within the Project area. No TECs listed under the TSC Act or EPBC Act have been recorded, or are considered likely to occur, within the Project area.

Vertebrate Fauna

The broad fauna habitat types in the Project area are associated with the secondary grassland (with or without scattered regrowth trees) and relatively small discontinuous secondary woodland and forest remnants.

A total of 197 native vertebrate species have been located within the Project area and surrounds during the fauna surveys from 1996 to 2009, comprising 18 amphibians, 14 reptiles, 128 birds and 37 mammals. Fauna species are represented by terrestrial, aquatic and arboreal amphibians, reptiles, a range of woodland and forest birds and arboreal and ground-dwelling mammals.

A total of 18 threatened fauna species listed under the TSC Act and/or EPBC Act have been recorded in the Project area and/or the immediate surrounds.

Four threatened birds and four threatened mammals have been recorded in the Project area, namely the Swift Parrot, Brown Treecreeper (eastern subspecies), Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale, Squirrel Glider, Eastern Freetail-bat and Eastern Bentwing-bat. Of these, only the Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale and Squirrel Glider listed under the TSC Act are considered likely to have viable populations residing within the Project area. However the populations of these species are not confined only to the appropriate habitats in the Project area, given that such habitats are sub-optimal (e.g. fragmented regrowth habitat with limited hollows for hollow-dependant fauna) and that records of these species as well as suitable habitats also occur outside of the Project area.

The Swift Parrot and Eastern Bentwing-bat may utilise foraging habitat resources in the Project area, although these species would not breed in the Project area given the lack of suitable breeding resources or specific behavioural limitations. The once only sighting of a pair of Brown Treecreepers (eastern subspecies) in the Project area has been interpreted as the species being a non-resident within the Project Area. However it could not be determined if the sighting represented a bonded pair or a dispersal/migratory movement.

Summary

In summary the following conclusions were made:

- Disturbance associated with the Project would result in the removal of fauna habitats and the displacement and/or loss of native vertebrate individuals. However the proposed impact avoidance, mitigation and offset measures are likely to maintain regional fauna biodiversity in the short-term and to likely improve it in the medium to long-term.
- Disturbance associated with the Project would result in a decrease in the diversity of flora in the local area. The enhancement and conservation measures proposed as part of the offset would help maintain (and possibly improve) the flora biodiversity values of a substantial area of vegetation outside of the Project area.
- The Project disturbance would remove known habitat of the following threatened species as well as very likely displace resident individuals: Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale and Squirrel Glider, although the Project is unlikely to lead to the local extinction of any threatened fauna species or place any at risk of local or regional extinction.
- The Project would not impact any listed threatened flora species, TECs or threatened populations.
- The Project would not impact any critical habitat as no critical habitats are known to occur within the vicinity of the Project area.

E9 REFERENCES

Agriculture and Resource Management Council of Australia and New Zealand and Australia and New Zealand Environment and Conservation Council (1996) *National Principles for the Provision of Water for Ecosystems 1996.*

Agricultural Water Management (2009) *Duralie Extension Project Irrigation Water – Suitability Assessment*.

Algers, B. (1978) The Impact of Continuous Noise on Animal Health. *Acta Veterinaria Scandinavica (Supplementum)* 67: 1-26.

Allaire, P.N. (1978) *Effects on Avian Populations Adjacent to an Active Strip Mine*. Symposium on Surface Mining and Fish/Wildlife Needs in Eastern United States, West Virginia.

Ames, D.R. (1978) *Physiological Responses to Auditory Stimuli.* In J.L. Fletcher and R.G. Busnel (Eds) *Effects of Noise on Wildlife*. Academic Press, New York.

Anderson, J., Law, B. and Tidemann, C. (2006) Stream use by the large-footed myotis Myotis macropus in relation to environmental variables in northern New South Wales. *Australian Mammology* 28(1): 15 - 26

Austeco Environmental Consultants (2003) *Squirrel Glider Impact Assessment and Mitigation: The Proposed Heritage Retirement Village. Part Lot 404, DA 923/01, Spinifex Avenue, Tea Gardens.* Draft report prepared for Great Lakes Council.

Australian Museum (2009a) *Australian Museum Database Records within a Search Area between 151°50', 32°24', 151°50', 32°12', 152°03', 32°24', 152°03', 32°12'.*

Australian Museum (2009b) *Rose-crowned Fruit-dove*.
Website: http://www.birdsinbackyards.net/bird/360
Date Retrieved: 9 September 2009.

Australian Museum Business Services (1995) *Fauna Impact Statement for the Gloucester and Chichester Management Areas*.

Ayers, D., Nash, S. and Baggett, K. (1996) *Threatened Species of Western New South Wales*. NSW National Parks and Wildlife Service, Hurstville.

Barrett, G.W., Ford, H.A. and Recher, H.F. (1994). Conservation of woodland birds in a fragmented rural landscape. *Pacific Conservation Biology* 1: 245-256.

Bell, S.A.J. (2009) *Revised Vegetation Data Analysis: Gloucester Coal Project*. Report prepared for EcoBiological by Eastcoast Flora Survey, May 2009.

Bennett, A.F., Kimber, S.L. and Ryan, P.A. (2000) *Revegetation and Wildlife – A Guide to Enhancing Revegetated Habitats for Wildlife Conservation in Rural Environments*. Bushcase National and Research and Development Programme Research Report 2/00.

Berger, L., Speare, R. and Hyatt, A. (1999) *Chytrid Fungi and Amphibian Declines: Overview, Implications and Future Directions*. In Campbell, A. (Ed) (1999) *Declines and Disappearances of Australian Frogs.* Environment Australia, Canberra.

Beyer, G., Goldingay, R. and Sharpe, D.J. (2008) The characteristics of squirrel glider (*Petaurus norfolcensis)* den trees in subtropical Australia. *Australian Journal of Zoology* 56: 13-21.

Birds Australia (2009) *Database Records for the Search Area: -31 50 to 32 45 and 151 23 to 152 28.*

Blakers, M., Davies, S.J. and Reilly, P.N. (1984) *The Atlas of Australian Birds*. Royal Australian Ornithologists Union and Melbourne University Press, Melbourne.

Botanic Gardens Trust (2009a) *Xanthium occidentale* Bertol.
Website: http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Xanthium~occidentale
Date Retrieved: 14 October 2009.

Botanic Gardens Trust (2009b) *Chrysanthemoides monilifera* (L.) Norl.
Website: http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Chrysanthemoides~monilifera
Date Retrieved: 14 October 2009.

Botanic Gardens Trust (2009c) *Blackberry.*
Website: http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&search=yes&namesearch=rubus&dist=&constat=I
Date Retrieved: 14 October 2009.

Botanic Gardens Trust (2009d) *Ageratina adenophora* (Spreng.) R.M.King & H.Rob.
Website: http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Ageratina~adenophora
Date Retrieved: 14 October 2009.

Botanic Gardens Trust (2009e) *Lantana camara.*
Website: http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Lantana~camara
Date Retrieved: 14 October 2009.

Brown, P.B. (1989) *The Swift Parrot Lathamus discolor: A Report on Its Ecology, Distribution and Status*, *Including Management Considerations*. Technical Report. Department of Lands, Parks and Wildlife, Hobart.

Bureau of Meteorology (2009) *Climate Statistics for Girvan State Forest Weather Station.* Website: http://www.bom.gov.au/climate/averages/tables/cw_061022.shtml

Busnel, R.G. (1978) *Introduction*. In J.L. Fletcher and R.G. Busnel (Eds) *Effects of Noise on Wildlife*. Academic Press, New York.

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

Debus, S.J.S. (1994) The Sooty Owl *Tyto tenebricosa* in New South Wales. *Aust. Birds* 28 (Suppl.): S4-S19.

Debus, S.J.S. (1995) *Bird Survey of the Proposed Duralie Coal Mine Site, Stroud*. Appendix Gd in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

Debus, S.J.S. (1997) The Barking Owl in New South Wales*. Australian Birds* 30: 53-80.

Department of Environment and Climate Change (2007a) *Indicative Coastal Floodplain Endangered Ecological Community (EEC) Map Series – Dungong (9233).*

Department of Environment and Climate Change (2007b) *River-flat Eucalypt Forest on Coastal Floodplain. Identificaton Guidelines for Endangered Ecological Communities*.

Department of Environment and Climate Change (2008) *Recovery Plan for the Koala (Phascolarctos cinereus)*.
Website: http://www.environment.nsw.gov.au/resources/threatenedspecies/08450krp.pdf
Date Retrieved: 16 September 2009.

Department of Environment and Conservation (2004a) *Threatened Biodiversity Survey and Assessment Guidelines*.

Department of Environment and Conservation (2004b) *Environmental Guidelines for the Use of Effluent by Irrigation.*

Department of Environment and Conservation (2005a) *Guthrie's Grevillea – Profile.*
Website: http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10364
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005b) *White-flowered Wax Plant – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10196
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005c) *Swift Parrot – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10455
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005d) *Brown Treecreeper – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10171
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005e) *Speckled Warbler – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10722
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005f) *Grey-crowned Babbler – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10660
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005g) *Brush-tailed Phascogale – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10613
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005h) *Squirrel Glider – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10604
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005i) *Eastern Freetail-bat – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10544
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005j) *Large-footed Myotis – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10549
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005k) *Eastern Bentwing-bat – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10534
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005l) *Freckled Duck – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10771
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005m) *Grey Falcon – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10330
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005n) *Bush Stone-curlew – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10113
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005o) *Rose-crowned Fruit-dove – Profile*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10708
Date retrieved: 9 September 2009.

Department of Environment and Conservation (2005p) *Gang-gang Cockatoo – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10975
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005q) *Turquoise Parrot – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10555
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005r) *Regent Honeyeater – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10841
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005s) *Hooded Robin (south-eastern form) – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10519
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005t) *Olive Whister – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10583
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005u) *Diamond Firetail – Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10768
Date Retrieved: 17 September 2009.

Department of Environment and Conservation (2005v) *Yellow-bellied Glider– Profile.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10601
Date Retrieved: 17 September 2009.

Department of Environment and Conservation and Department of Primary Industries (2005) *Draft Guidelines for Threatened Species Assessment.*

Department of Environment, Climate Change and Water (2009a) *Webpage*.
Website: http://www.environment.nsw.gov.au/
Date Retrieved: 14 September 2009.

Department of Environment, Climate Change and Water (2009b) *Atlas of NSW Wildlife Records for the Search Area: 350000E, 6376000N, 450000E, 6476000N.*

Department of Environment, Climate Change and Water (2009c) *Search the Atlas of NSW Wildlife*.
Website: http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp
Date Retrieved: 14 September 2009.

Department of Environment, Climate Change and Water (2009d) *Field Survey Methods.*
Website: http://www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm
Date retrieved: September 2009.

Department of Environment, Climate Change and Water (2009e) *Vegetation Type Database.*
Website: http://www.environment.nsw.gov.au/
Date retrieved: September 2009.

Department of Environment, Climate Change and Water (2009f) *Threatened Species Home Page.*
Website: www.threatenedspecies.environment.nsw.gov.au
Date retrieved: September 2009.

Department of Environment, Climate Change and Water (2009g) *Critical Habitat Register.*
Website: http://www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm
Date Retrieved: 16 September 2009.

Department of Environment, Climate Change and Water (2009h) *Threatened Species, Popuations and Ecological Communities in the Karuah Manning CMA sub-region.*
Website: www.threatenedspecies.environment.nsw.gov.au
Date retrieved: September 2009.

Department of Environment, Climate Change and Water (2009i) *Principles for the Use of Biodiversity Offsets in NSW*.
Website: http://www.environment.nsw.gov.au/biocertification/offsets.htm
Date Retrieved: September 2009.

Department of Environment, Climate Change and Water (undated a) *Monkerai Nature Reserve*.
Website: http://www.environment.nsw.gov.au/NationalParks/parkHome.aspx?id=N0747
Date Retrieved: 14 September 2009.

Department of Environment, Climate Change and Water (undated b) *Ghin-doo-ee National Park.*
Website: http://www.environment.nsw.gov.au/NationalParks/parkHome.aspx?id=N0125
Date Retrieved: 14 September 2009.

Department of Industry and Investment (2009) *Dungong 1:100,000 Geology Mapsheet.*
Data Received: September 2009.

Department of Land and Water Conservation (2004) *NSW Groundwater Dependent Ecosystem Policy*.

Department of Primary Industries (2005a) *Weed Profile: Bitou Bush*.

Department of Primary Industries (2005b) *Weed Management Guide – Blackberry – Rubus fruticosus aggregate*.

Department of Primary Industries (2005c) *Fact Sheet – Crofton Weed.*

Department of Primary Industries (2005d) *Weed Management Guide –Lantana – Lantana camara.*

Department of Primary Industries (2008) *Primefacts – Lantana.*

Department of Primary Industries - Fisheries (2009a) *Policy and Guidelines for Fish Friendly Waterway Crossings.*

Department of Primary Industries - Fisheries (2009b) *Register of Critical Habitat.*
Website: http://www.dpi.nsw.gov.au/fisheries/species-protection/species-conservation/what/register-of-critical-habitat
Date Retrieved: 14 September 2009.

Department of the Environment and Heritage (2006) *Significant Impact Guidelines – Matters of National Enironmental Signficance.*

Department of the Environment, Water, Heritage and the Arts (2009a) *Webpage.*
Website: http://www.environment.gov.au/
Date Retrieved: 14 September 2009.

Department of the Environment, Water, Heritage and the Arts (2009b) *Protected Matters Database Records within a Search Area between -31.8612, 151.3811, -32.7747, 151.3811, -32.7747, 152.4864, -31.8612, 152.4864.*

Department of the Environment, Water, Heritage and the Arts (2009c) *Register of Critical Habitat.*
Website: http://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl
Date Retrieved: 14 September 2009.

Dowling B, (2001) *Bowens Road North Project Flora Survey and Assessment*. Report prepared for Stratford Coal Pty Ltd.

Duncan, A., Baker, G.B. and Montgomery, N. (1999) *The Action Plan for Australian Bats*. Environment Australia, Canberra.

Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

Duralie Coal Pty Ltd (2002) *Duralie Coal Mine Vegetation Clearance Protocol.*

Duralie Coal Pty Ltd (2006) *Duralie Extended Modification Statement of Environmental Effects.*

Duralie Coal Pty Ltd (2007a) *Annual Environmental Management Report Duralie Coal Mine.*

Duralie Coal Pty Ltd (2007b) *Duralie Coal Mine Rehabilitation Management Plan.*

Duralie Coal Pty Ltd (2007c) *Duralie Coal Mine Noise Monitoring Plan.*

Duralie Coal Pty Ltd (2007d) *Duralie Coal Mine Air Quality Monitoring Program (Incorporating Air Quality Management).*

Duralie Coal Pty Ltd (2008a) *Annual Environmental Management Report.*

Duralie Coal Pty Ltd (2008b) *Duralie Coal Mine Irrigation Management Plan*.

Duralie Coal Pty Ltd (2008c) *Duralie Coal Mine Site Water Management Plan.*

Eby, P. (2000) A *Case for Listing Grey-headed Flying-fox Pteropus poliocephalus as Threatened in NSW under IUCN Criterion A2*. In Richards, G. (2000) (ed.) *Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox in New South Wales.* Australasian Bat Society Inc.

EcoBiological (2009a) *Flora and Fauna Survey Report: Duralie Coal Mine*, *Gloucester, New South Wales.*

EcoBiological (2009b) *Flora and Fauna Surrvey Report: Gloucester Coal Properties East of Bucketts Way, Gloucester, New South Wales*.

Eller, B. M. (1977) Road Dust Induced Increase in Leaf Temperature. *Environmental Pollution* 13: 99-107.

Environmental Management and Planning Services (1996) *Aquatic Environmental Studies Duralie Coal Project New South Wales - Baseline Surveys August 1995 – March 1996.* Appendix Ge in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

ERM Mitchell McCotter (1996a) *Flora Survey for Proposed Duralie Coal Mine Near Gloucester*. Appendix Fa in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

ERM Mitchell McCotter (1996b) *Winter Fauna Survey for Proposed Duralie Coal Mine Near Gloucester.* Appendix Ga in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

Farmer, A. M. (1993) The Effects of Dust on Vegetation – A Review. *Environmental Pollution* 79: 63-75.

Flegg, J. (2002) *Birds of Australia*. New Holland Publishers Pty Ltd, Sydney.

FloraSearch (2005) *Vegetation Mapping and Targeted Threatened Flora Species Search for Duralie Extended*.

Floyd, A. (1990) *Australian Rainforest in New South Wales*. Survey Beatty & Sons Pty Ltd.

Fly-by-Night Bat Surveys Pty Ltd (1996) *Winter Survey of the Bat Fauna of the Proposed Duralie Coal Mine near Gloucester, New South Wales.* Attachment GaB in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

Frith, H.J. (1977) *Waterfowl in Australia*. Angus and Robertson Sydney. In Gardner, J.L. (2002) Breeding Biology of the Speckled Warbler (*Chthonicola sagittata*). *Australian Journal of Zoology* 50: 169-181.

Gardner, J.L. (2004) Winter flocking behaviour of Speckler Warblers and the Allee effect. *Biological Conservation* 118: 195-204.

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

Gibbons, P. and Boak, M. (2008) The value of paddock trees for regional conservation in an agricultural landscape. *Ecological Management & Restoration* 3(3): 205-210.

Gibbons, P., Lindenmayer, D.B., Barry, S.C. and Tanton M.T. (2002) Hollow selection by vertebrate fauna in forests of southeastern Australia and implications for forest management. *Biological Conservation* 103(1): 1-12.

Gilbert & Associates (2009) *Duralie Extension Project Surface Water Assessment*.

Goldney, D.C. and Cox, S.J. (1996) *An Assessment of the Impacts on the Platypus Population in the Mammy Johnsons River Associated with the Proposed Duralie Coal Mine Project*. Appendix Gf in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement*.

Goodrick, G.N. (1970) *A survey of wetlands of coastal New South Wales*. Technical Memorandum No. 5. CSIRO, Canberra.

Great Lakes Council (2006) *Plants Declared Noxious.* Website: http://www.greatlakes.local-e.nsw.gov.au/files/75609/File/Declared.pdf Retrieved: 16 September 2009.

Great Lakes Council (2008) *Noxious Weeds.* Website: http://www.greatlakes.local-e.nsw.gov.au/environment/74341/74371.html Date Retrieved: 16 September 2009.

Great Lakes Council (2009) *Draft Great Lakes Local Environmental Plan (Amendment No 44)*. Website: http://www.greatlakes.nsw.gov.au/planbld/GLLocalEnvironPlan.htm

Greg Richards and Associates (2001) *An Assessment of the bat fauna at the proposed Bowens Road North Project, via Stratford, New South Wales.* Report prepared for Stratford Coal Pty Ltd.

Hall, L.S. and Richards, G. (2000) *Flying Foxes: Fruit and Blossom Bats of Australia*. UNSW Press: Sydney.

Harden, G.J. (ed.) (2000) *Flora of New South Wales Volume 1.* NSW University Press, Sydney.

Henderson, L. E. (2000) *Soil Landscapes of the Dungog 1:100 000 Sheet.* Department of Land and Water Conservation.

Heritage Computing (2009) *Duralie Extension Project Groundwater Assessment.* Report prepared for Duralie Coal Pty Ltd.

Higgens, P J. (1998) *Handbook of Australian, New Zealand and Antarctic Birds, Volume 4.* Oxford University Press, Melbourne.

Hines, H. B. and the South-east Queensland Threatened Frogs Recovery Team (2002) *Recovery Plan for Stream Frogs of South-east Queensland 2001-2005.* Report to Environment Australia, Canberra. Queensland Parks and Wildlife Service, Brisbane.

House, S. (2003) *Lower Hunter & Central Coast Regional Biodiversity Conservation Strategy, Technical Report, Digital Aerial Photo Interpretation & Updated Extant Vegetation Community Map, May 2003*. Lower Hunter & Central Coast Regional Environmental Management Strategy, Callaghan, NSW.

Hoye, G.A. and Dwyer, P.D. (1998) *Large-eared Pied Bat (Chalinolobus dwyeri).* In Strahan, R. (1998) (ed.) *The Mammals of Australia.* New Holland Publishers, Sydney.

Hoye, G.A. and Richards, G.R. (1995) *Greater Broad-nosed Bat Scoteanax rueppellii*. In Strahan, R. (Ed.) *The Mammals of Australia*. Frenchs Forest: New Holland Publishers Pty Ltd.

Institute for Environmental Monitoring and Research (2001) *Fifth Annual Report*. New Brunswick, Canada.

Invertebrate Identification Australasia (2008a) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 1*, *September 2002*.

Invertebrate Identification Australasia (2008b) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 2, March 2003.*

Invertebrate Identification Australasia (2008c) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 3, September 2003.*

Invertebrate Identification Australasia (2008d) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 4, March 2004*.

Invertebrate Identification Australasia (2008e) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 5, June 2004*.

Invertebrate Identification Australasia (2008f) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 6, September 2004*.

Invertebrate Identification Australasia (2008g) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 7, March 2005*.

Invertebrate Identification Australasia (2008h) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 8, September 2005*.

Invertebrate Identification Australasia (2008i) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 9, April 2006*.

Invertebrate Identification Australasia (2008j) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 10, September 2006*.

Invertebrate Identification Australasia (2008k) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 11, March 2007*.

Invertebrate Identification Australasia (2008l) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 12, September 2007*.

Invertebrate Identification Australasia (2008m) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 13, February 2008*.

Invertebrate Identification Australasia (2008n) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 14, September 2008*.

Invertebrate Identification Australasia (2009) *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine, Study 1, Survey 15, March 2009*.

Johnson, G. and Baker-Gabb, D. J. (1994) *The Bush Thick-knee in Northern Victoria (Part 1): Conservation and Management.* Arthur Rylah Institute Technical Report No. 129. In Department of Environment and Conservation (2006) *Recovery Plan for the Bush Stone-curlew, Burhinus grallarius.* Department of Environment and Conservation, NSW.

Kaseloo, P.A. (2005) *Synthesis of Noise Effects on Wildlife Populations*. Department of Biology, Virginia State University.

Keith, D. (2004) *Ocean Shores to Desert Dunes: The Native Vegetation of NSW and ACT.*

King, B.R. (1980) Social organization and behaviour of the Grey-crowned Babbler *Pomatostomus temporalis*. *Emu* 80(2): 59 - 76

Lemckert, F. and Brassil, T. (2000) Movements and habitat use of the endangered giant barred river frog (*Mixophyes iteratus*) and the implications for its conservation in timber production forests. *Biological Conservation* 96(2): 177-184.

Lindenmayer, D. (2002) *Gliders of Australia – A Natural History.* University of New South Wales Press, Kensington.

Lindenmayer, D. and Burgman, M. (2005) *Practical Conservation Biology.* CSIRO Publishing, Collingwood, Australia.

Lynch, T. E. and Speake, D. W. (1978) *Eastern Wild Turkey Behavioural Responses Induced by Sonic Boom.* In J. L. Fletcher and R. G. Busnel (1978) (eds.) *Effects of Noise on Wildlife.* Academic Press, New York.

Marchant, S. and Higgins, P.J. (1990) (Eds.) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 1: Ratites to Ducks: Part A Ratites to Petrels*. Oxford University Press, Melbourne.

Marchant, S. M. and Higgins, P. J. (1993) (Eds.) *Handbook of Australian, New Zealand and Antarctica Birds. Volume 2: Raptors to Lapwings.* Oxford University Press, Melbourne. In Ayers, D., Nash, S. and Bagget, K. (1996) *Threatened Species of Western New South Wales.* NSW National Parks and Wildlife Service, Hurstville.

Morcombe, M. (2004) *Field Guide to Australian Birds: Complete Compact Edition*. Steve Parish Publishing.

Mount King Ecological Surveys (2001) *Bowns Road North Project, Stratford: Fauna Survey and Assessment.* Appendix FA in Resource Strategies (2001) *Bowens Road North Project Environmental Impact Statement.* Report prepared for Stratford Coal.

National Koala Conservation and Management Strategy Steering Committee (2009) *National Koala Conservation and Management Strategy 2009 – 2014.*

National Parks and Wildlife Service (1999a) *Forest Ecosystem Classification and Mapping for the Upper and Lower North East CRA Regions.* A project undertaken for the Joint Commonwealth NSW Regional Forest Agreement Steering Committee as part of the NSW Comprehensive Regional Assessments.

National Parks and Wildlife Service (1999b) *Threatened Species Information – Squirrel Glider*.

National Parks and Wildlife Service (1999c) *Threatened Species Information – Australasian Bittern.*

National Parks and Wildlife Service (1999d) *Threatened Species Information – Bush Stone-curlew.*

National Parks and Wildlife Service (1999e) *Threatened Species Information – Spotted-tailed Quoll.*

National Parks and Wildlife Service (1999f) *Threatened Species Information – Yellow-bellied Glider.*

National Parks and Wildlife Services (2000a) *Lower Hunter Central Coast Extant Vegetation Community Map and Technical Report.*

National Parks and Wildlife Services (2000b) *Threatened Species of the Lower North Coast of New South Wales.* NSW National Parks and Wildlife Service, Coffs Harbour.

National Parks and Wildlife Service (2001a) *Hygiene Protocol for the Control of Disease in Frogs.*

National Parks and Wildlife Service (2001b) *Threatened Species Information - Syzygium paniculatum*.

National Parks and Wildlife Service (2008) *Monkerai Nature Reserve Plan of Management.* NSW National Parks and Wildlife Service.

National Water Quality Management Strategy (2006) *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1).*

Noss, R. F. (1991) *Landscape connectivity: different functions at different scales*. In Hudson, W. E. (Ed) *Landscape Linkages and Biodiversity.* Island Press, Covelo.

NSW Agriculture (2004) *Noogoora Burr and Californian Burr*. Agfacts, third edition.

NSW Government (2009) *Database Records within a Search Area between 151.4, -32.75, 152.4, -31.85.*

NSW Scientific Committee (1999a) *Invasion of Native Plant Communities by Bitou Bush and Boneseed.*
Website: http://www.environment.nsw.gov.au/committee/ListOfScientificCommitteeDeterminations.htm
Date Retrieved: 6 October 2009.

NSW Scientific Committee (1999b) *Giant Barred Frog – endangered species listing*.
Website: http://www.environment.nsw.gov.au/determinations/GiantBarredFrogEndSpListing.htm
Date Retrieved: 6 October 2009.

NSW Scientific Committee (2000a) *Predation by the Feral Cat.*
Website: http://www.environment.nsw.gov.au/committee/ListOfScientificCommitteeDeterminations.htm
Date Retrieved: 6 October 2009.

NSW Scientific Committee (2000b) *Ecological Consequences of High Frequency Fires.*
Website: http://www.environment.nsw.gov.au/committee/ListOfScientificCommitteeDeterminations.htm
Date Retrieved: 6 October 2009.

NSW Scientific Committee (2001a) *Final Determination for Brown Treecreeper (Eastern sub-species) (Climacteris picumnus victoriae).*

NSW Scientific Committee (2001b) *Final Determination for the Speckled Warbler.*

NSW Scientific Committee (2001c) *Black-chinned Honeyeater (eastern subspecies) – vulnerable species listing.*
Website: http://www.environment.nsw.gov.au/determinations/BlackchinnedHoneyeaterVulSpListing.htm
Date Retrieved: 6 October 2009.

NSW Scientific Committee (2001d) *Hooded Robin (southeastern form) – vulnerable species listing.*
Website: http://www.environment.nsw.gov.au/determinations/HoodedRobinSoutheasternFormVulSp Listing.htm
Date Retrieved: 6 October 2009.

NSW Scientific Committee (2002) *Final Determination for Competition and Grazing by the Feral European Rabbit (Oryctolagus cuniculus).*

NSW Scientific Committee (2003a) *Final Determination for Invasion of Native Plant Communities by Exotic Perennial Grasses.*

NSW Scientific Committee (2003b) *Final Determination for Infection of Frogs by Amphibian Chytrid Causing the Disease Chytridiomycosis.*

NSW Scientific Committee (2004) *Final Determination for Predation by the European Red Fox (Vulpes vulpes).*

NSW Scientific Committee (2005) *Gang-gang Cockatoo – vulnerable species listing.*
Website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10975
Date Retrieved: 6 October 2009.

NSW Scientific Committee (2006a) *Invasion and Establishment of Exotic Vines and Scramblers.*
Website: http://www.environment.nsw.gov.au/committee/ListOfScientificCommittee Determinations.htm
Date Retrieved: 6 October 2009.

NSW Scientific Committee (2006b) *Invasion, Establishment and Spread of Lantana camara.*
Website: http://www.environment.nsw.gov.au/committee/ListOfScientificCommittee Determinations. htm
Date Retrieved: 6 October 2009.

NSW Scientific Committee (2008a) *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing.*
Website: http://www.environment.nsw.gov.au/determinations/FreshwaterWetlandsEnd SpListing.htm
Date Retrieved: 21 September 2009.

NSW Scientific Committee (2008b) *River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions - Endangered Ecological Community Listing*.
Website: http://www.environment.nsw.gov.au/determinations/RiverflatEucalyptForestEndSp Listing.htm
Date Accessed: 5 October 2009.

NSW Scientific Committee (2008c) *Lowland rainforest on floodplain in the NSW North Coast Bioregion - endangered ecological community listing.*
Website: http://www.environment.nsw.gov.au/determinations/LowlandRainforest NorthCoastEnd ComListing.htm
Date Retrieved: 21 September 2009.

Parnaby, H. A. (1983) *Great Pipistrelle.* In Strahan, R. (Eds.) *The Australian Museum's Complete Book of Australian Mammals*. Angus and Robertson, Sydney.

Paul Webber Consulting Services (1996) *Herpetological Survey of the Proposed Duralie Coal Mine via Gloucester, NSW.* Appendix Gc in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

Payne, R. (1991) New Findings of the rare tree Syzygium paniculatum (Myrtaceae) in theWyong area, New South Wales*. Cunninghamia* 2(3): 495-498.

Payne, R. (1997) *The Distribution and Reproductive Ecology of Syzygium paniculatum and Syzygium australe (Myrtaceae) in the Gosford-Wyong Region.* Unpublished Thesis prepared for the award of Masters of Natural Resources, University of New England. Armidale NSW.

Pellow, B.J., Henwood, M.J. and Carolin, R.C. (2009) *Flora of the Sydney Region – Fifth Edition*.

Phillips, W. (1995) *Eastern False Pipistrelle*. In Strahan, R. (ed.) *The Mammals of Australia*. Frenchs Forest: New Holland Publishers Pty Ltd.

Phillips, W. (1998) *Eastern False Freetail-bat (Falsistrellus tasmaniensis).* In Strahan, R. (1998) (ed.) *The Mammals of Australia.* New Holland Publishers, Sydney.

Pizzey, G. and Knight, F. (1999) *Field Guide to the Birds of Australia.* Harper Collins Publishers, Sydney, Australia.

Pizzey, G. and Knight, F. (2006) *Field Guide to the Birds of Australia.* Harper Collins Publishers, Sydney, Australia.

Place Planning and Design (2003) *Duralie Coal Mine – Pre-clearance Survey and Habitat Assessment*.

Planning NSW (2004) *Joint Vegetation Mapping Project NSW Western Regional Assessments, Brigalow Belt South Bioregion.* Report to Resource and Conservation Assessment Council NSW Western Regional Assessments Project WRA/24. Planning NSW, Dubbo.

Poole, G. (1982) *Sound Advice Poultry Notes.* NSW Department of Agriculture and Fisheries.

Quin, D. G. (1993) *Sociology of the Squirrel Glider and the Sugar Glider.* PhD Thesis. University of New England, Armidale.

Quin, D.G. (1995) Population Ecology of the Squirrel Glider (*Petaurus norfolcensis*) and the Sugar Glider (*P. breviceps*) (Marsupialia:Petauridae) at Limeburners Creek, on the Central North Coast of New South Wales. *Wildlife Research* 22: 471-505.

Radle, A.L. (2007) *The Effect of Noise on Wildlife: A Literature Review*. College of Education, University of Oregon, Eugene, Oregon.

Richard Heggie Associates (1997) *Cowal Gold Project Noise, Transportation and Blasting Impact Statement.*

Robinson, M. (1998) *A Field Guide to Frogs of Australia.* Reed New Holland, Australia.

Rowston, C., Catterall, C.P. and Hurst, C. (2002) Habitat preferences of squirrel gliders, *Petaurus norfolcensis*, in the fragmented landscape of southeast Queensland. *Forest Ecology and Management* 164(1-3): 197-209.

Royal Botanic Gardens & Domain Trust (1999) *Grevillea guthrieana* Olde & Marriott.
Available at: http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Grevillea~guthrieana
Date Accessed: 14 October 2009.

Schodde, R. and Mason, I.J. (1980) *Nocturnal Birds of Australia.* Landsdowne, Melbourne.

Schulz, M. (1998) Bats and other fauna in disused Fairy Martin *Hirundo arial* nests. *Emu* 98: 184–191.

Serventy, V. N. (1985) *The Waterbirds of Australia. National Photographic Index of Australian Wildlife.* Angus and Robertson, Sydney.

Shaw, E. A. (1978) *Symposium of the Effects of Noise on Wildlife.* In J.L. Fletcher and R. G. Busnel (eds.) (1978) *Effects of Noise on Wildlife.*

Slater, P., Slater, P. and Slater, R. (1986) *The Slater Field Guide to Australian Birds*. Weldon Publishing, Australia.

Smith, P.J., Smith, J.E., Pressey, R.L. and Whish, G.L. (1995) *Birds of Particular Conservation Concern in the Western Division of New South Wales: Distributions, Habitats and Threats*. National Parks and Wildlife Service Occasional Paper 20. New South Wales National Parks and Wildlife Service, Hurstville.

Soderquist, T. (1998) *Brush-tailed Phascogale (Phascogale tapoatafa*).

Spencer, W.B. (1896) *Summary of Results.* Pages 139-99 in Spencer, W.B. (ed.) (1896) *Reports of the Work of the Horn Scientific Expedition to Central Australia.* Dulau: London.

Streeter, I.P., Moore, R.T., Skinner, J.J., Martin, S.G., Terrel, T.L., Klimstra, W.D., Tate, J. Jnr. and Nolde, M.J. (1979) *Energy Impacts and Wildlife Management: Which Way to Turn?* Proceedings of the 44th North American Wildlife Conference.

Suckling, G.C. (1998) *Squirrel Glider.* In Strahan, R. (1998) (ed.) *The Mammals of Australia.* New Holland Publishers, Sydney.

Swift Parrot Recovery Team (2001) *Swift Parrot Recovery Plan.* Department of Primary Industries, Water and Environment, Hobart.

Sydney Royal Botanic Gardens (2009) *Sydney Royal Botanical Gardens Database Records within a Search Area: -31.85, 151.4, -31.85, 152.4, -32.75, 152.4, -32.75, 151.4.*

Tanton, M.T.T. (1994) *Fauna Impact Statement. Proposed Foresty Operations in the Eden Mangement Area. Environmental Impact Statement.* Vol. B: Appendix 1. State Forests of NSW, Sydney. In National Parks and Wildlife Service (1999) *Threatened Species Information – Yellow-bellied Glider (Petaurus australis).*

Tidemann, C.R. (1998) *Grey-headed Flying-fox*, *Pteropus poliocephalus.* In Strahan, R. (ed.) *The Mammals of Australia*. Frenchs Forest: New Holland Publishers Pty Ltd.

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

van der Ree, R. (2002) The population ecology of the squirrel glider (*Petaurus norfolcensis*) within a network of remnant linear habitats. *Wildlife Research* 29(4): 329–340.

van der Ree, R. and Bennett, A.F. (2003) Home range of the squirrel glider (*Petaurus norfolcensis*) in a network of remnant linear habitats. *Journal of Zoology* 259(4): 327-336.

van der Ree, R., Bennett, A.F. and Gilmore, D.C. (2004) Gap-crossing by gliding marsupials: thresholds for use of isolated woodland patches in an agricultural landscape. *Biological Conservation* 115(2): 241-249.

van der Ree, R., Bennett, A.F. and Soderquist, T.R. (2006) Nest-tree selection by the threatened brush-tailed phascogale (*Phascogale tapoatafa*) (Marsupialia: Dasyuridae) in a highly fragmented agricultural landscape. *Wildlife Research* 33: 113–119.

van der Ree, R., Soderquist, T.R. and Bennett, A.F. (2001) Home-range use by the brush-tailed phascogale (*Phascogale tapoatafa*) (Marsupialia) in high-quality, spatially limited habitat. *Wildlife Research* 28(5) 517–525.

Van Dyck, S. and Strahan, R. (Eds.) (2008) *The Mammals of Australia*. 3rd Edition, New Holland Publishers.

Wall, J.P. (2004) *Biodiversity Surrogates: Vegetation.* A report to the Resource and Conservation Assessment Council for the Nandewar Western Regional Assessment.

Walters, J.R., Ford, H.A. and Cooper, C.B. (1999) The ecological basis of sensitivity of brown treecreepers to habitat fragmentation: a preliminary assessment. *Biological Conservation* 90(1): 13-20.

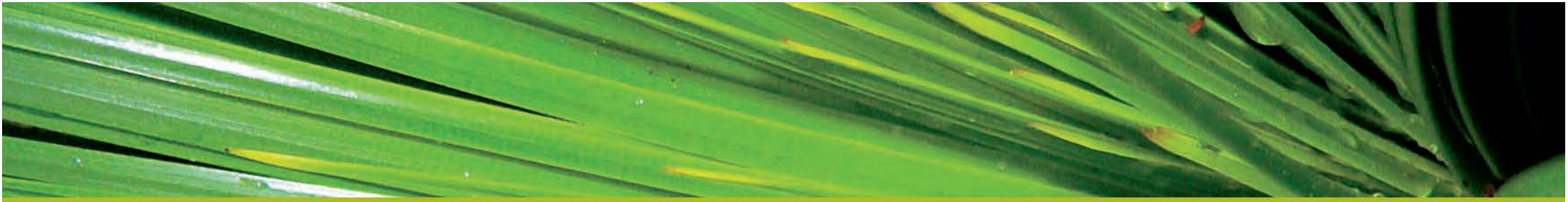
Woodward-Clyde (1996a) *Determination of Significant Effects on Threatened Species, Populations or Ecological Communities, or their Habitats. Section 5A – Environmental Planning and Assessment Act (As Amended)*. Attachment GbA in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement*.

Woodward-Clyde (1996b) *Summer Flora Report.* Appendix Fb in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement*.

Woodward-Clyde (1996c) *Summer Fauna Report.* Appendix Gb in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement*.

ATTACHMENT EA

FLORA AND FAUNA SURVEY REPORT:
DURALIE COAL MINE (ECOBIOLOGICAL, 2009a)



ecobiological

survey & assessment

Flora and Fauna Survey Report:

Duralie Coal Mine, Gloucester, New South Wales.

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July 2009

Report prepared for Gloucester Coal Pty Ltd.

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Executive Summary

EcoBiological was commissioned by Gloucester Coal Pty Ltd to undertake flora and fauna surveys for theDuralie Coal Mine operations in Gloucester, NSW.

A list of threatened flora and fauna reported from the local area was compiled from data obtained from the National Parks and Wildlife Service (NPWS) Atlas of NSW Wildlife, and from a variety of other databases and reports.

Field surveys were conducted between April 2007 and April 2009.

Flora

Data collected during the field surveys revealed that the study area supported 331 plant species within nine defined natural vegetation communities and areas of disturbed land.

Three Endangered Ecological Communities (EECs) have been determined to occur within the study area. The Riparian Closed Forest is determined to form a part of the *Lowland rainforest on floodplain in the NSW North Coast Bioregion* EEC. The Cabbage Gum Floodplain Forest constitutes part of the *River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC. The Freshwater Wetland Complex would form a part of the *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC.

Fauna

A total of 156 species of fauna were recorded across the study area, including 11 threatened species listed under the TSC Act (Squirrel Glider, Brush-tailed Phascogale, Koala, Eastern Bentwing-bat, Eastern Freetail-bat, Large-footed Myotis, Swift Parrot, Brown Treecreeper, Speckled Warbler, Grey-crowned Babbler and Giant Barred Frog).

Two of these species (Swift Parrot and Giant Barred Frog) are also listed as Endangered under the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act).

Definitions

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

Arboreal – living in a tree or trees. Contrasted with *terrestrial*, living on the ground; *aquatic*, living in water; *amphibious*, living on land and in the water.

Aquatic – living in the water.

Cryptic – hidden. A cryptic species is one that is difficult to detect in the natural environment.

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.

Exudate – a substance that has been exuded. Used here mainly to refer to the gums of certain trees and the nutritious excreta of some sap sucking insects.

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.

Insectivorous – feeding on insects and other arthropods.

Jaw sheaths – used here in reference to the hard, black sheath of keratin (similar to fingernails or horn) over the upper and lower jaw cartilage in tadpole mouthparts.

Lentic – living in still water.

Life cycle – the series or stages of reproduction, growth, development, aging and death of an organism.

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.

Papillae – small, nipple-like, fleshy projections around a tadpole's oral disk.

Range – this term has the same meaning as *distribution*, which is a better term.

Rapid Data Point – field survey method used in vegetation mapping.

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.

Spiracle – referred to here as the external tube which expels water used for respiration from the gills of tadpoles.

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

Taxon – the scientific name of a category of animals. The practice and study of naming organisms is known as *taxonomy*.

Terrestrial – living on the ground.

Territory – an area occupied by one or more individuals and defended against other members of the species. A territory is usually centred on a more or less permanent nest, burrow, den or resting place.

Viable – the capacity to successfully complete each stage of the life cycle under normal conditions.

Abbreviations

DECC Department of Environment and Climate Change

EEC Endangered Ecological Community

EP&A Act *Environmental Planning and Assessment Act* 1979

EPBC Act *Environment Protection and Biodiversity Conservation Act* 1999

GIS Geographic Information System

GPS Global Positioning System

ha hectares

km kilometres

LEP Local Environment Plan

LGA Local Government Authority

NPWS National Parks and Wildlife Service

RDP Rapid Data Point (field survey method used in vegetation mapping)

ROTAP Rare or Threatened Australian Plants

SEPP State Environment Planning Policy

sp Species (singular)

spp Species (plural)

subsp subspecies

TSC Act *Threatened Species Conservation Act* 1995

var. variety

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1. Introduction

1.1. Scope

EcoBiological was commissioned by Gloucester Coal Pty Ltd to conduct flora and fauna surveys at the Duralie mine. The location of the study area (area of investigation) is shown in Figure 1.

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 approximately 1009 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 that adjoins the study area is shown in Figure 2.

1.3. Geology, Topography and Soils

The study area is comprised of three soil landscapes including Gloucester Bucketts, Stroud Road and Gloucester River landscapes.

Gloucester Bucketts landscape is characterised by rolling to very steep hills on Permian basic and acidic volcanics and sediments in the Stroud-Gloucester Basin and Karuah Mountains region to the east. Relief ranges from 60-350m, elevation is between 100-550m, and slopes range from 25 to >50% (Henderson, 2000). Surface boulders and rock outcrop are common across the terracetting and hummocky terrain, with occasional small (30-50m) scarps. Soils consist of moderately deep, well-drained Bleached Leptic Tenosols (Lithosols) and shallow, rapidly drained Clastic Rudosols (Lithosols) on upper slopes and ridges on rhyolites and acid volcanics (Henderson, 2000). Moderately deep, well-drained Chernic-Leptic Tenosols (Lithosols or soils of no suitable group) also occur on steep basaltic slopes (Henderson, 2000). Geology and regolith consists of Permian Alum Mountain Volcanics including basalt, rhyolites, rhyolitic ignimbrite, pyroclastic breccias, andesites, trachybasalts, shale, conglomerate, sandstone, siltstone, and minor coal (Henderson, 2000).

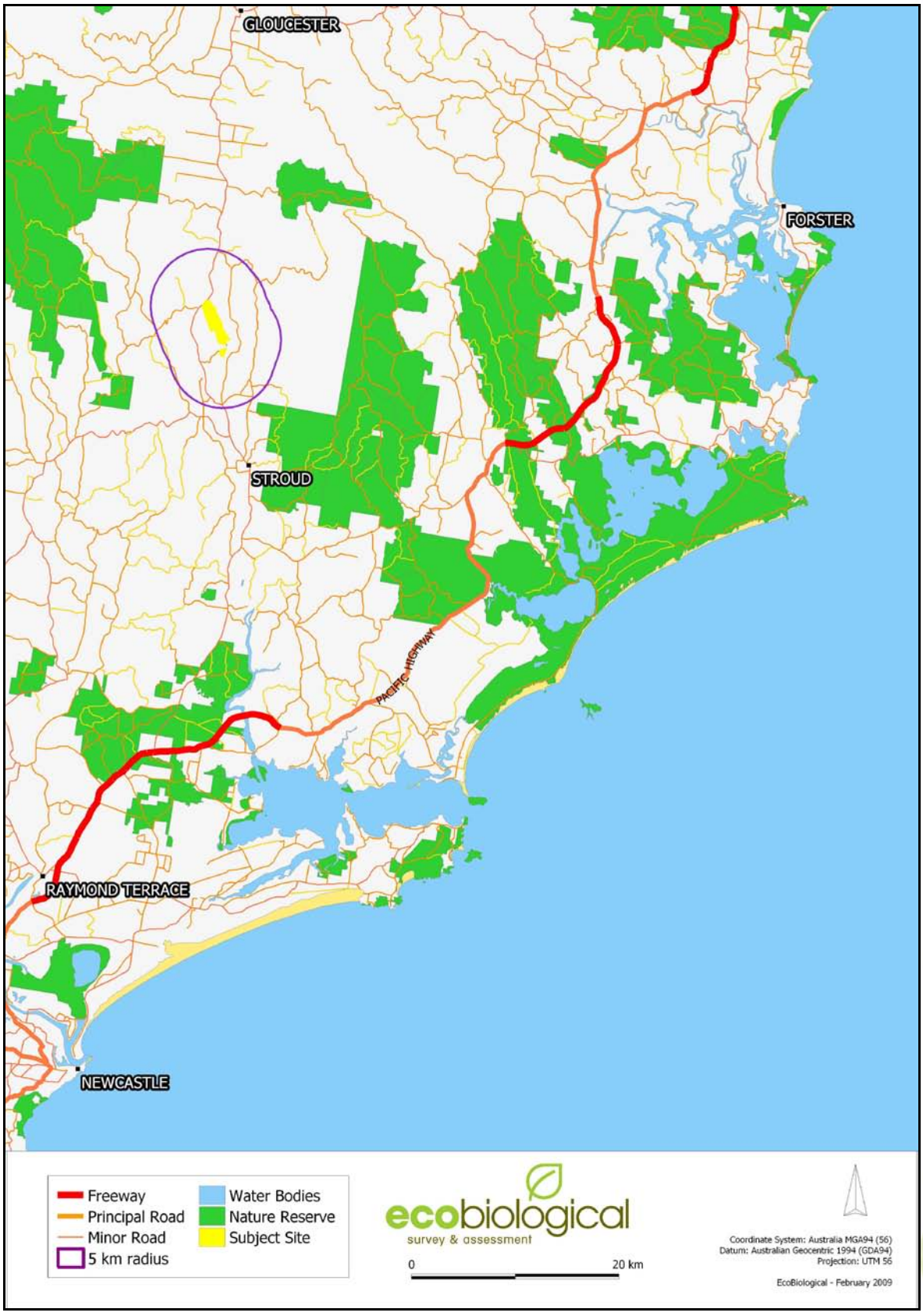


Figure 1: The location of the study area within the surrounding region.

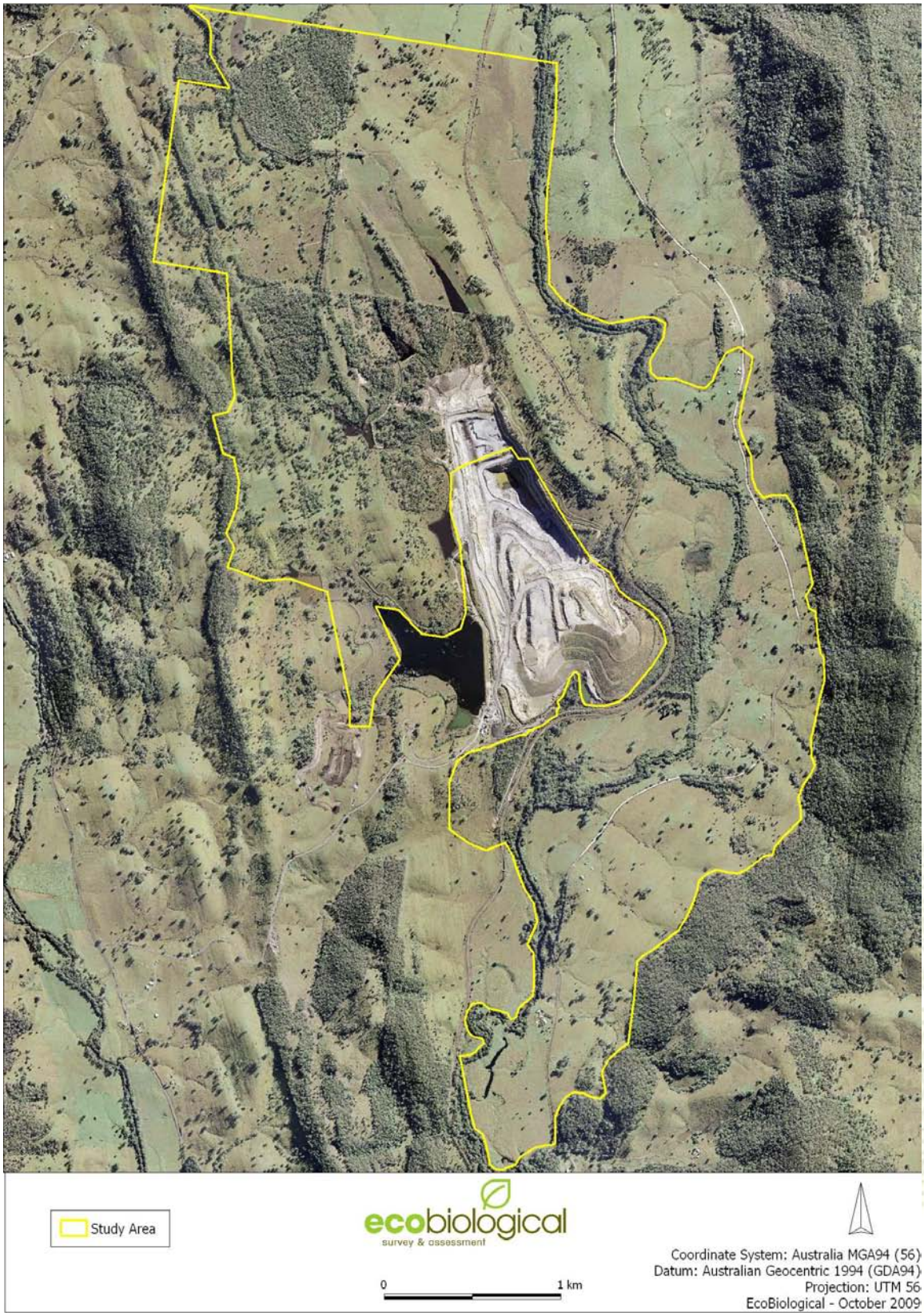


Figure 2: Aerial photograph showing the study area and surrounding landscape.

The Stroud Road landscape is characterised by rolling to undulating low hills on Permian Alum Mountain Volcanics in the Stroud-Gloucester Basin region in the south-eastern part of the sheet. Relief is between 40-90m with elevation ranging from 80-160m and slopes of 2 to <25% (Henderson, 2000). Moderately broad crests, convex upper slopes and moderately broad (20-50m) drainage plains occur throughout (Henderson, 2000). On sandstone and rhyolite ridges, between 2 and 10% rock outcrop occurs (Henderson, 2000). Soils consist of moderately deep, well-drained Vertic Brown Dermosols (Chocolate Soils; some Brown Clays) with moderately deep, well-drained Red Ferrosols (Krasnozems); moderately deep, well-drained Chernic-Leptic Tenosols on basaltic ridge crests; and deep imperfectly drained Black Vertosols (Black Earths) on drainage plains (Henderson, 2000). Shallow, rapidly drained Bleached-Leptic Tenosols (Lithosols) on rhyolite, sandstone and conglomerate also occur (Henderson, 2000). Regolith consists of sediments containing conglomerate, sandstone, siltstone and coal (Henderson, 2000). The volcanic suite contains basalt flows, rhyolite and rhyolitic ignimbrite (Henderson, 2000).

Gloucester River landscape consists of broad level alluvial plains in the Stroud-Gloucester Basin region in the north-east of the area. Relief is <1m, elevation ranges from 90-130m, and slopes are <2% (Henderson, 2000). 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 (Henderson, 2000). Regolith consists predominately of alluvial deposits derived from the surrounding Permian sedimentary and volcanic rocks (Henderson, 2000). Also present in the study area is a Gloucester River landscape variant (gua), where alluvium drains from the Permian Alum Mountain Volcanics (Henderson, 2000). Soil types here include Melanic Mesotrophic Brown Dermosols (Chernozems) and Mottled Epipedal Black Vertosols (Black Earths) (Henderson, 2000).

2. Survey Methods

2.1. Data Review, Weather and Logistics

2.1.1. Review of Databases and Literature

A list of threatened flora and fauna reported from the local area (defined as a 5km radius from the study area) was obtained from the Department of Environment and Climate Change database, the Atlas of NSW Wildlife (DECC, 2009).

In addition to a search of the Atlas of NSW Wildlife, a review of past ecological reports carried out in the general area (Debus, 1995; ERM Mitchell McCotter, 1996a; ERM Mitchell McCotter, 1996b; Hoye, 1995; Webber, 1996; Woodward-Clyde, 1996a; Woodward-Clyde, 1996b), EcoBiological consultant records, and a variety of other databases were consulted for any additional threatened species records.

A series of field survey 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 for any species listed on Schedules 1 and 2 of the TSC Act that were considered likely to occur in the type of habitat present in the study area. The likelihood of any 'key threatening processes' occurring in the study area was also assessed.

2.1.2. Weather Conditions and Survey Activities

The study area was surveyed on numerous occasions throughout April, May, July and November 2007; February and August 2008; and January, February and April 2009. A full list of survey activities and weather conditions during the survey period is provided in Table 1. Temperatures, total rainfall and moon information for the survey period are provided in Table 2 (climate data was obtained from Lostock Dam weather station).

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

Activity	Date	Weather Conditions
Flora investigation		
20x20m quadrat surveys and meandering transects	2/05/07, 3/05/07, 7/05/07, 29-30/08/07 7/08/08, 11-14/08/08 24/01/09, 29-30/04/09, 1/04/09	Flora surveys were consistently conducted on fine days, no rain and low wind.
Fauna and fauna habitat investigation		
Fauna trapping	16/4/07 – 20/4/07 6/4/09 – 11/4/09	Calm to light breezes, clear to partly cloudy skies, no rain, mild temperatures
Spotlighting	17/4/07, 18/4/07, 17/7/07, 18/8/08, 30/1/09, 6/4/09, 7/4/09, 8/4/09	Calm to light breeze, mild temperatures, clear to partly cloudy, no rain
Anabat Call Recording	17/4/07, 18/4/07, 17/7/07, 18/8/08, 30/1/09, 6/4/09, 7/4/09	Calm to light breeze, mild temperatures, clear to partly cloudy, no rain
Nocturnal Call Playback	17/4/07, 18/4/07, 17/7/07, 18/8/08, 6/4/09, 7/4/09, 8/4/09, 9/4/09	Calm to light breeze, mild temperatures, clear to partly cloudy, no rain
Bird Survey	18/4/07, 17/7/07, 28/11/07, 18/8/08, 19/8/08, 21/8/08, 7/4/09, 8/4/09, 9/4/09	Calm to light breeze, mild to warm temperatures, clear to partly cloudy, no rain
Amphibian Survey	18/4/07, 19/4/07, 26/11/07, 28/11/07, 29/1/09, 30/1/09, 24/2/09 – 26/2/09, 6/4/09, 9/4/09, 10/4/09	Calm to light breeze, mild to warm temperatures, clear to partly cloudy, no rain
Reptile Survey	19/4/07, 26/11/07, 28/11/07, 29/1/09, 30/1/09, 7/4/09, 8/4/09	Calm to light breeze, mild to warm temperatures, clear to partly cloudy, no rain
SAT Tests	15/2/08, 20/8/08	Calm to light breeze, mild temperatures, clear to partly cloudy, no rain

Table 2: Temperatures, total rainfall and moon information for the survey period.

Date	Temperature (°C)			
	Maximum	Minimum	Rainfall (mm)	Moon Phase
16/04/2007	29.6	15	1.6	Waning crescent
17/04/2007	24.6	15.5	0	New moon
18/04/2007	24.4	13.4	0	Waxing crescent
19/04/2007	25.3	12.2	0	Waxing crescent
20/04/2007	26.4	13.6	0	Waxing crescent
17/07/2007	14.1	1.2	0	Waxing crescent
26/11/2007	27.7	15.0	0	Waning gibbous
28/11/2007	27.2	14.3	0.2	Waning gibbous
18/08/2008	1.5	14.8	0	Waning gibbous
19/08/2008	2.6	17.0	0	Waning gibbous
21/08/2008	3.5	-	0	Waning gibbous
29/01/2009	15.0	35.5	0	Waxing crescent
30/01/2009	16.2	35.7	0	Waxing crescent
24/02/2009	16.5	33.5	0	Waning crescent
25/02/2009	19.0	31.1	0.4	New moon
26/02/2009	18.8	25.5	1.0	Waxing crescent
6/04/2009	17.5	22.5	0	Waxing gibbous
7/04/2009	15.0	19.8	1.4	Waxing gibbous
8/04/2009	14.0	22.1	0	Waxing gibbous
9/04/2009	12.4	23.4	0	Full moon
10/04/2009	13.0	24.6	0	Waning gibbous
11/04/2009	14.2	24.2	0	Waning gibbous

Source: BOM 2009.

2.2. Vegetation Communities and Floristic Diversity

Vegetation mapping and floral species diversity surveys involved initial aerial photographic interpretation, followed by ground-truthing field observations.

2.2.1. Vegetation Community Mapping

An initial site visit, including a brief survey of the vegetated areas within the study area, was conducted to broadly determine vegetation status, community diversity and the potential locations for placing survey quadrats based on stratifiying the community types.

The 2007 surveys defined communities by the dominant species in the overstorey, shrub and ground layers. Both natural and modified or non native vegetation community types were investigated. The approach utilised for the vegetation community classification and the determination of significance involved the following systematic approach:

- Determining floral species diversity;
- Determining dominant species and vegetation structure; and
- Mapping boundaries of and describing vegetation communities, walking the boundaries of each community with a hand held GPS unit. Tracks from the GPS were then imposed over an ortho-rectified aerial photograph.

2.2.2. Flora Survey Techniques

Systematic flora surveys were conducted across the study area and consisted of the following steps as described below.

The floristic content and threatened species targeted surveys were conducted through site visits and surveys of 0.04ha (20m x 20m) quadrats and meandering transects. Methods used were based on DECC (2004). These visits were conducted over several periods to cover most seasons and flora species' life cycles.

Quadrats

Thirty-two individual quadrats of the overall 89 quadrats analysed by Bell (2009) (Appendix 2) were set out in the areas pre-determined in the 2007, 2008 and 2009 surveys (Figure 3). Each species within the quadrat was identified applying the Braun-Blanquet scale (Poore 1955; scale shown in Appendix 7) to describe the cover abundance. Where any species was not able to be identified in the field, samples were taken and identified at a later date.

Random Meanders

Species observed in meandering walks between quadrats and in surrounding native and modified vegetation areas were recorded and added to the overall species list. These meandering routes were also used to undertake targeted surveys for threatened flora species identified as occurring in the region.

Floristic Identification and Nomenclature

Floristic identification and nomenclature was based on Harden (1992, 1993, 2000 and 2002) with subsequent revisions as published on PlantNet (://plantnet.rbgsyd.nsw.gov.). A database and literature search was conducted to determine the likelihood of threatened flora species occurring within the study area. The list was compiled from the following:

- ROTAP (Briggs and Leigh, 1996);
- NPWS Atlas of NSW Wildlife database records;
- Schedules from the NSW TSC Act 1995 and the Commonwealth EPBC Act 1999;
- Flora of NSW (Harden 1992-2002); and
- National Herbarium of NSW (://plantnet.rbgsyd.nsw.gov.).

2.2.3. Data Analysis

Statistical data analysis was used to group the quadrat survey data and classify the vegetation communities. The analysis was prepared by Stephen Bell of Eastcoast Flora Survey (Bell 2009) and the report is attached in Appendix 2.

Utilising the species identification and Braun-Blanquet scale data from the

overall 89 flora survey quadrats from surounding vegetated areas from Stratford to Duralie (32 quadrats were surveyed within this study area), three analysis methods were applied. The attached data analysis report details the analytical process.

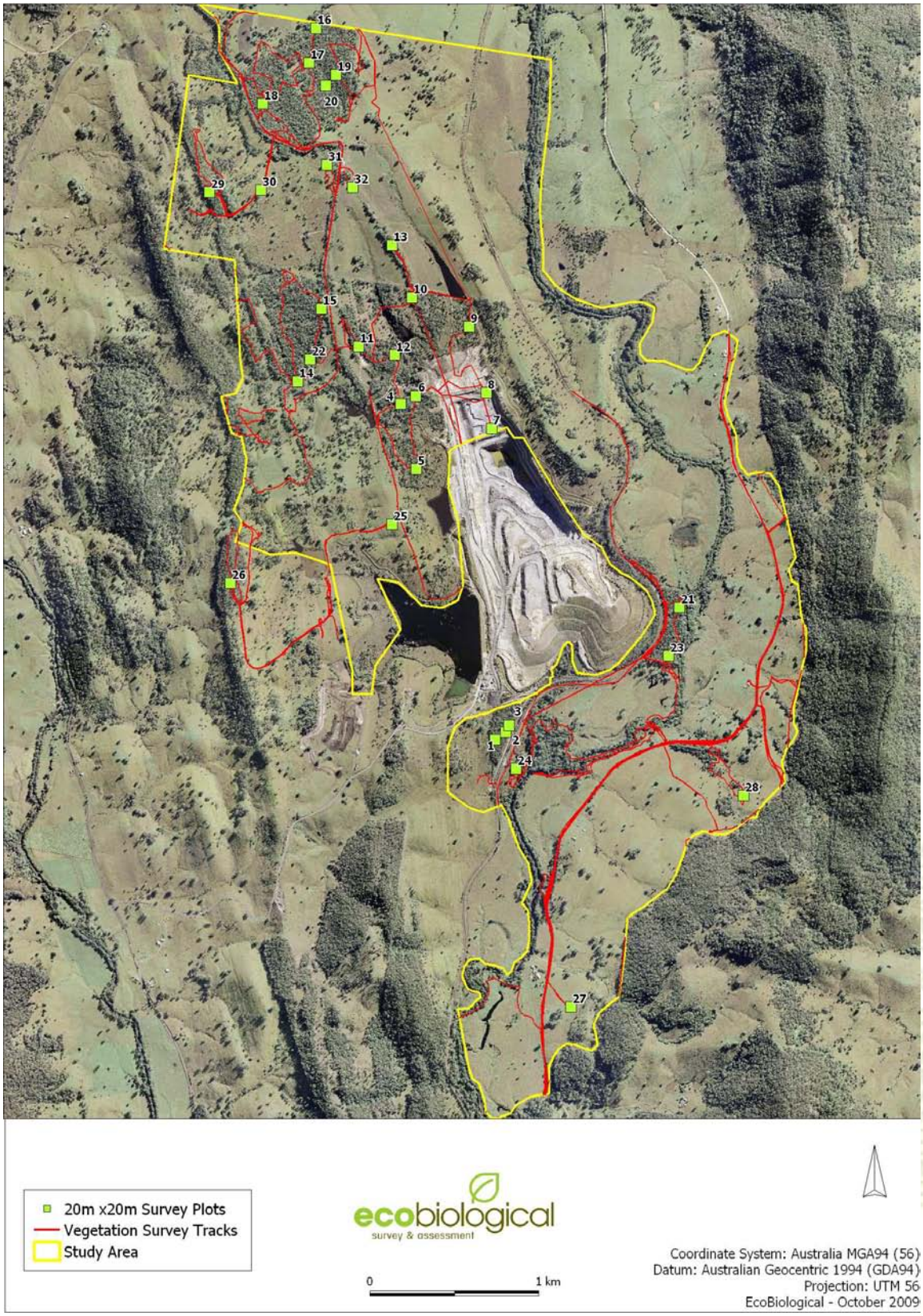


Figure 3: Aerial photograph of the study area showing the location of flora survey quadrats and random meandering tracks.

2.3. Fauna

2.3.1. Fauna Habitat Assessment

A fauna habitat assessment (meandering transects and point surveys) was conducted within nine zones across the study area to investigate the habitat value of each site for native fauna (Figure 5).

Data recorded included connectivity (within and between zones), structural layers, abundance of hollows and fallen wood, observations of fauna presence such as nests and scratches on trees and regeneration, erosion and grazing levels. The results of this assessment are described in Appendix 4.

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, thermoregulation 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).

A walking survey of the study area was undertaken to visually locate trees containing habitat hollows. A GPS waypoint of each tree containing hollows was recorded as well as the number of hollows present and the internal diameter of each hollow in three size classes (small <8cm; medium 8-20cm; large >20cm).

Koala Habitat Identification Using the Spot Assessment Technique (SAT)

Potential Koala habitat and signs of Koala presence such as faecal pellets and claw marks were identified using the Spot Assessment Technique (Phillips & Callaghan, 1995). Activity levels were calculated as the percentage equivalent of the quotient derived by dividing the number of trees that had one or more Koala faecal pellets recorded beneath them, by the total number of trees sampled.

Eight SAT tests were undertaken across the study area (Figure 5). The minimum recommended 20 trees sampled for each site was achieved within the property boundaries. A total of 160 trees were investigated. The results are described in section 3.2.1.

SEPP 44 Koala Habitat Protection

A survey of the study area was undertaken to locate trees listed in Schedule 2 of SEPP 44 (Table 3) as part of the flora surveys described in section 2.2 above. SEPP 44 requires that any development proposals affecting one hectare or more of a property must be evaluated for potential and core 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'. The results of this assessment are located in section 3.2.1.

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

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

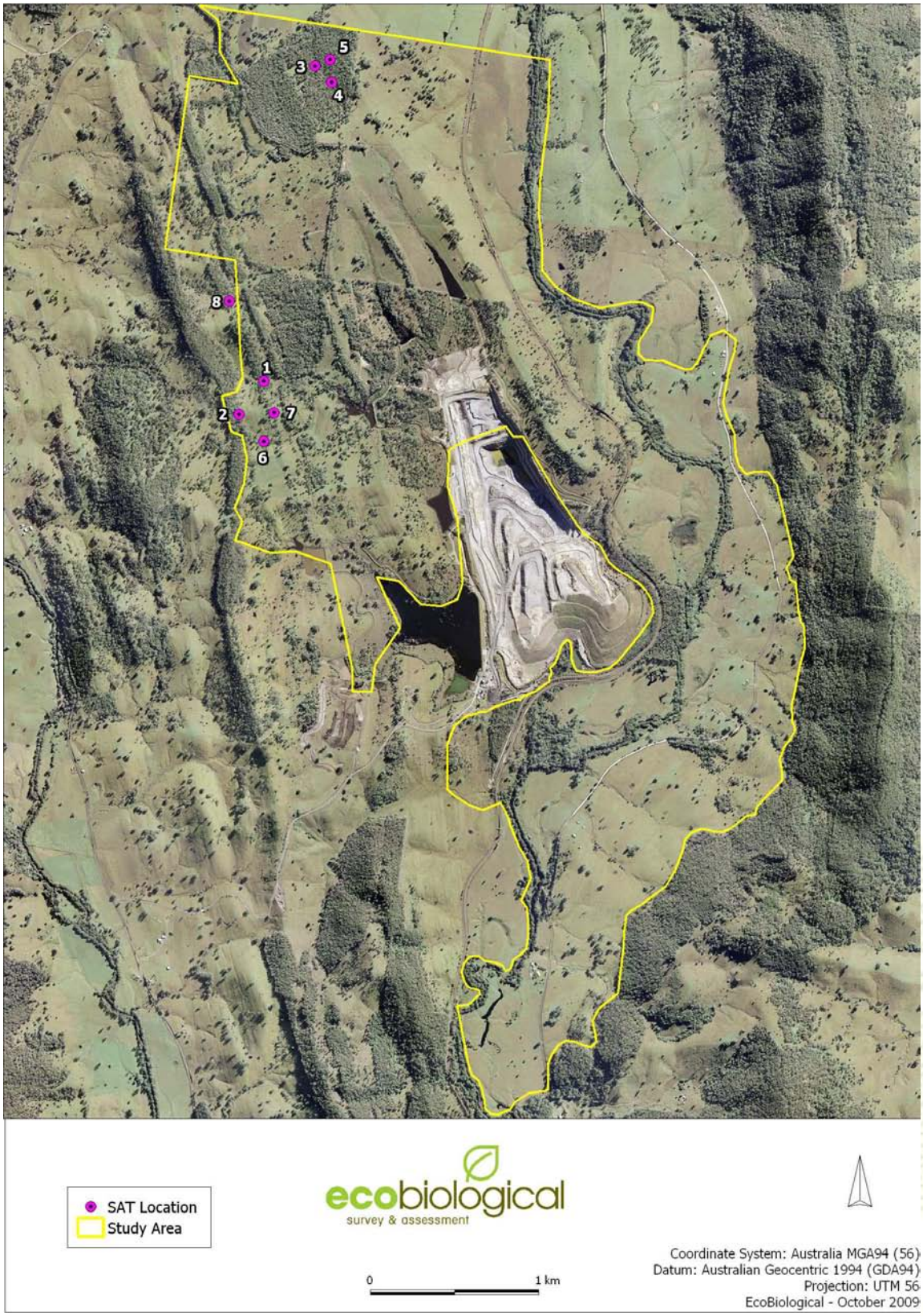


Figure 4: Aerial photograph of the study area showing the location of Koala SAT tests.

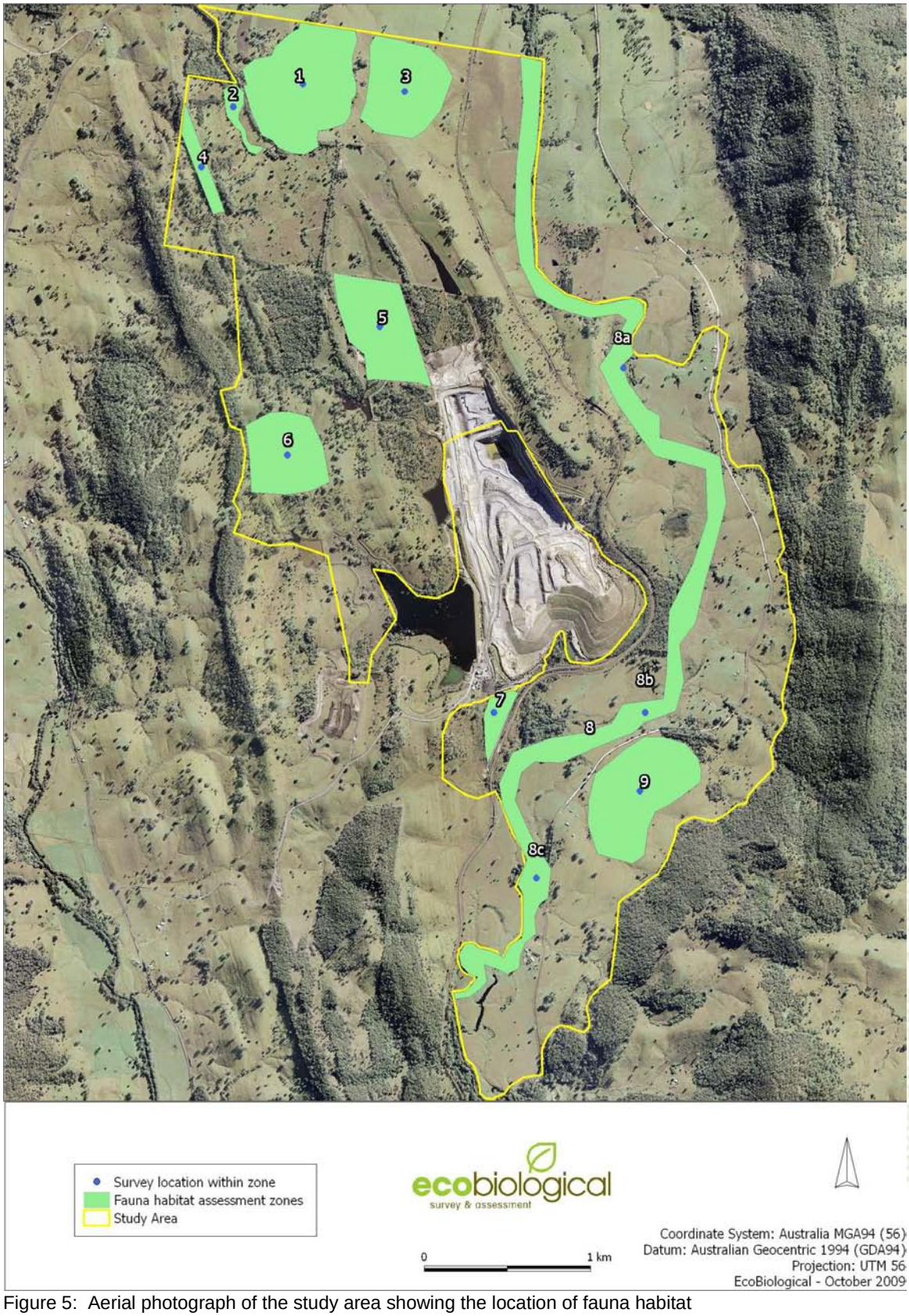


Figure 5: Aerial photograph of the study area showing the location of fauna habitat assessment zones and point survey locations.

2.3.2. Fauna Survey Techniques

The assessment of fauna was undertaken across the study area and the following fauna groups (amphibian, reptile, bird and mammal) were surveyed in accordance with the Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004a) and the Lower Hunter Central Coast Regional Environmental Management Strategy: Flora and Fauna Guidelines (Murray *et al.* 2002a, 2002b). These methods are outlined below.

The study area was stratified based on broad fauna habitat types.

The location of all fauna trapping and Anabat recording locations are shown in Figure 6. The total trap night count is shown in Table 4.

Ten trapping transects were designed to assess the presence of arboreal and terrestrial mammals utilising the study area (Figure 7). Traps were placed along transects 1 – 4 in April 2007 with an additional two trapping transects and four hair tube only transects utilised in April 2009.

Table 4: Trapping statistics for the study area.

Trap type	April 2007 Transects 1 - 4		April 2009 Transects 5 & 6		April 2009 Hair Tube Transects 1 - 4		Trap nights
	Traps	Nights	Traps	Nights	Traps	Nights	
Aboreal Mammals							
Hair Tubes	35	4	40	4	69	4	576
Elliot B Tree	15	4	12	4	-	-	108
Terrestrial Mammals							
Elliot A	60	4	50	4	-	-	440
Cage	11	4	12	4	-	-	92
Elliot B Ground	-	-	50	4	-	-	200
Hair Tubes - Ground	-	-	10	4	21	4	124
Harp Trap	4	4	-	-	-	-	16
Reptiles							
Type IV Funnel Traps	12	4	-	-	-	-	48

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 the species normal abundance), or abundant (encountered frequently and in large numbers relative to the species normal abundance). Relative abundance for each fauna species detected is shown in Appendix 3.

The occurrence of threatened species is discussed in detail in section 3.2.3.

Arboreal Mammals

To survey arboreal mammals, 27 Elliot B traps, and 75 hair tubes were placed in trees at heights of 3m or above and at intervals of approximately 20m, at each of Transects 1 – 6; and 69 hair tubes were placed in trees at each of Hair Tube Transects 1 – 4. 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.

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 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. The traps were collected after a four-night period.

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 on foot from dusk over 8 nights (totalling 21.5 person hours) at 19 locations to identify the presence of any arboreal mammals (for spotlighting dates see Table 1). 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.

Eleven hours of call playback was also undertaken at 19 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). 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. The results of these surveys are described in section 3.2 and Appendix 3.

Terrestrial Mammals

In order to identify any small terrestrial mammals, 20 Elliot A and 3 Cage traps were placed along each of Transects 1, 2 and 3 at regular intervals. Each transect was approximately 400m in length and traps were placed out at approximately 20m intervals. Transect 4 had little to no ground cover layer suitable for small terrestrial mammals, therefore only 3 Cage traps were placed along this transect. 25 Elliot A, 25 Elliot B, 6 cage traps and 5 hair tubes were placed on the ground at regular intervals along each of Transects 5 and 6. A handful of nesting material was also placed in each trap to enable a trapped animal to maintain an appropriate body temperature.

Twenty one hair tubes were placed on the ground along each of Hair Tube Transects 1-4.

Elliot A and Elliot B traps and hair tubes were baited with a mix of rolled oats, honey, peanut butter and treacle. During the April 2007 trapping period, cage traps were baited with raw chicken to target Spotted-tail Quolls. The traps were set in position for four consecutive nights and checked each morning.

As previously stated, spotlighting was undertaken from dusk over 8 nights (totalling 21.5 person hours) also 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, an identification was made.

The results of these surveys are described in section 3.2 and Appendix 3.

Bats

Anabat II bat-call recorders (Titley Electronics, Ballina) were used to record the calls of any Microchiropteran bats feeding in the area. The units were set up at dusk and recording occurred for a total of 78 recording hours over 7 nights at 14 locations. This involved a combination of some locations being recorded overnight, and others being recorded for one or more hours. The anabat recording locations are shown in Figure 6 and the dates of anabat surveys are shown in Table 1. Approximately 1700 calls were analysed by Kristy Peters of EcoBiological.

Four harp traps were positioned in bat 'flyways' along Transects 1-4 and set in position for four consecutive nights and checked each morning. 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 of blossoming trees were undertaken to identify any Megachiropteran bat species.

The results of these surveys are described in section 3.2 and Appendix 3.

Birds

The method employed to survey diurnal birds was an area search of various habitat zones and water bodies on the Duralie mine site. Plot-based surveys and meandering transects were conducted in April, July and November 2007, August 2008 and April 2009 at a total of 20 locations (Figure 7). Twelve 1-ha plots were surveyed for between 20 – 30 minutes within the forested and wooded areas across the mine (Figure 7). Eight meandering transects of between 20-60 minutes duration were also undertaken to target threatened woodland bird species likely to occur in habitat present across the study area (Figure 8).

Bird plots are denoted with B followed by 1 – 12 and transects with T followed by 1 – 8 in Figure 8. Plots and transects were surveyed on the following dates:

- 18/4/07 – B1 – B4
- 17/7/07 – T2 & T4
- 28/11/07 – T1
- 18/8/08 – B5 – B9
- 19/8/08 – B10, T3
- 21/8/08 – T5
- 7/4/09 – T6, T7, B9 – B12
- 8/4/08 – B9 – B12 repeated, T8
- 9/4/08 – T8 repeated

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

Targeted surveys for the Glossy Black-Cockatoo were undertaken across the study area. Visual and auditory searches were conducted in areas of forest and woodland containing *Allocasuarina* spp. as well as searches beneath preferred feed trees for evidence of feeding signs (i.e. crushed *Allocasuarina* cones).

Visual and auditory searches for the Swift Parrot were conducted in areas of eucalypt forest and woodland across the study area during the July 2007 survey period, targeting flowering trees.

Targeted diurnal searches were undertaken for the Bush Stone-curlew and Large Forest Owl species by walking areas of potentially suitable habitat within the forested areas of the study area (Figure 8). Gully lines and potential roosting habitat in the vicinity of Trapping Transects 1, 2 and 3 were walked to attempt to flush Bush Stone-curlews and search for evidence of roosting Owls such as white wash around the base of trees and regurgitated pellets.

Targeted nocturnal bird surveys were conducted on 8 nights at a total of 19 locations during the April and July 2007, August 2008 and April 2009 survey periods (Figure 8). After dark, the calls of threatened nocturnal bird species (Bush Stone-curlew, Powerful Owl, Barking Owl, Masked Owl, Sooty Owl, 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 results of these surveys are described in section 3.2 and Appendix 3.

Amphibians

Standardised survey techniques for amphibian species were employed throughout the survey period and included diurnal habitat searches, nocturnal spotlight surveys, call playback and dip netting for tadpoles (Figure 9). In particular, Barred River Frogs (frogs of the genus *Mixophyes*), the Booroolong Frog (*Litoria booroolongensis*) and the Green and Golden Bell Frog (*Litoria aurea*) were targeted due to potentially suitable habitat for these species being detected across the study area.

During diurnal surveys lasting at least 20 minutes, dip netting and visual searches were carried out to locate any tadpoles present in any water bodies. During nocturnal surveys lasting at least 30 minutes, spotlight searches were carried out by walking lengths of suitable habitat and using head torches to search for frogs by eye shine or by physical sightings. A total of 17 point locations and 10 stream transects were surveyed over 12 days/nights totalling 23 survey hours. The dates of amphibian surveys are shown in Table 1.

Adult frogs encountered were identified by visual confirmation or by their distinct advertisement calls. Tadpoles were keyed out using diagnostic features including mouthparts (tooth rows, jaw sheaths and papillae), pigmentation, body size, tail structure (musculature, fin depth, fin shape, tip shape), eye direction and spacing, pupil pigmentation, nare shape and spacing, spiracle height and direction, vent length and direction, and tadpole behaviour according to Anstis (2002).

The results of these surveys are described in section 3.2 and Appendix 3.

Reptiles

Type IV funnel traps (similar to a fish or lobster trap) were paired along two 26m runs of drift fence near Transect 1 and Transect 2. Trapping lines were left in place for four consecutive days and nights and traps were checked daily.

During survey periods across the study area suitable reptile habitat was inspected to detect the presence of any reptile species by way of occupancy, scats or other detectable traces. Suitable habitat included roadsides, rock outcrops and crevices, any fallen hollow logs and limbs, burrows and suitable rubbish items such as sheets of tin. Reptile survey locations are shown in Figure 10. A total of 21 locations were surveyed over 7 days/nights totalling 16 survey hours. The dates of reptile surveys are shown in Table 1.

The results of these surveys are described in section 3.2 and Appendix 3.

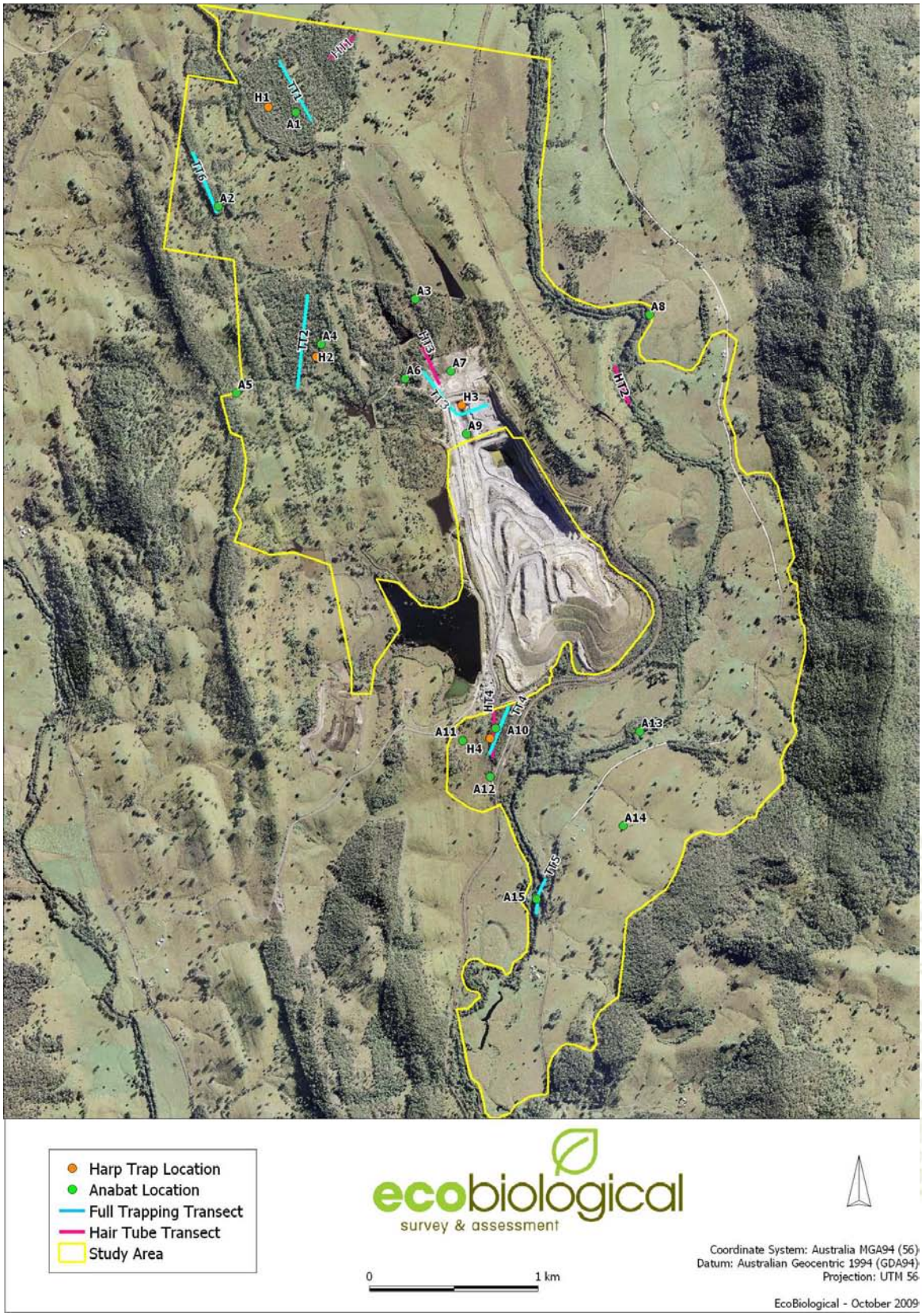


Figure 6: Aerial photograph of the study area showing the location of fauna trapping transects and Anabat recording locations.

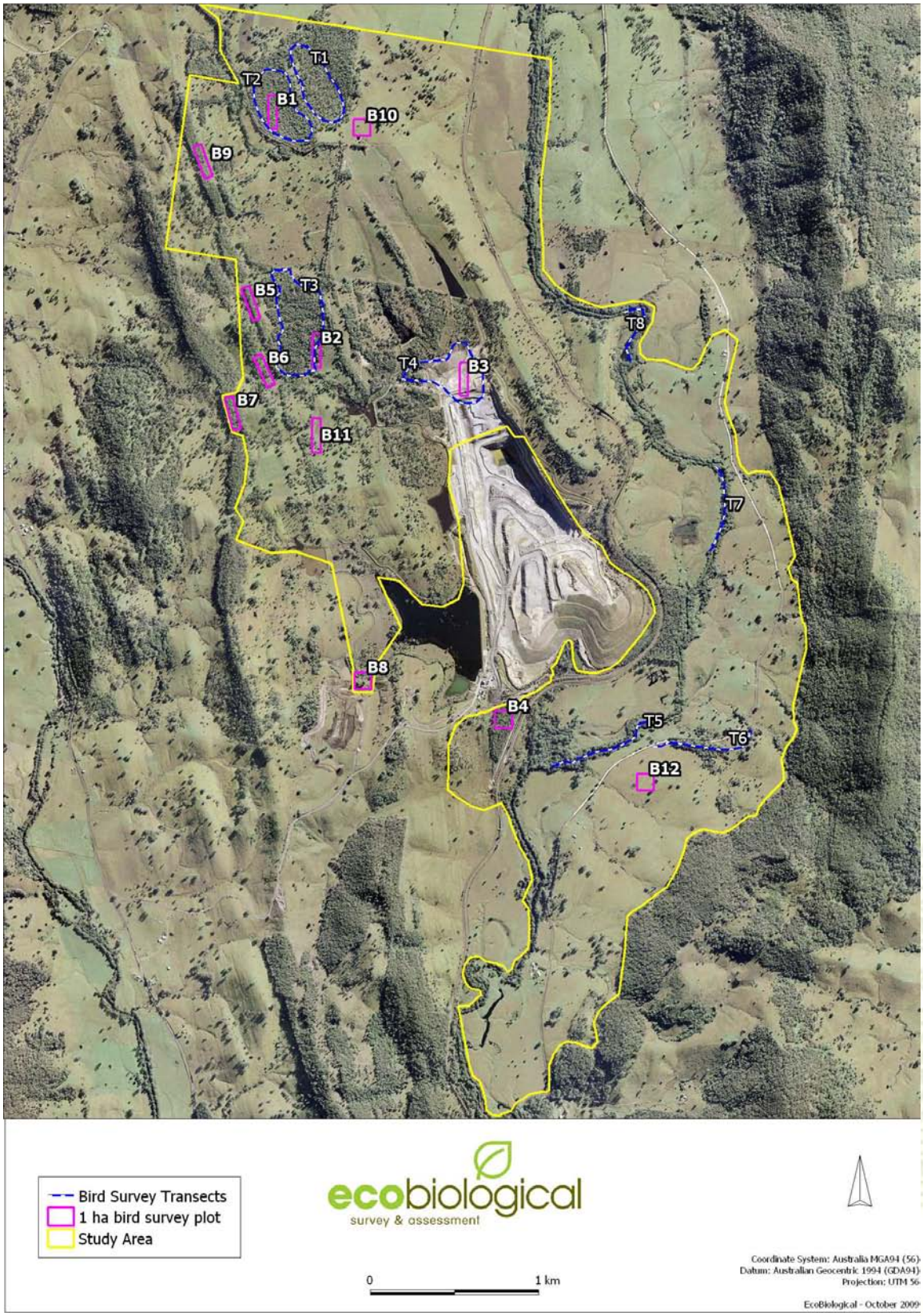


Figure 7: Aerial photograph of the study area showing the location of bird survey plots and transects.

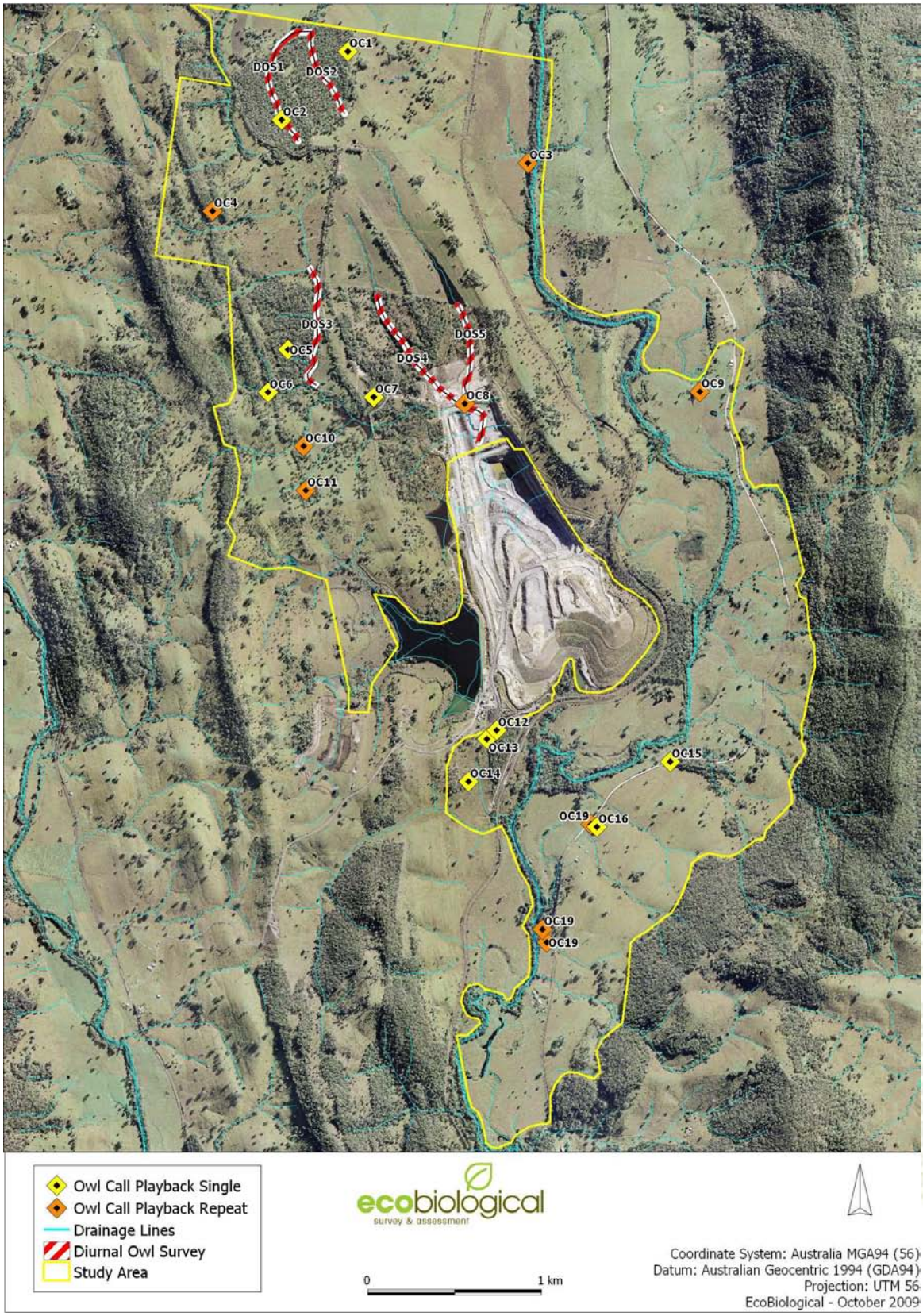


Figure 8: Aerial photograph of the study area showing the location of diurnal and nocturnal surveys for threatened nocturnal birds.

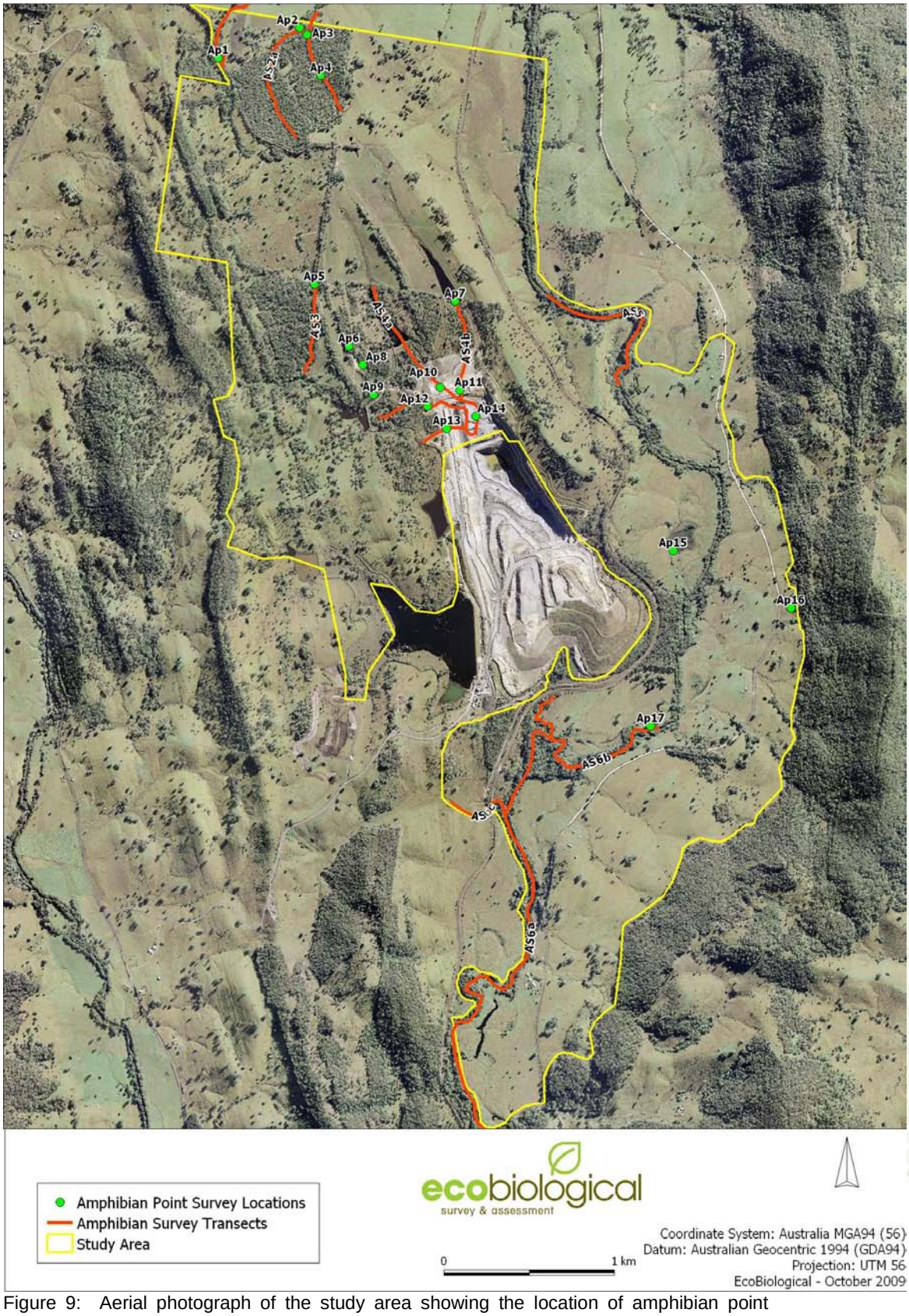


Figure 9: Aerial photograph of the study area showing the location of amphibian point surveys and transects.

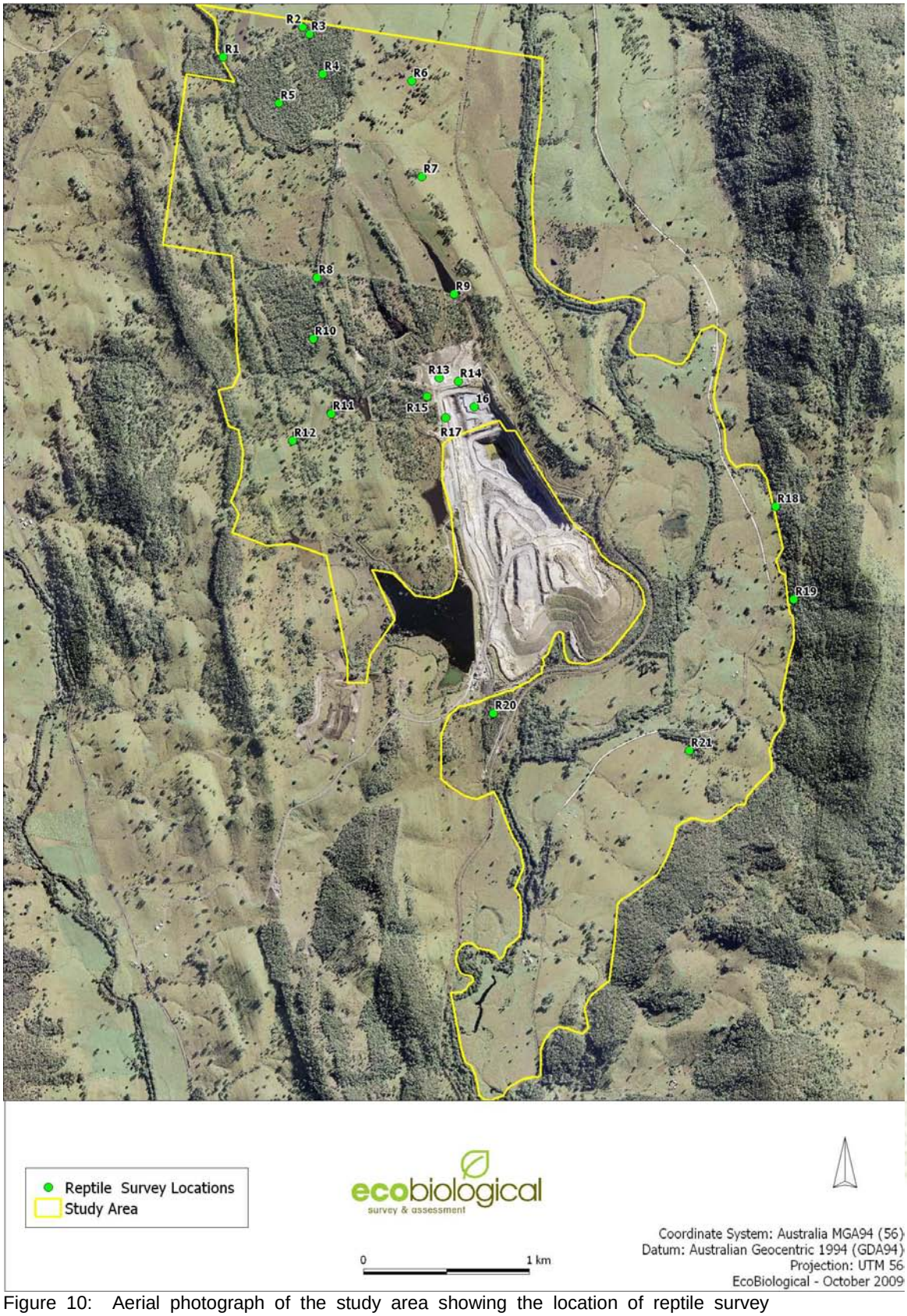


Figure 10: Aerial photograph of the study area showing the location of reptile survey locations.

2.4. Targeted Survey for Threatened Species

The records of threatened species, listed in the Atlas of NSW Wildlife, previously recorded within a five-kilometre radius of the study area are detailed in the following sections. In addition to a search of the Atlas of NSW Wildlife, a review of past ecological reports (Debus, 1995; ERM Mitchell McCotter, 1996a; ERM Mitchell McCotter, 1996b; Hoye, 1995; Webber, 1996; Woodward-Clyde, 1996a; Woodward-Clyde, 1996b), EcoBiological consultant records, and other species databases (Bionet) were consulted for any additional threatened species records.

Flora

Four threatened flora species were previously recorded within a 5-kilometre radius of the study area (Table 5). No species have previously been recorded within the Duralie study area.

Table 5: Threatened flora species recorded within a 5-kilometre radius of the study area.

Scientific Name	Common Name	Conservation Status	Last Date Recorded
Asperula asthenes		V	-
Eucalyptus glaucina	Slaty Red Gum	V	15/03/2007
Grevillea guthrieana		E*	26/09/1997
Syzygium paniculatum		V*	1/4/1917

E = Endangered; V = Vulnerable (NSW TSC Act 1995)

* also listed under the EPBC Act.

Fauna

A total of 20 threatened fauna species, comprising one amphibian, one reptile, five birds and 13 mammals were previously recorded within a 5-kilometre radius of the study area (Table 6). A further 26 threatened fauna species have been recorded in the wider area, as determined by other sources (Table 7).

Table 6: Threatened fauna species recorded within a 5-kilometre radius of the study area.

Class/Scientific Name	Common Name	TSC Act Status	Last Date Recorded
Amphibia			
Mixophyes iteratus	Giant Barred Frog	E*	20/12/2001
Reptilia			
Hoplocephalus stephensii	Stephens' Banded Snake	V	22/10/1995
Aves			
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	30/04/2005
Ninox strenua	Powerful Owl	V	11/09/2002
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subsp.)	V	24/11/2004
Ptilinopus magnificus	Wompoo Fruit-Dove	V	20/09/2003
Chthonicola sagittata	Speckled Warbler	V	21/02/1999
Mammalia			
Dasyurus maculatus	Spotted-tailed Quoll	V*	11/09/2002
Kerivoula papuensis	Golden-tipped Bat	V	18/12/2001
Macropus parma	Parma Wallaby	V	11/09/2002
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	27/10/2003
Mormopterus norfolkensis	Eastern Freetail Bat	V	20/12/2001
Myotis macropus	Large-footed Myotis	V	27/08/2004
Petaurus australis	Yellow-bellied Glider	V	31/10/1996
Petaurus norfolcensis	Squirrel Glider	V	17/08/2003
Petrogale penicillata	Brush-tailed Rock-wallaby	E*	22/10/1995
Phascogale tapoatafa	Brush-tailed Phascogale	V	27/07/2003
Phascolarctos cinereus	Koala	V	20/12/2003
Planigale maculata	Common Planigale	V	16/8/2003
Scoteanax rueppellii	Greater Broad-nosed Bat	V	27/10/2003

E = Endangered; V = Vulnerable (NSW TSC Act 1995)
* also listed under the EPBC Act.

Table 7: Additional threatened fauna species in the wider area.

Class/Scientific Name	Common Name	Legal Status	Last Date Recorded
Amphibia			
Litoria aurea	Green and Golden Bell Frog	E*	-
Litoria booroolongensis	Booroolong Frog	E*	-
Litoria brevipalmata	Green-thighed Frog	V	-
Mixophyes balbus	Stuttering Frog	E*	-
Reptilia			
Hoplocephalus bitorquatus	Pale Headed Snake	V	-
Aves			
Burhinus grallarius	Bush Stone-curlew	E	-
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-
Climacteris picumnus	Brown Treecreeper	V	-
Lathamus discolor	Swift Parrot	E*	-
Lophoictinia isura	Square-tailed Kite	V	-
Melanodryas cucullata cucullata	Hooded Robin	V	-
Melithreptus gularis	Black-chinned Honeyeater	V	-
Neophema pulchella	Turquoise Parrot	V	-
Ninox connivens	Barking Owl	V	-
Stagonopleura guttata	Diamond Firetail	V	-
Tyto longimembris	Eastern Grass Owl	V	-
Tyto novaehollandiae	Masked Owl	V	-
Tyto tenebricosa	Sooty Owl	V	-
Anthochaera phrygia	Regent Honeyeater	E*	-
Mammalia			
Cercatetus nanus	Eastern Pygmy Possum	V	-
Chalinolobus dwyeri	Large-eared Pied Bat	V*	-
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-
Miniopterus australis	Little Bentwing-bat	V	-
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V	-
Pteropus poliocephalus	Grey-headed Flying Fox	V*	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-

*also listed under the EPBC Act.

2.5. Survey Effort

Table 1 lists the dates of the flora and fauna investigation periods. The time invested in each survey method applied is summarised in Table 8.

Table 8: Time invested in each survey method applied during the investigation period.

Activity	Sampling Effort
Flora Survey and Vegetation Mapping	106 person hrs
Spotlighting	21.5 person hrs
Anabat Call Recording	78 recording hrs
Call Playback	11 person hrs
Bird Survey	12.5 person hrs
Amphibian Survey	23 person hrs
Reptile Survey	16 person hrs

3. Field Survey Results

3.1. Flora

The floristic survey conducted across the study area identified a total of 331 species (Appendix 4). The majority of native species were identified within the remnant forested areas. The species list includes all species recorded in quadrats and random meanders. The tables provided in Appendix 4 indicate in which vegetation community type the species were found (columns 1-8 refer to community types 1-8 described in section 3.1.1).

The surveys identified 57 introduced, exotic or weed species, although it is likely this number would be greater over the whole study area. These weed species were more commonly found in the cleared and disturbed areas which were not surveyed as intensively as the areas having natural vegetation. Noxious species at the site were Lantana, Blackberry and Crofton Weed. These plants were in infestation in disturbed areas, however, were less frequent to absent ion the natural vegetation communities.

No threatened flora or ROTAP species were observed during the flora surveys at the Duralie study area.

3.1.1. Vegetation Community Types

The vegetation data analysis report (Appendix 2) defined the 9 vegetation floristic groups to be utilised as a basis for classifying the vegetation across the surveyed mine areas at Duralie. These groups were:

- Group 1 - Riparian Closed Forest
- Group 2 - Cabbage Gum Floodplain Forest
- Group 3 - Stringybark-Paperbark Forest
- Group 4 – Red Gum Grassy Woodland
- Group 5 - Spotted Gum-Red Ironbark-Thick-leaved Mahogany Forest
- Group 6 - Grey Gum – Red Gum -Apple Riparian Forest
- Group 7 - Spotted Gum-Grey Ironbark-Thick-leaved Mahogany Forest
- Group 8 – Secondary Grasslands (result of clearing)
- Group 9 – Freshwater Wetland Complex

The remainder of the land is described as cleared and/or lands managed for agriculture i.e. cropping.

Three Endangered Ecological Communities (EECs) have been determined within the study area. The Riparian Closed Forest is determined to form a part of the *Lowland rainforest on floodplain in the NSW North Coast Bioregion* EEC. The Cabbage Gum Floodplain Forest constitutes part of the *River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC. The Freshwater wetland Complex would form a part of the *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC.

The vegetation community types have been derived from field observations, with interpretive data results from the Vegetation Data Analysis (Appendix 2 - Bell 2009). Results from the data analysis report (Bell 2009) grouped data from 89 survey quadrats, where 32 survey quadrats were located within the Duralie study area. The overall data was collected from survey locations from Stratford to Duralie. This shows a vegetation community variation and similarity across a broader range, however, the specific survey details for the quadrats within the Duralie study area are discussed specifically for this report. Appendix 6 details the quadrats identified in this report and links these to the quadrat numbers from the data analysis (Bell 2009).

The data collected for the data analysis report had limitations, generally associated with past land disturbances across the surveyed area. Groupings appear to support high levels of internal variations, consistent with regrowth from disturbance and agricultural practices. These groupings may form a more general open forest, where canopy species, understorey vegetation regrowth and weed composition create background noise making it difficult to always identify the natural dominant vegetation types.

Figure 11 illustrates the vegetation communities extant across the study area. Profiles of native vegetation communities occurring within the study area are detailed below. Vegetation classification and profiles detailed below include classifications derived in part from Bell (2009). The profiles detail the general descriptions, floristic and structural variations and relationships to other communities.

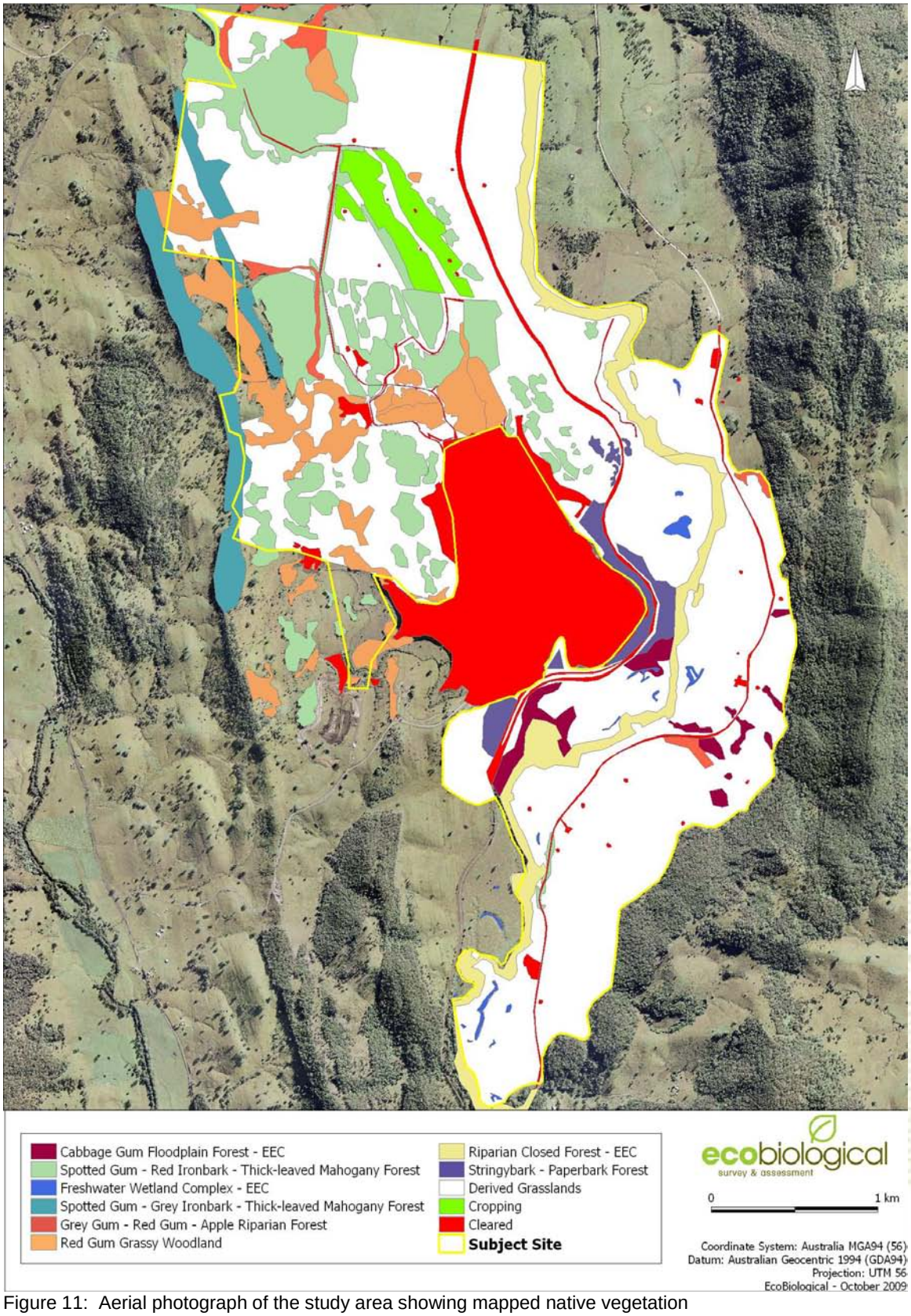


Figure 11: Aerial photograph of the study area showing mapped native vegetation communities.

Group 1 - Riparian Closed Forest

Vegetation Formation - Rainforests

Vegetation Class – Dry Rainforests

Equivalent Vegetation Type - *Weeping Lilly Pilly - Water Gum riparian rainforest of the southern North Coast* (DECC Vegetation Type Database (2009).

Conservation Status:

The *Lowland rainforest on floodplain in the NSW North Coast Bioregion* EEC is known to be associated with the *Weeping Lilly Pilly - Water Gum riparian rainforest of the southern North Coast* vegetation community. The NSW Scientific Committee final determination for *Lowland rainforest on floodplain in the NSW North Coast Bioregion* EEC recognises the Suballiance 26: *Waterhousea floribunda - Tristaniopsis laurina (Floyd 1990)* as a major nominated rainforest Suballiance.

The community had key indicator species *Waterhousea floribunda* (Weeping Lilly Pilly) and *Tristaniopsis laurina* (Water Gum) in the canopy and a suitable species composition throughout the sub canopy. The site shows signs of clearing and impacts from agriculture, including significant invasion of exotic plant species.

The Riparian Closed Forest is determined to form a part of the *Lowland rainforest on floodplain in the NSW North Coast Bioregion* EEC.

Structure:

Closed riparian forest to 15m high with emergent eucalypts to 35m. The shrub diversity was moderate and cover was sparse. The ground cover was sparse (<50%) below the closed forest canopy.

General description:

The riparian vegetation along Mammy Johnsons River was restricted to approximately 10-20m either side of the watercourse. The vegetation had a dense canopy of riparian species. The typical canopy composition had *Waterhousea floribunda* (Weeping Lilly Pilly), *Tristaniopsis laurina* (Water Gum) and *Casuarina cunninghamii* (River Oak) as dominant species. The common emergents were *Eucalyptus saligna* (Sydney Blue Gum) with *E. amplifolia* subsp. *amplifolia* (Cabbage Gum) common at permanent

depressions and swampy areas and often adjacent to mapped Cabbage Gum Floodplain forests.

The mid stratum was diverse and the common species throughout the mapped community were *Callistemon salignus* (Willow Bottlebrush), *Ficus coronata* (Sandpaper Fig), *Guioa semiglauca, Streblus brunonianus* (Whalebone Tree) and *Wilkiea huegeliana* (Veiny Wilkiea).

The ground and river bank stratum consisted typically of *Lomandra longifolia* (Spiny-headed Mat-rush), *Maytenus silvestris* (Orangebark), *Adiantum hispidulum* (Rough Maidenhair Fern), *Doodia aspera* (Prickly Rasp Fern), *Pellaea falcata* (Sickle Fern) and *Urtica urens* (Small Nettle).

The riparian strip is heavily infested with weeds, particularly mid stratum species such as *Ligustrum sinense* (Small-leaved Privet), *Solanum mauritianum* (Wild Tobacco Bush), and ground and riverine species such as *Ageratina riparia* (Mistflower), *Rubus fruticosus* (Blackberry), *Tradescantia fluminensis* (Wandering Jew) and grasses such as *Pennisetum clandestinum* (Kikuyu Grass).

Known Floristic/Structural Variations:

No other known community variants were surveyed in the Duralie study area.

The structure varied from low closed forest to a tall moist forest (Plates 1 and 2).

Distribution:

In the study area, this community is restricted to the valley floor, within the riparian zone surrounding Mammy Johnsons River. The creek extends for the length of the study area, north to south.

Habitat:

The Riparian Closed Forest was found on alluvial substrate in the riparian zone, where soils were rich and deep. The creek has permanent flow.

Relationship to Other Communities:

This community merges with Blue Gum-Grey Gum Moist Sheltered Forests (not within study area) and Cabbage Gum Floodplain Forest.

Plate 1. Closed riparian forest on Mammy Johnsons River.

Plate 2. Tall Blue Gum forest adjacent and over the closed forest on Mammy Johnsons River.

Group 2 - Cabbage Gum Floodplain Forest

Vegetation Formation – Grassy Woodlands

Vegetation Class – Coastal Valley Grassy Woodlands

Equivalent Vegetation Type - *Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (*DECC Vegetation Type Database 2009).

Conservation Status:

The *River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC is known to be associated with the vegetation community *Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands*.

The community had key indicator species in the canopy, groundcover, rushes/grasses and vines, and a good representation of the characteristic species in all stratum (sourced from Identification Guidelines for Endangered Ecological Communities *River-flat Eucalypt Forest on Coastal Floodplains*, DECC, December 2007). The locality does not meet the identication guide (south of Port Stephens), however, the land form is indicative of an alluvial floodplain, being approximately 40m ASL and generally quite flat.

The Cabbage Gum Floodplain Forest is determined to form a part of the *River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC.

Structure:

Open woodland to tall open forest 30m high (Plate 3). Where mid stratum was present, it was 5-10m high with moderate to dense cover. The shrub and ground cover was moderate to sparse under the dense mid stratum, generally less than 50%, and up to 100% in the open woodland areas.

General description:

The Cabbage Gum Floodplain Forest within the study area has been significantly impacted by clearing and cattle grazing.

This community is strongly dominated by *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum). Occasional species were *E. siderophloia* (Grey Ironbark), *E. resinifera* (Red Mahogany), *E. saligna* (Sydney Blue Gum) and *E. globoidea* (White Stringybark).

The mid stratum varied from absent in disturbed areas to dense *Melaleuca nodosa* thicket in disturbed areas and *M. decora, M. styphelioides* (Prickly-leaved Tea Tree) and *M. linariifolia* (Flax-leaved Paperbark). *Pittosprum undulatum* and *Callistemon salignus* (Willow Bottlebrush) were also common throughout the community.

The shrub stratum was generally elevated to about 2m, with *M. nodosa, Breynia oblongifolia* (Coffee Bush), *Exocarpos cupressiformis* (Cherry Ballart), *Leptospermum polygalifolium* subsp. *cismontanum,* and *Ozothamnus diosmifolius* (Rice Flower) as common species.

The ground stratum had many wet or moist species such as *Carex appressa* (Tall Sedge), *Lomandra longifolia* (Spiny-headed Mat-rush), *Hibbertia aspera* (Rough Guinea Flower) and *Juncus usitatus.* The typical grasses were *Microlaena stipoides* var *stipoides* (Weeping Grass), *Entolasia marginata* (Bordered Panic), *Entolasia stricta* (Wiry Panic) and *Oplismenus imbecillis.* Common ground herbs were *Hydrocotyl peduncularis, Galium propinquum* and *Gonocarpus teucrioides* (Raspwort).

The vine *Parsonsia straminea* (Common Silkpod) was common throughout the forested areas.

The main weed species were typical of disturbed and pasture improved areas. Common species in the forested areas were *Hypochaeris radicata* (Catsear) and *Senecio madagascariensis* (Fireweed) and grasses such as *Paspalum dilatatum* (Paspalum) and *Pennisetum clandestinum* (Kikuyu Grass).

Known Floristic/Structural Variations:

No floristic variants were surveyed in the Duralie study area.

Structural variants were a result of disturbance, where open woodlands and isolated patches are found along the former extant, and dense forested areas of lower disturbance.

Distribution:

This community is restricted to the alluvial soils on the valley floor, generally adjacent to riparian zones and water courses. The community can become relatively wide where floodplains expand, and can also exist as narrow strips where water courses and associated floodplains are restricted. On the study area, this community was found on the floodplains surrounding Mammy Johnsons River.

Habitat:

The Cabbage Gum Floodplain Forest was restricted to the floodplain areas, where alluvial soils were deep and rich. The floodplain has many soaks and oxbows resulting from historical river flows. The ground shows signs of frequent sheet flows, with many minor drainage lines.

Relationship to Other Communities:

This community generally occupied the floodplains around the Riparian Closed Forest and was more or less bordered by Stringybark- Paperbark Forest on footslopes.

Plate 3. Cabbage Gum Floodplain Forest on floodplains surrounding Mammy Johnsons River.

Group 3 - Stringybark -Paperbark Forest

Vegetation Formation – Dry Sclerophyll Forests (Shrubby subformation)

Vegetation Class – North Coast Dry Sclerophyll Forests

Equivalent Vegetation Type - *Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin (*DECC Vegetation Type Database 2009).

Structure:

Open woodland to tall open forest 25-30m high. In less disturbed or cleared areas the mid stratum was to 5m high with moderate to dense cover. The shrub and ground cover was moderate under the dense mid stratum.

General description:

This vegetation community was found at the lower slopes adjacent to the floodplain area.

The dominant species were *Eucalyptus acmenoides* (White Mahogany) and *E. carnea* (Thick-leaved Mahogany). Other common species were *E. amplifolia* subsp *amplifolia* (Cabbage Gum), *E. fibrosa* (Red Ironbark), *E. siderophloia*, *E. globoidea* (White Stringybark) and *Angophora floribunda* (Rough-barked Apple).

The mid layer had dense *Melaleuca nodosa* (Paperbark) dominant (Plate 4) throughout the surveyed areas, with *Acacia ulicifolia* (Prickly Moses) also common. *Leptospermum polygalifolium* subsp. *cismontanum* (Tantoon), *Breynia oblongifolia* (Coffee Bush) and *Zieria smithii* (Sandfly Zieria) were dominant and common on the drainage lines.

The forested areas had a moderate to sparse shrub and ground layer, mainly due to a dense mid layer. *Hibbertia aspera* (Rough Guinea Flower), *H. diffusa* (Wedge Guinea Flower). *Leucopogon juniperinus* (Prickly Beard-heath), *Pteridium esculentum* (Common Bracken) and *Gahnia clarkei* (Tall Saw-sedge) were common shrub species.

The common grasses included *Entolasia stricta* (Wiry Panic) and *E. marginata* (Bordered Panic), *Microlaena stipioides, Imperata cylindrica var. major* (Blady Grass) and *Lomandra longifolia* (Spiny-headed Mat-rush). The common herbs were *Gonocarpus teucrioides* (Raspwort), *Dichondra repens*

(Kidney Weed), *Pratia purpurascens* (Whiteroot) and *Lindsaea linearis* (Screw Fern). Orchid species were regularly recorded, typically being *Chiloglottis diphylla* and *Acianthus fornicatus* (Pixie Caps).

The vines *Glycine microphylla* (Small-leaf Glycine) and *Parsonsia straminea* (Common Silkpod) were common throughout the community.

Known Floristic/Structural Variations:

This community had no variations.

Distribution:

This community type is known from other locations across the valley area, and is generally located on sandy soils on gentle rises adjacent to floodplain areas.

Relationship to Other Communities:

At the study area, this community was isolated by the rail lines and the mine, however was relatively restricted to lower slopes and sandy soils. It merged to the east with the Cabbage Gum Floodplain Forest.

Plate 4. Stringybark forest at the study area showing the dense Melaleuca mid stratum.

Group 4 – Red Gum - Grassy Woodland

Vegetation Formation – Grassy Woodlands

Vegetation Class – Coastal Valley Grassy Woodlands

Equivalent Vegetation Type - *Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast (*DECC Vegetation Type Database 2009).

Structure:

Open forest, Grassy Woodland to Woodland to 20-30m tall (Plates 5 and 6). Generally a sparse mid stratum and dense grassy ground stratum, likely due to land use history. Mid stratum moderate to dense on undisturbed drainage lines.

General description:

This vegetation community extended along the modified drainage lines and lower slopes on the study area at Duralie. The community demonstrated significant past disturbance, which made the data analysis difficult to clearly define a community type. The boundary of this vegetation was mapped by defining the extent of *Eucalyptus tereticornis* (Forest Red Gum) dominance.

The dominant species was *E. tereticornis* (Forest Red Gum), with *E. moluccana* (Grey Box) and *E. siderophloia* (Grey Ironbark) as co-dominants. *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum), *E. fibrosa* (Red Ironbark), *E. globoidea* (White Stringybark) and *Angophora floribunda* (Rough-barked Apple) were also common species.

Allocasuarina torulosa (Forest Oak) was common throughout the community. The mid layer was relatively sparse, yet on the drainage lines the occurrence of *Melaleuca linariifolia* (Flax-leaved Paperbark), *M. styphelioides* (Prickly-leaved Tea Tree) and *Callistemon salignus* (Willow Bottlebrush) became moderate to dense.

The lower slope and gully had a moderate shrub cover consisting of *Leucopogon juniperinus* (Prickly Beard-heath), *Breynia oblongifolia* (Coffee Bush), *Gahnia clarkei* (Tall Saw-sedge) and a moderate diversity of ground cover species.

The higher slopes had a grassy woodland structure, having a mixture of

native grasses, ferns and herbs. Most common were grasses such as *Themeda australis* (Kangaroo Grass), *Aristida vagans* (Threeawn Speargrass), *Cymbopogon refractus* (Barbed Wire Grass) and *Imperata cylindrica* (Blady Grass).

Current land use and management (grazing pastures and cropping) was seen in areas of this mapped community, impacting the ground layer composition .

In more disturbed areas *Imperata cylindrica* (Blady Grass) and exotic grasses were common, particularly *Pennisetum clandestinum* (Kikuyu Grass).

Known Floristic/Structural Variations:

This community varied from Red Gum dominated broad drainage lines to Grey Box- Red Gum– Apple- Ironbark composition on the lower slopes.

Distribution:

This community type was located on the lower slopes and along drainage courses throughout the study area. It is likely that the community extended over a much larger area prior to clearing for agricultural uses.

Relationship to Other Communities:

This community was generally bordered on the higher slopes by Spotted Gum – Ironbark forests.

Plate 5. Forest Red Gum Grassy Forest at Duralie.

Plate 6. Forest Red Gum Grey Box Forest woodland regrowth.

Group 5 - Spotted Gum-Red Ironbark-Thick-leaved Mahogany Forest

Vegetation Formation - Dry Sclerophyll Forests (Shrub/grass subformation)

Vegetation Class - Hunter-Macleay Dry Sclerophyll Forests

Equivalent Vegetation Type - *Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast (*DECC Vegetation Type Database 2009).

Structure:

Dry Sclerophyll open forest to 20-30m, with sparse to moderate mid and shrub stratum, and a mixed herb and grassy ground stratum exceeding 50% cover.

General description:

This vegetation community has been separated from the Spotted Gum-Grey Ironbark-Thick-leaved Mahognay Forest (Group 7) principally based on substrate. This community had conglomerate substrates, where the Group 7 community had volcanic and exposed rocky substrate. The *Eucalyptus fibrosa* (Red Ironbark) was common in this community and almost absent in the Group 7 community.

Spotted Gum-Red Ironbark-Thick-leaved Mahognay Forest (Group 5) was dominated by *Corymbia maculata* (Spotted Gum), *E.siderophloia* (Grey Ironbark) and *E. carnea* (Thick-leaved Mahogany), with localised *E. microcorys* (Tallowwood) and *E. fibrosa* (Red Ironbark) co-dominmant (Plate 7).

The mid layer was moderate to relatively sparse across its range. The most common species was *Allocasuarina torulosa* (Forest Oak).

The shrub layer was sparse and common species were *Bursaria spinosa* (Blackthorn), *Leucopogon juniperinus* (Prickly Beard-heath), *Daviesia ulicifolia* (Gorse Bitter Pea), *Breynia oblongifolia* (Coffee Bush) and *Acacia ulicifolia* (Prickly Moses).

The grasses *Entolasia stricta* (Wiry Panic), *Aristida vagans, Themeda australis* (Kangaroo Grass), *Echinopogon caespitosus* (Hedgehog-grass) and *Cymbopogon refractus* (Barbed Wire Grass) dominated the ground cover

across its range. Other indicative ground species included *Cheilanthes sieberi* subsp. *sieberi* (Poison Rockfern), *Lomandra multiflora* (Many-flowered Mat-rush), *Pratia purpurescens, Pomax umbellata, Opercularia diphylla, Vernonia cinerea* and *Brunoniella australis* (Blue Trumpet). The typical ground vines were *Glycine tabacina, Desmodium varians* (Slender Tick-trefoil) and *Billardiera scandens* var. *scandens* (Hairy Apple Berry).

Known Floristic/Structural Variations:

Floristic variations were identified where the dominant Ironbark varied between *Eucalyptus fibrosa* (Red Ironbark) and *E. siderophloia* (Grey Ironbark).

This community structure remained relatively stable throughout its spread within the Duralie study area.

Distribution

This community was on the side slopes adjacent to the Red Gum community associations and on the lower slopes and ridges across the valley where the soils were conglomerate.

It is likely that this community was more widespread prior to clearing for agriculture.

Relationship to Other Communities:

This community merged with the Red Gum Forest and is similar to the Spotted Gum-Grey Ironbark Forest, which dominated the sharp ridges and crests on volcanic substrate, further to the west.

Plate 7. Spotted Gum / Red Ironbark / Thick-leaved Mahogany Grassy Forest at Duralie.

Group 6 - Grey Gum - Redgum-Apple Riparian Forest

Vegetation Formation – Grassy Woodlands

Vegetation Class – Coastal Valley Grassy Woodlands

Equivalent Vegetation Type - *Grey Box - Forest Red Gum - Grey Ironbark open forest of the hinterland ranges of the North Coast* (DECC Vegetation Type Database 2009).

Structure:

Open Forest to 35m tall, with a dense mid stratum to 15m and moderate shrub layer. The ground stratum was relatively dense (>60%).

General description:

This community was present around the main drainage lines at the Duralie study area. The dominant canopy trees included *Eucalyptus canaliculata* (Grey Gum) with either sub dominant or co dominant *Angophora floribunda* (Rough-barked Apple) and *E. acmenoides* (White Mahogany). *E. tereticornis* (Forest Red Gum) was present throughout the community.

The mid stratum on the drainage lines was relatively dense with *Melaleuca styphelioides* (Prickly-leaved Tea Tree), *M. linariifolia* (Flax-leaved Paperbark) and *Glochidion ferdinandi* var. *ferdinandi* (Cheese Tree) on banks of the drainage line. Some *Casuarina cunninghamii* was present along these watercourses although sparse.

Acacia irrorata (Green Wattle), *Leucopogon juniperinus* (Prickly Beard-heath), *Bursaria spinosa* (Blackthorn) and *Breynia oblongifolia* (Coffee Bush) were common shrubs throughout.

The wetter drainage lines generally had dense cover of *Gahnia clarkei* (Tall Saw-sedge), *Leptospermum polygalifolium* subsp. *cismontanum* (Tantoon), *Carex appressa* (Tall Sedge) and *Hibbertia aspera* (Rough Guinea Flower). Native grasses included *Entolasia marginata* (Bordered Panic), *Themeda australis* (Kangaroo Grass) and *Imperata cylindrica* (Blady Grass). Common herbs were *Dichondra repens* (Kidney Weed) and *Adiantum aethiopicum* (Common Maidenhair) and orchids *Chiloglottis diphylla* and *Acianthus fornicatus* (Pixie Caps), also indicative of a moist or protected environment.

Known Floristic/Structural Variations:

This community had two defined variations, likely based on previous disturbance regimes:

- Variant 1 (Plate 8): Open forest in deeper gully drainage lines extending onto open paddocks on the western portion of Duralie, generally dominated by *Eucalyptus canaliculata* (Grey Gum), *E. tereticornis* (Forest Red Gum) and scattered *Angophora floribunda* (Rough-barked Apple). The mid layer was dominated by *Acacia irrorata* (Green Wattle) and *Melaleuca styphelioides* (Prickly-leaved Tree).

- Variant 2 (Plate 9): Narrow drainage lines on open land on the northern portion of the Duralie study area, currently having significant disturbance associated with cattle grazing. This variation contained eucalypt canopy dominated by *Eucalyptus acmenoides* (White Mahogany), *Angophora floribunda* (Rough-barked Apple) with *Callistemon salignus* (Willow Bottlebrush) and *Melaleuca styphelioides* (Prickly-leaved Tea Tree) dominant in the mid layer.

Relationship to Other Communities:

This community was restricted around narrow drainage lines downslope from dry sclerophyll open forest and often adjacent to Cabbage Gum Floodplain or Red Gum forests.

Plate 8. Grey Gum - Redgum-Apple Riparian Forest variant 1 on the drainage line at Duralie site.

Plate 9. Grey Gum - Redgum-Apple Riparian Forest variant 2 on the drainage line at Duralie site.

Group 7- Spotted Gum-Grey Ironbark-Thick-leaved Mahogany Forest

Vegetation Formation - Dry Sclerophyll Forests (Shrub/grass subformation)

Vegetation Class - Hunter-Macleay Dry Sclerophyll Forests

Equivalent Vegetation Type - *Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast (*DECC Vegetation Type Database 2009).

Structure:

Open forest with a sparse mid stratum as a consequence of prior land use and management. Where protected the shrub layer is moderate and the ground cover exceeds 60% cover. For the majority of the area, grazing continues to restrict the structure to tall woodland.

General description:

This community was found on steep slopes and ridges having exposed igneous rock outcrops (Plate 10). This community within the study area had been previously logged and is currently used for grazing.

The dominant canopy species are *Corymbia maculata* (Spotted Gum), *Eucalyptus siderophloia* (Grey Ironbark), *E. crebra* (Narrow-leaved Ironbark), *E. microcorys (*Tallowwood), *E. canaliculata* (Grey Gum) and *E. carnea* (Thick-leaved Mahogany).

The mid stratum consisted almost entirely *Allocasuarina torulosa* (Forest Oak).

The shrub layer was relatively sparse at most locations. The common species were *Persoonia linearis* (Narrow-leaved Geebung), *Podolobium ilicifolium*, *Bursaria spinosa* (Blackthorn) and *Acacia ulicifolia* (Prickly Moses).

The ground cover had native grasses (typically *Themeda australis* [Kangaroo Grass] and *Imperata cylindrica* (Blady Grass) and common herbs were typically *Pratia purpurascens* (Whiteroot), *Gonocarpus teucrioides* (Raspwort), *Hibbertia diffusa* (Wedge Guinea Flower) and *Leucopogon juniperinus* (Prickly Beard-heath).

Relationship to Other Communities:

This community was similar to the Spotted Gum-Red Ironbark-Thick-leaved Mahogany Forest, however, composition varied, likely due to the difference in substrate (on conglomerate or volcanic).

Plate 10. Spotted Gum – Grey Ironbark forest on steep slopes and volcanic substrate.

Group 8- Secondary Grasslands

Structure:

Grasslands to open woodlands with scattered tree regrowth and/or mature remnant trees. For the majority of the area, grazing and irrigation is the ongoing land use.

General description:

A general Grassland community classification (Secondary Grassland) was given for cleared and grazed agricultural land that no longer supports a distinct natural vegetation community.

This community is generally found on the slopes, lower ridges and drainage lines. The majority of the identified grassland areas are likely to have formerly been Red Gum dominated and Spotted Gum-Red Ironbark forest communities, demonstrated by the remaining trees, surrounding vegetation and the soil types.

The species composition has an assemblage indicating some pasture improvement has occurred, however, the native species composition was approximately 50% in most surveyed areas. The Cabbage Gum Floodplain

Forest show a higher degree of disturbance and management, and the native species composition was lower than weed composition.

The common native grass species in the grassland areas were *Themeda australis* (Kangaroo Grass), *Imperata cylindrica* (Blady Grass), *Sporobolus elongates, Microlaena stipoides* var. *stipoides* (Weeping Grass), *Entolasia stricta* (Wiry Panic), *Capillipedium parviflorum* (Scented-top Grass) and *Aristida vagans* (Threeawn Speargrass). Herbs and sedges such as *Juncus usitatus*, *Glycine clandestina*, *Desmodium rhytidophyllum*, *Carex maculata* and *Pteridium esculentum* (Common Bracken) were common throughout.

The typical weed species across the grassland areas were *Axonopus fissifolius* (Narrow-leafed Carpet Grass), *Andropogon virginicus* (Whisky Grass), *Paspalum dilatatum* (Paspalum), *Sporobolus africanus* (Paramatta Grass), *Pennisetum clandestinum* (Kikuyu Grass), *Chloris* species and *Setaria* species. The common weed herbs in the grasslands were *Senecio madagascariensis* (Fireweed), *Conyza species, Cyperus brevifolius* and *Cyperus congestus*, *Plantago lanceolata* (Lambs Tongues) and *Verbena bonariensis* (Purpletop).

Relationship to Other Communities:

This community whilst significantly disturbed is related to the surrounding communities, viz, the Spotted Gum-Red Ironbark-Thick-leaved Mahogany Forest, the Red Gum Grassy Woodlands and the Cabbage Gum Floodplain Forests.

Plate 11. Grassland on low crests within the western section of the study area.

Group 9 - Freshwater Wetland Complex

No quadrats were surveyed in this community within the study area and consequently, do not form a part of the analysis provided within the Bell report (2009). The location and mapping has been conducted through aerial imagery and knowledge of the site gained throughout the field surveys. Farm dams were not considered as a part of this community.

Vegetation Formation – Forested Wetlands

Vegetation Class – Coastal Floodplain Wetlands

Equivalent Vegetation Type - *Coastal floodplain sedgelands, rushlands, and forblands of the North Coast (*DECC Vegetation Type Database 2009).

Conservation Status:

The Freshwater wetland Complex would form a part of the *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC.

This community can occur as a derived community - possibly from Forested Wetlands. It occurs in man-made water bodies, drainage lines and depressions across a wide variety of environments. Although it does occur in original form in a wide variety of situations associated with coastal plains, valleys, lagoons and other sites of poor drainage, it is likely to be derived from anthropological land uses at the study area, however, original and derived communities may be difficult to distinguish (DECC 2009).

The community had key indicator species in rushes, grasses, aquatic plants and forbs.

Structure:

Wetland derived on depressions of Mammy Johnson's River alluvial plains, river oxbows and billabongs. Open water bodies and swamps.

General Description:

The Freshwater Wetland Complex occurs in depressions in the alluvial plains having a permanent or periodical inundation of fresh water. At the subject site, the locations are likely to be man made ponds resulting from historical land uses and oxbows formed from historic meandering river patterns.

Distribution:

The Freshwater Wetland Complex community is found on the alluvial plains adjacent to Mammy Johnsons River.

Relationship to Other Communities:

The determined freshwater wetland community has a close relationship to the mapped Cabbage Gum Floodplain Forest and the Riparian Closed Forest, and integrated into the cleared agricultural land.

3.1.2. Vegetation Condition Assessment

The vegetation condition assessments are from site interpretation and indicate that significant disturbance and modification has occurred across the study area. Vegetation with relatively little evidence of modification generally has minimal timber harvesting (few stumps, coppicing, cut logs), minimal firewood collection, minimal exotic weed cover, minimal grazing and trampling by introduced or overabundant native herbivores, minimal soil disturbance, minimal canopy dieback, no evidence of recent fire or flood, not subject to high frequency burning, and evidence of recruitment of native species. Table 9 shows an estimated condition for all 8 vegetation types mapped on the study area.

Table 9. Vegetation Condition Assessment table.

Vegetation Condition Indicators.	Vegetation Groups							
	1	2	3	4	5	6	7	8
Timber Harvesting	1	3	3	3	2	1	2	3
Firewood Collection	0	0	0	0	0	0	0	0
Exotic Weed Cover	2	2	1	2	1	1	1	3
Grazing Impacts and Trampling by Introduced or Overabundant Native Herbivores	3	3	2	2	2	2	1	3
Soil Disturbance	2	2	1	2	1	1	1	2
Canopy Dieback	0	0	1	2	1	1	1	0
Evidence of Recent Flood or High Velocity Flows	3	0	0	0	0	0	0	0
Frequency of Burning	0	0	1	0	1	0	1	0
Natural Recruitment of Native Species, unless High Levels of Anthropogenic Disturbance are Observed	2	2	3	1	2	3	3	1

0 = Nil; 1 = Minimal; 2 = Moderate; 3 = High.

3.2. Fauna

3.2.1. Fauna Habitat

Fauna habitat assessment proformas completed for the 9 representative zones within the study area are provided in Appendix 5.

Dry Sclerophyll Forest

Numerous remnant patches of dry sclerophyll forest exist across the study area, surrounded by areas of cleared land. Most of the forest is regrowth, with only small numbers of old growth trees present. A substantial level of grazing occurs in several of the remnant patches, although this has not stopped regeneration occurring, with evidence of regeneration in most remnant patches.

The number of habitat layers varies between patches, with some containing a grass, shrub, mid-storey and canopy layer, while others lack a shrub layer or contain only a grass and tall canopy layer with little undergrowth. The dominant tree height in all patches ranges from 10-20m.

Good internal connectivity exisits in almost all of the dry sclerophyll forest patches. External connectivity is generally poor, with only thin strips of remnant vegetation (often sparse) connecting patches to other areas of vegetation in some directions.

The level of hollow abundance is low, attributed to the small number of old growth trees remaining. The forest floor is covered mostly by grass, with some areas covered by leaf litter or sedges, and some small areas remaining bare. There is a reasonable level of ground log abundance in most patches.

Grassy Woodlands

Consists mostly of remnant forest dominated by regrowth, or grasslands with only scattered remnant trees present. Regeneration is occurring in most areas, with moderate to high levels of grazing observed. In some areas internal connectivity is good, while in others it is extremely poor. External connectivity is generally poor.

Many areas contain only a canopy and grass layer, while some areas also contain a sparse shrub and mid-storey. The canopy generally consists of Eucalypts with a dominant tree height of 15-20m.

The level of hollow abundance is low with only a small number of old growth trees present. The ground is dominated by grass with small amounts of leaf litter and bare ground also present. Minimal to moderate levels of ground log abundance occur throughout.

Dry Rainforest Grassland

Generally remnant regrowth forest with some large old growth trees remaining. Occurs predominately along waterways and is heavily infested with Privet in areas. There is little to no evidence of regeneration occurring with low levels of grazing observed throughout. In most areas internal connectivity is good, while poor in others. This forest runs along the entire length of some waterways and connects to large patches of remnant forest in areas.

Large areas of this forest type consist only of a ground and canopy layer although a mid-storey occurs in places. Dominant tree heights range from 10-20m.

Very few hollows exist although some trunk scratches were observed in a small number of trees. Herb, grasses and ferns cover much of the ground, although in places there are large areas of bare ground, particularly on the lower river banks. Tall grasses and weed species adjoin the riparian zone. Minimal amounts of ground log abundance were observed throughout.

Various plants found at the study area provide particular fauna habitat attributes as listed in Table 10.

Table 10. Plants found on site which provide particular fauna habitat attributes.

Common Name	Scientific Name	Habitat Values
Wattle	*Acacia decurrens, Acaia irrorata subsp irrorata*	Squirrel Glider feed Tree
Forest Oak	*Allocasuarina littoralis, Allocasuarina torulosa*	Glossy Black Cockatoo feed tree
Rough-barked Apple	*Angophora subvelutina*	Yellow-bellied Glider sap tree
Bottlebrush	*Callistemon spp*	Nectar producing plant
Spotted Gum	*Corymbia maculata*	Yellow-bellied Glider sap tree
Cabbage Gum	*Eucalyptus amplifolia*	Yellow-bellied Glider sap tree; Koala food tree
Narrow-leaved Ironbark	*Eucalyptus crebra*	Winter-flowering eucalypt
Thin-leaved Stringybark	*Eucalyptus eugenioides*	Yellow-bellied Glider sap tree
White Stringybark	*Eucalyptus globoidea*	Winter-flowering eucalypt
Tallowwood	*Eucalyptus microcorys*	Prime Koala food tree (SEPP 44)
Grey Box	*Eucalyptus moluccana*	Yellow-bellied Glider sap tree
Grey Gum	*Eucalyptus propinqua*	Yellow-bellied Glider sap tree; Koala food tree
Grey Gum	*Eucalyptus punctata*	Yellow-bellied Glider sap tree; prime Koala food tree (SEPP 44)
Forest Red Gum	*Eucalyptus tereticornis*	Yellow-bellied Glider sap tree; Winter-flowering eucalypt; prime Koala food tree (SEPP 44)
Cherry Ballart	*Exocarpus spp*	Fruit bearing plant
Orchids	*Family: ORCHIDACEAE*	Orchids
Figs	*Ficus spp*	Fruit bearing plants
Tea-tree	*Leptospermum spp*	Nectar producing plants
Paperbark	*Melaleuca spp*	Nectar producing plant; *Melaleuca quinquenervi*a is a Koala browse tree
Geebung	*Persoonia spp*	Fruit-bearing plant
Bramble	*Rubus spp*	Fruit bearing plant
Grass Tree	*Xanthorrhoea spp*	Nectar bearing plant

Habitat Tree Hollow Surveys

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

Of the 611 hollows detected, 414 were small (<8 cm diameter), 134 medium (8-20 cm diameter) and 63 large (>20 cm diameter) (Figure 12). The locations of 184 trees (stag and living) on-site, which had habitat hollows, are plotted in Figure 13.

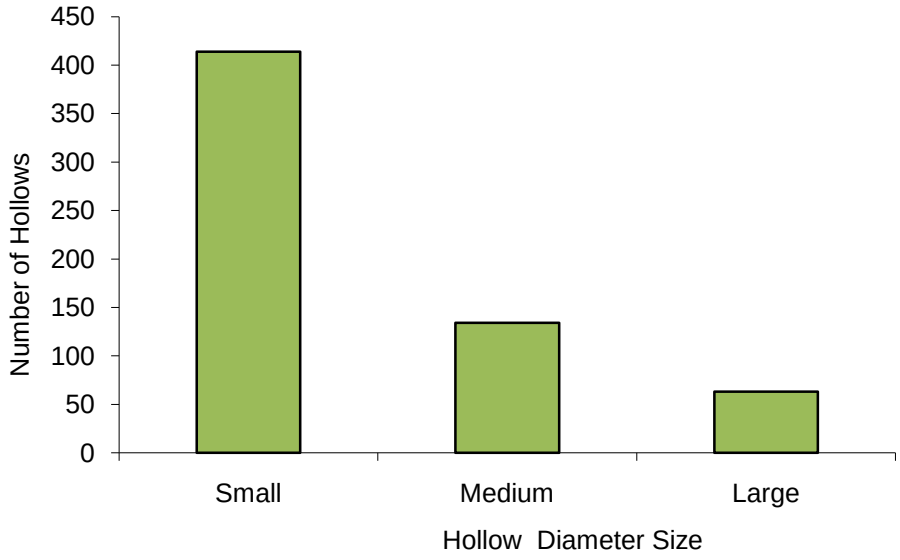


Figure 12: Number of trees within each hollow diameter size class.

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

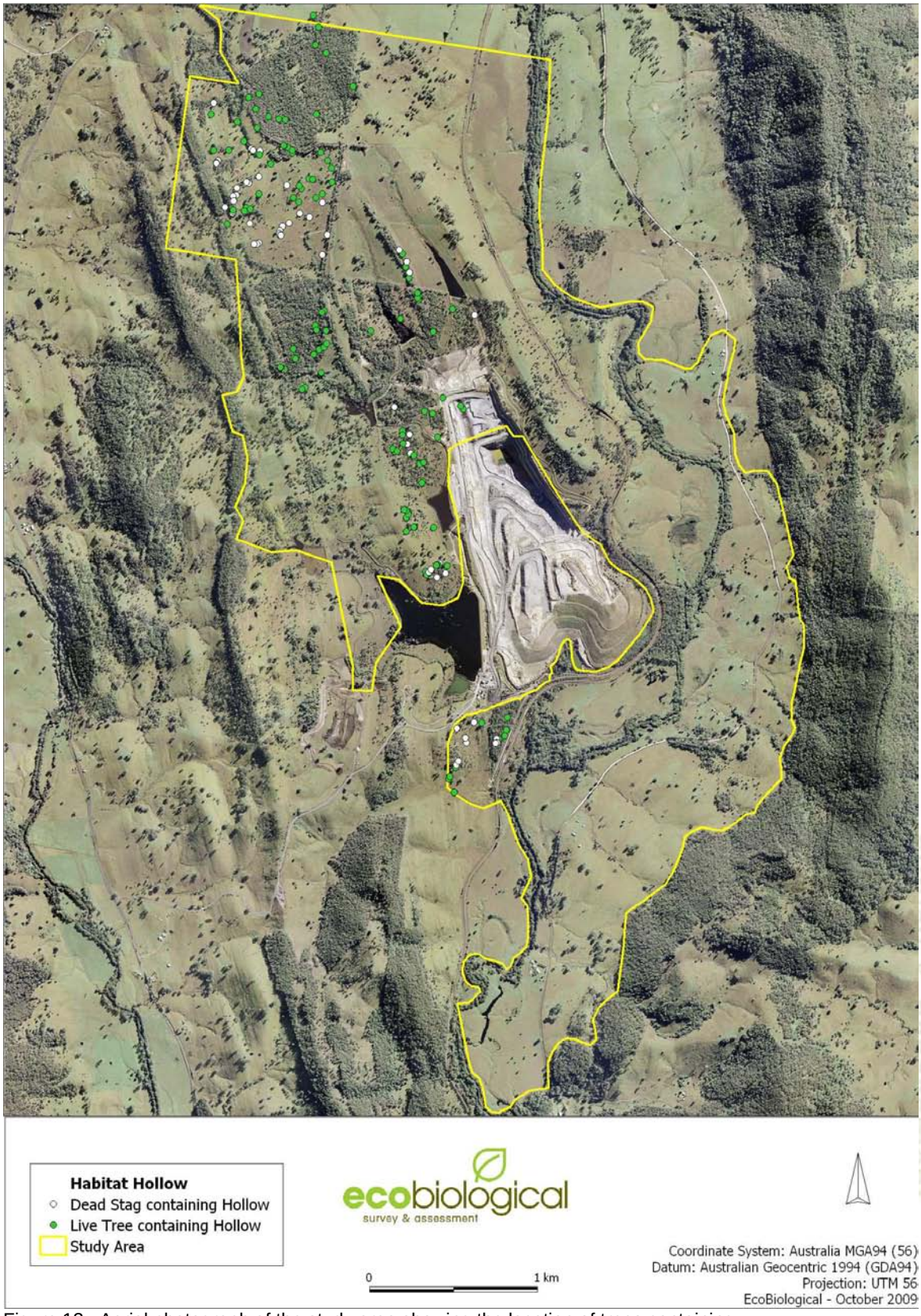


Figure 13: Aerial photograph of the study area showing the location of trees containing habitat hollows.

SEPP 44 Koala Habitat

Three listed SEPP 44, Schedule 2 feed tree species were recorded within the study area (*Eucalyptus tereticornis* (Forest Red Gum), *E. microcorys* (Tallowwood) and *E. punctata* (Grey Gum)). In some areas, these trees were found to constitute greater than 15% of the total number of trees in the upper and lower strata of the tree component. These areas were targeted for fieldwork using the Spot Assessment Technique.

Koala Spot Assessment Technique (SAT) Results

The minimum recommended 20 trees sampled for each site was achieved with a total of 160 trees investigated. The activity level for each SAT is expressed as the percentage equivalent of the quotient derived by dividing the number of trees which had one or more koala faecal pellets recorded beneath them by the total number of trees sampled. The results from the SAT for all test sites returned between 0% - 5% activity level (Table 11, Figure 14).

Table 11: Results of SAT tests undertaken in the study area.

SAT Test Number	Trees With Pellets	Total Trees Surveyed	Activity Level %
1	0	20	0
2	1	20	5
3	0	20	0
4	0	20	0
5	0	20	0
6	0	20	0
7	0	20	0
8	0	20	0

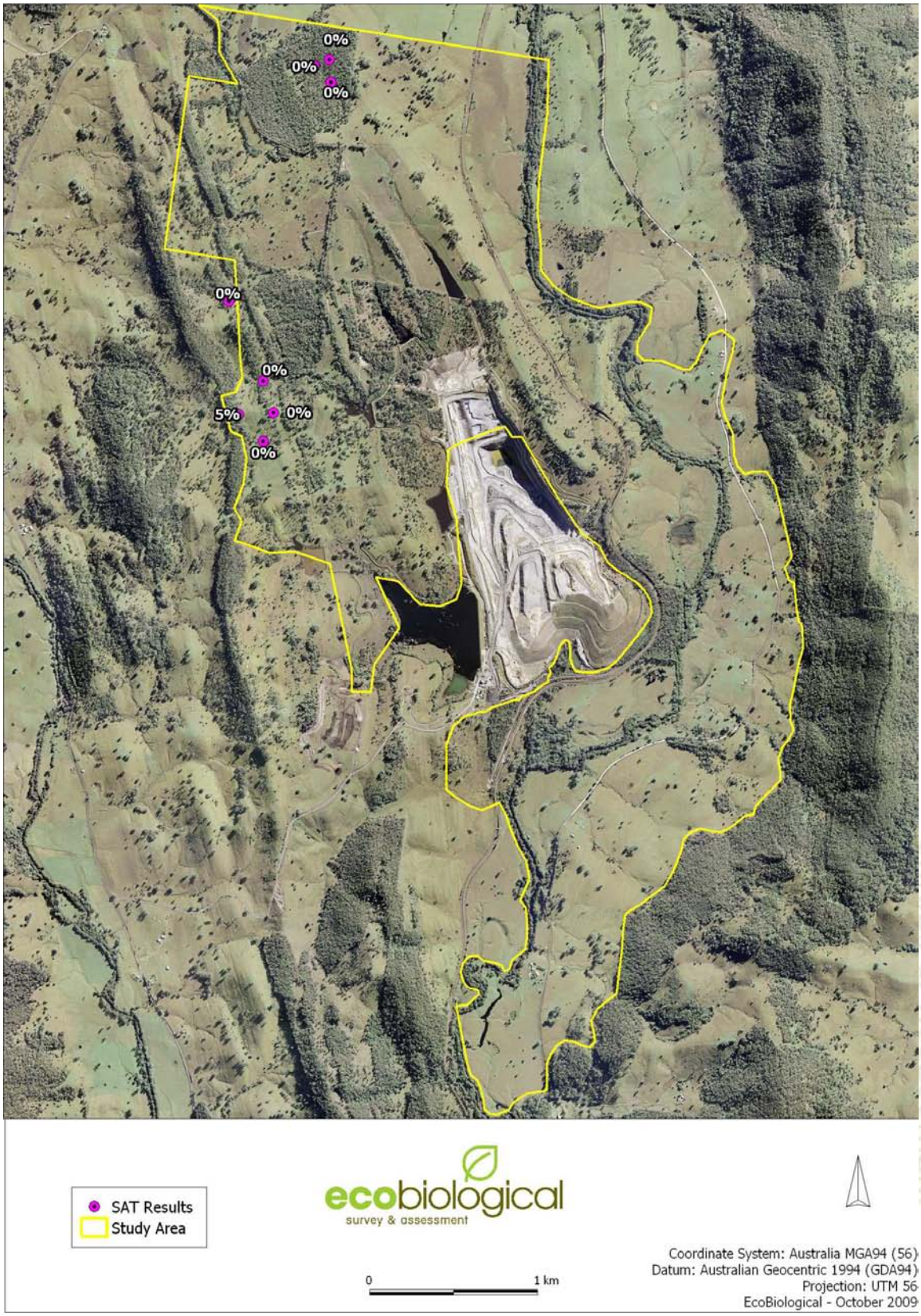


Figure 14: Aerial photograph of the study area showing the location of Koala SAT tests and corresponding results.

3.2.2. Fauna Species Composition

A total of 156 fauna species were recorded within the study area. A list of these species is shown in Appendix 2. These species included 17 frogs, 12 reptiles, 99 birds, 11 bats and 5 arboreal and 12 terrestrial mammals. The relative abundance for each species is also shown in Appendix 2.

3.2.3. Threatened Fauna Species

Eleven threatened fauna species were recorded during the surveys (Figure 15). These species, together with their sampling location, respective co-ordinates and number of individuals observed, are outlined in Table 12.

All of the threatened species recorded at the study site are listed as Vulnerable under the TSC Act, with the exception of the Swift Parrot and Giant Barred Frog, which are both listed as Endangered under the TSC Act. Both of these latter species are also listed as Endangered under the EPBC Act and are therefore potentially matters of national significance. The detection of the Giant Barred Frog in particular is a significant finding, as this record along with 3 other records located in close proximity to the study site forms the only known population of Giant Barred Frog between the Hunter and Manning Rivers (no populations known to occur between the Watagan Mountains in the South and Lansdowne State Forest in the north). This population, therefore, is the only known population in the entire Gloucester Valley.

Table 12. Threatened fauna species recorded in the study area.

Scientific Name	Common Name	Survey Method	Habitat recorded in	Sampling location co-ordinates / date observed			No. of individuals observed
Amphibians				Longitude	Latitude	Date	
Mixophyes iteratus	Giant Barred Frog	Nocturnal amphibian survey	Riparian Closed Forest along Mammy Johnsons River NB: In total 6 females were caught and inspected and were found to be in good body condition. 5 adult males were sighted, 2 of which were caught and released. A further 10-11 males were heard calling unprovoked.	151.9506683	-32.30478268	26/2/09	1 recently metamorphosed juvenile was caught and released.
				151.9466244	-32.30443393	26/2/09	1 male sighted
				151.9447814	-32.31097207	25/2/09	1 male calling
				151.9401451	-32.32102205	24/2/09	1 male sighted/1 male calling
				151.9439412	-32.3069739	25/2/09	1 male sighted
				151.9446855	-32.30635246	25/2/09	1 female sighted
				151.944872	-32.30562508	25/2/09	1 female sighted
				151.9407519	-32.32303094	24/2/09	1 female sighted / 6-7 calling males
				151.9399218	-32.32013164	24/2/09	1 female sighted
				151.9447112	-32.31323744	25/2/09	2 male & 1 female sighted
				151.9413228	-32.32417842	24/2/09	2 males calling
				151.945433	-32.30545837	25/2/09	1 female sighted
Birds							
Chthonicola sagittata	Speckled Warbler	Bird survey	Spotted Gum - Red Ironbark - Thick-leaved Mahogany Forest	151.9281	-32.2716	18/4/07	2 individuals sighted
			Spotted Gum - Red Ironbark - Thick-leaved Mahogany Forest	151.9292	-32.2711	18/4/07	2 individuals sighted
			Spotted Gum - Red Ironbark - Thick-leaved Mahogany Forest	151.9308	-32.2713	28/11/07	3 individuals sighted
			Red Gum Grassy Woodland	151.9403	-32.2859	18/4/07	1 individual sighted
Climacteris picumnus	Brown Treecreeper	Opportunistic sighting	Spotted Gum - Thick-leaved Mahogany Forest	151.9276	-32.2707	8/4/09	2 individuals sighted along edge of Cheerup Road
Lathamus discolor	Swift Parrot	Opportunistic sighting	Spotted Gum - Thick-leaved Mahogany Forest	151.9282	-32.2696	7/08/08	1 individual sighted
Pomatostomus temporalis temporalis	Grey-crowned Babbler	Opportunistic sighting	Spotted Gum - Thick-leaved Mahogany Forest	151.9295	-32.2721	16/4/07	Group of 6 birds observed along Cheerup Road

Table 12 cont. Threatened fauna species recorded in the study area.

Scientific Name	Common Name	Survey Method	Habitat recorded in	Sampling location co-ordinates / date observed			No. of individuals observed
Mammals				Longitude	Latitude	Date	
Miniopterus oceanensis	Eastern Bentwing-bat	Anabat analysis	Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest	151.9302	-32.271	6 – 7/4/09	Unknown
			Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest	151.9263	-32.2863	6 – 7/4/09	Unknown
			Riparian Closed Forest	151.9449	-32.3132	6 – 7/4/09	Unknown
			Grasslands	151.9507	-32.3092	6 – 7/4/09	Unknown
Mammals							
Mormopterus norfolkensis	Eastern Freetail-bat	Anabat analysis	Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest	151.9263	-32.286	6 – 7/4/09	Unknown
			Riparian Closed Forest	151.9449	-32.3134	6 – 7/4/09	Unknown
			Riparian Closed Forest	151.9524	-32.2823	6 – 7/4/09	Unknown
Myotis macropus	Large-footed Myotis	Anabat analysis	Riparian Closed Forest	151.9515489	-32.30428442	29/1/09	Unknown
			Riparian Closed Forest	151.9505644	-32.30934205	6 – 7/4/09	Unknown
			Grasslands	151.9523733	-32.28203143	6 – 7/4/09	Unknown
Phascolarctos cinereus	Koala	SAT test (1 Koala scat found)	Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest	151.9264	-32.2872	19/8/08	Not applicable
Petaurus norfolcensis	Squirrel Glider	Elliott B Tree trap Spotlighting	Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest	151.9302	-32.269903	17 – 19/4/07 (trapped) 18/4/07 (spotlighted)	4 individuals captured 2 individuals sighted
			Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest	151.9305	-32.283257	17 – 19/4/07 (trapped) 18/4/07 (spotlighted)	6 individuals captured 3 individuals sighted
			Red Gum Grassy Woodland	151.9401	-32.285845	17/4/07 (spotlighted) 18/4/07 (trapped)	1 individual sighted 2 individuals captured
Phascogale tapoatafa	Brush-tailed Phascogale	Elliott B Tree trap Spotlighting	Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest	151.9244	-32.274738	6/4/09	1 individual captured
			Riparian Closed Forest	151.952335	-32.30368559	30/1/09	1 individual sighted

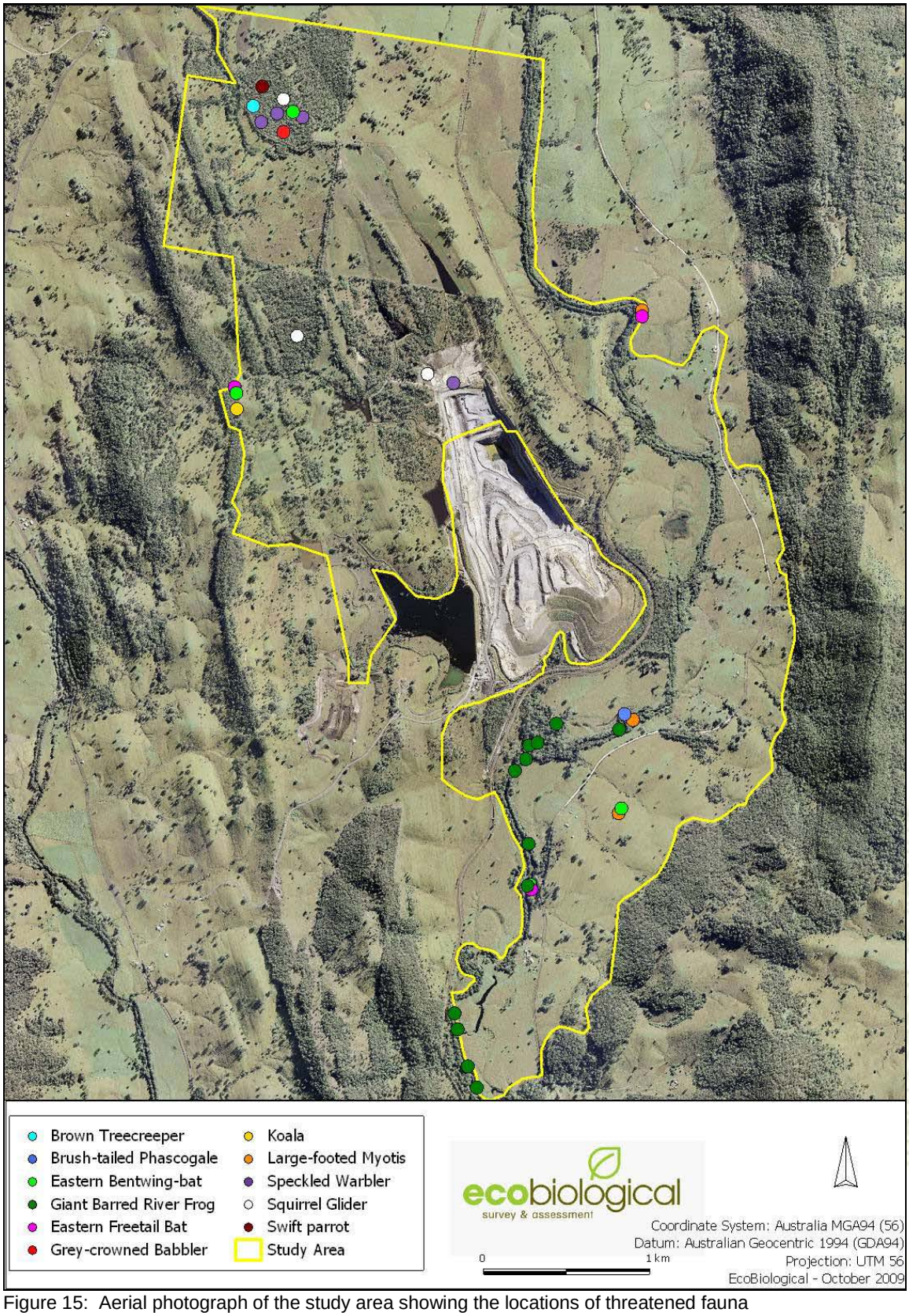


Figure 15: Aerial photograph of the study area showing the locations of threatened fauna detected during field surveys.

4. Conclusions

Field surveys of the study area were conducted between April 2007 and April 2009. The key findings are summarised below.

Vegetation Community Mapping

A total of nine defined vegetation communities were recorded in the study area. There were also areas of cropping recorded across the study area. Vegetation condition ranged from remnant forest in reasonable condition, including some older growth forest supporting trees with habitat hollows, to highly degraded vegetation from clearing, agricultural activities and weed invasion.

Three Endangered Ecological Communities (EECs) have been determined to occur within the study area. The Riparian Closed Forest is determined to form a part of the *Lowland rainforest on floodplain in the NSW North Coast Bioregion* EEC. The Cabbage Gum Floodplain Forest constitutes part of the *River Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC. The Freshwater Wetland Complex would form a part of the *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* EEC.

Flora

Data collected during the field surveys revealed that the study area supported 331 plant speies, 57 of which are introduced, exotic or weed species. These weed species were more commonly found in the cleared and disturbed areas, and along Mammy Johnsons River. No threatened flora species were recorded within the study area.

Fauna

A total of 156 species of vertebrate fauna were recorded across the study area, including 11 threatened species listed under the NSW TSC Act (Giant Barred Frog, Speckled Warbler, Brown Treecreeper, Swift Parrot, Grey-crowned Babbler, Eastern Bentwing-bat, Eastern Freetail-bat, Large-footed Myotis, Squirrel Glider, Koala and Brush-tailed Phascogale). The Swift Parrot and Giant Barred Frog are also listed as Endangered under the EPBC Act.

Four species of vertebrate fauna recorded within the study area are introduced. Thirteen bird species recorded are listed as marine species under the EPBC Act.

5. References

Adam P. & Robinson D. (1996). Negative effects of fuel reduction burning on the habitat of the Grey-crowned Babbler, *Pomatostomus temporalis. Victorian Naturalist* 113: 4-9.

Allison, F.R. & Hoye, G.A. (1995). Eastern Freetail-bat. *The Mammals of Australia.* Ronald Strahan (Ed). Reed New Holland.

Anstis, M. (2002). *Tadpoles of South-Eastern Australia: A Guide with Keys.* Reed New Holland, Sydney.

Archer, M., Flannery, T.F. & Grigg, G.C. (1985). *The Kangaroo.* Weldons, Sydney.

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

Barker, J., Grigg, C.G. & Tyler, M.J. (1995). *A Field Guide to Australian Frogs.* Surrey Beatty & Sons: Norton.

Barrett, G.W., Silcocks, A., Barry, S., Cunningham, R. & Poulter, R. (2003). *The New Atlas of Australian Birds.* Royal Australasian Ornithologists Union, Melbourne.

Barrett, G.W., Ford, H.A. and Recher, H.F. (1994). Conservation of woodland birds in a fragmented rural landscape. Pacific Conservation Biology 1, 245-256.

Bureau of Meteorology (2009). Viewed on 10 June 2009, http://www.bom.gov.au/climate/dwo/.

Beruldsen, G.R. (1980). A Field Guide to Nests and Eggs of Australian Birds. Rigby, Adelaide.

Bibby, C.J., Burgess, N.D. and Hill, D.A. (2000). Bird Census Techniques. Academic Press Limited, London.

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

Brereton, R. (1997). *Management prescriptions for the Swift Parrot in production forests.* Report to the Tasmanian RFA Environment and Heritage Technical Committee.

Briggs, J.D. & Leigh, J.H. (1996). *Rare or Threatened Australian Plants*, CSIRO.

Brown, P.B. (1989). *The Swift Parrot Lathamus discolor*, White: A report on its ecology, distribution and status, including management considerations. Technical Report, Department of Lands, Parks and Wildlife.

Brunner, H., Triggs, B. & Ecobyte Pty Ltd. (2002). Hair ID. An interactive tool for identifying Australia mammalian hair. CSIRO Publishing, Collingwood, Victoria.

Carthew, S.M., Goldingay, R.L. & Funnell, D.L. (1999). Feeding behaviour of the Yellow-bellied Glider (*Petaurus australis*) at the western edge of its range. *Wildlife Research* 26, 199-208.

Chambers, L.E. (1995). The Gang-gang Cockatoo in field and aviary. Victorian Ornithological Research Group: Brunswick East, Victoria.

Churchill, S. (1998). *Australian Bats*, Reed New Holland, Australia.

Cleland, J.B., & Sims, E.B. (1968). Food of the Glossy Black-Cockatoo. *South Australian Ornithologist* 25, 47.

Clout, M.N. (1989). Foraging Behaviour of Glossy Black-Cockatoos. *Australian Wildlife Research* 16, 467-473.

Cogger, H. (2000). *Reptiles and Amphibians of Australia* - 6th edn. Reed New Holland.

Cooper, C.B., Walters, J.R. & Ford, H. (2002). Effects of remnant size and connectivity on the response of Brown Treecreepers to habitat fragmentation. *Emu*: 102, 249-256.

Debus, S. (1995). Bird survey of the proposed Duralie Coal Mine site, Stroud. Report prepared for Duralie Coal Pty Ltd, December 1995.

Debus, S. & Czechura, G.V. (1989). The Square-tailed Kite *Lophoictinia isura*: a review. *Australian Bird Watcher* **13**: 81-97.

Debus, S. (1994). Aspects of the Biology, Conservation and Management of Threatened Forest Owls and Raptors in North-eastern New South Wales. MSc thesis, University of New England, Armidale.

DEC (2004). Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft), NSW Department of Environment and Conservation, Hurstville, NSW.

Department of Environment and Conservation NSW (2005). Green and Golden Bell Frog *Litoria aurea* Recovery Plan. DEC NSW, Hurstville, NSW.

Department of Environment and Conservation (2005). *Draft Recovery Plan for the Large Forest Owls*: Powerful Owl *Ninox strenua* Sooty Owl *Tyto tenebricosa* Masked Owl *Tyto novaehollandiae*. NSW DEC, Sydney, NSW.

Department of Environment & Climate Change (2007). River Flat Eucalypt Forest on Coastal Floodplain: An identification Guide, DECC NSW.

Department of Environment & Climate Change (2009). Atlas of NSW Wildlife, NSW National Parks & Wildlife Service (department of DECC) http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp.

Dwyer, P.D. (1995). Little Bentwing-bat *Miniopterus australis* (Tomes, 1858). *The Mammals of Australia*. Ronald.Strahan (Ed) Reed New Holland.

Dwyer, P.D. (1995). Common Bentwing-bat *Miniopterus schreibersii* (Kuhl, 1817). *The Mammals of Australia*. Ronald.Strahan (Ed) Reed New Holland.

Eby, P. (2000). The results of four synchronous assessments of relative distribution and abundance of Grey-headed Flying-fox *Pteropus poliocephalus*. In *Proceedings of a Workshop to Assess the Status of the Grey-headed Flyingfox in New South Wales*. Richards, G. (ed). ://batcall.csu.edu.au/abs/ghff/ghffproceedings. .

Edgar, R. & Belcher, C. (2002). Spotted-tailed Quoll *Dasyurus maculatus* (Kerr, 1792). *The Mammals of Australia.* Ronald.Strahan (Ed) Reed New Holland.

Ekert, P.A. (2002). The *Woodland Birds of The Liverpool Plains, NSW*. Final Project Report 2002. Report on behalf of Birds Australia for World Wide Fund for Nature, Natural Heritage Trust, Threatened Species Network.

Ekert, P.A. (2004). Supplementary Bird Surveys and Focal Species Analysis in the Liverpool Plains. Report to the Liverpool Plains Land Management Committee, Gunnedah, NSW.

Eldridge, M.D.B. & Close, R.L. (1995). Brush-tailed *(Rock-wallaby Petrogale penicillata)* (Gray, 1825). *The Mammals of Australia*. Ronald Strahan (Ed). Reed New Holland.

ERM Mitchell McCotter Pty Ltd (1996a). Flora survey for proposed Duralie Coal Mine near Gloucester. Report prepared for Duralie Coal Pty Ltd, May 1996.

ERM Mitchell McCotter Pty Ltd (1996b). Winter fauna survey for proposed Duralie Coal Mine near Gloucester. Report prepared for Duralie Coal Pty Ltd, May 1996.

Floyd, A.G. (1990) Australian Rainforests in New South Wales. Surrey Beatty and Sons, Chipping Norton.

Ford, H.A., Barrett, G.W., Saunders, D.A., & Recher, H.F. (2001). Why have birds in the woodlands of southern Australia declined? *Biological Conservation* 97: 71-88.

Forshaw, J.M. (1989). Parrots of the World. Lansdowne Editions: Willoughby, Sydney.

Franklin, D.C., Menkhorst, P.W. & Robinson, J.L. (1989). Ecology of the Regent Honeyeater *Xanthomyza phrygia*. *Emu* **89**:140-154.

Frith, H.J. (1982). *Pigeons and Doves of Australia.* Rigby: Sydney.

Freudenberger, D. (1999). *Guidelines for Enhancing Grassy Woodlands for the Vegetation Investment Project*. A report commissioned by Greening Australia, ACT and SE NSW. CSIRO Wildlife and Ecology, Canberra.

Gardner, J. L. (2004). Winter flocking behaviour of speckled warblers and the Allee effect, Biological Conservation, 118, 195-204.

Gardner, J. L., Magrath, R. D. & Kokko, H. (2003). Stepping stones of life: natal dispersal in the group-living but noncooperative speckled warbler, Animal Behaviour, 66: 521-530.

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

Garnett, S.T., Crowley, G.M. & Barrett, G. (2001). National Land and Water Resource Audit. http://www.nlwra.gov.au/.

Gates, J.A. & Paton, D.C. (2005). The distribution of Bush Stone-curlews (*Burhinus grallarius*) in South Australia, with particular reference to Kangaroo Island. *Emu*, **105**: 241 – 247.

Geering, D. & French, K. (1998). Breeding biology of the Regent Honeyeater *Xanthomyza phrygia* in the Capertee Valley, New South Wales. *Emu* **98**:104-116.

Gibbons, P. and Lindenmayer, D. (2002) *Tree Hollows and Wildlife Conservation in Australia*. CSIRO Publishing, Canberra.

Gow, G. (1976). *Snakes of Australia.* Angus and Robertson, Sydney.
Hamer, A.J., Lane, S.J. & Mahony, M.J. (2002). Management of freshwater wetlands for the endangered green and golden bell frog (*Litoria aurea*): roles of habitat determinants and space. *Biological Conservation* 106(3): 413- 424.

Grey, M.J., Clarke, M.F. & Loyn, R.H. (1998). Influence of the Noisy Miner *Manorina melanocephala* on avian biodiversity and abundance in remnant Grey Box woodland. *Pacific Conservaton Biology***4**:55-69.

Harden, G.J. (ed) (1992). *Flora of New South Wales Volume 3*. NSW University Press: Sydney.

Harden, G.J. (ed) (1993). *Flora of New South Wales Volume 4*. NSW University Press: Sydney.

Harden, G.J. (ed) (2000). *Flora of New South Wales Volume 1*. NSW University Press: Sydney.

Harden, G.J . (ed) (2002). *Flora of New South Wales Volume 2*. NSW University Press: Sydney.

Harden, I. (1981). *Australian Parrots in Bush and Aviary*. Inkata Press, Melbourne and Sydney.

Higgins, P.J. (Ed.) (1999). *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 4, Parrots to Dollarbird. Oxford University Press, Melbourne.

Higgins, P.J. & Peter, J.M. (eds) (2002). '*Handbook of Australian, New Zealand and Antarctic Birds*. Volume 6: Pardalotes to shrike-thrushes'. Oxford University Press, Melbourne.

Holland, G.J. (2001). Opportunistic Vertebrate Predation by the Squirrel Glider (*Petaurus norfolcensis*) *The Victorian Naturalist*, 118 (4).

Hollands, D. (1991). *Birds of the Night*. Reed, Sydney.

Hoye, G. (1995). Winter survey of the bat fauna of the proposed Duralie Coal Mine Report prepared by Glenn Hoye of Fly By Night Bat Surveys Pty Ltd, July 1995.

Hoye, G.A. (1995). *A bat survey of the Morisset Forestry District*. Morisset Forestry District Environmental Impact Statement Supporting Document No. 5.

Hoye, G.A. & Dwyer, P.D. (1995). Large-eared Pied Bat *Chalinolobus dwyeri* (Ryan 1966) *The Mammals of Australia*. Ronald.Strahan (Ed) Reed New Holland.

Hoye, G.A. & Richards, G.C. (1995). Greater Broad-nosed Bat *Scoteanax rueppellii* (Peters, 1866) *The Mammals of Australia*, Ronald Strahan (Ed) Reed New Holland.

Henderson, L.E. (2000). Soil Landscapes of the Dungog 1:100000 Sheet. Department of Land and Water Conservation, Sydney.

Hunter Bird Observers Club. (1997). *Hunter region of New South Wales annual bird report number 6*. Hunter Bird Observers Club Inc.

Hunter Bird Observers Club. (1998). *Hunter region of New South Wales annual bird report number 6*. Hunter Bird Observers Club Inc.

Immelmann, K. (1982). *Australian Finches*. Angus and Robertson, Sydney.

Johnson, G. & Baker-Gabb, D.J. (1994). Bush Thickknee in Northern Victoria (Part 1): Conservation and Management. *Arthur Rylah Inst. Environ. Res. Tech. Report* 129(A).

Joseph, L. (1982). The Glossy Black-Cockatoo on Kangaroo Island. *Emu*. **82**, 46-49.

Kavanagh, R.P., Debus, S.J.S., Rose, A.B. & Turner, R.J. (1995). Notes on the diet and habitat of the Barking Owl *Ninox connivens* in New South Wales. *Australian. Bird Watcher* **16**: 137-144.

Kavanagh, R.P. (1997). Ecology and Management of Large Forest Owls in South-eastern Australia. PhD thesis, University of Sydney, Sydney.

Kavanagh, R.P., (2002a). Conservation and management of large forest owls in southeastern Australia. In *Ecology and Conservation of Owls*. Newton I., Kavanagh R., Olsen J., and Taylor I. (Eds) CSIRO.

Kavanagh, R.P., (2002b). Comparative diets of the Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl *(Tyto novaehallandiae*) in southeastern Australia. In *Ecology and Conservation of Owls*. Newton I., Kavanagh R., Olsen J., and Taylor I. (Eds) CSIRO.

Kavanagh, R.P. & Stanton, M.A. (2002). Response to habitat fragmentation by the Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*) and other nocturnal fauna in southeastern Australia Pp 265-277. In Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (eds.). *Ecology and Conservation of Owls*. CSIRO Publishing. Collingwood Victoria.

Keith, D. (2004) Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT. NSW Department of Environment and Conservation, Hurstville.

Lemckert, F. & Brassil, T. (2000). Movements and habitat use of the endangered Giant Barred River Frog (*Mixophyes iteratus*) and the implications for its conservation in timber production forests in Biological Conservation 96: 177-184.

Ley, A.J. & Williams, M.B. (1992). The conservation status of the Regent Honeyeater near Armidale, New South Wales. *Australian Bird Watcher* **14**:277-281.

Lou, J., Fox B.J. & Jeffreys E. (1994). Diet of the Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*): I. Composition, diversity and individual variation. *Wildlife Research* 21: 401-417.

Lunney, D. & Matthews, A. (2001). The contribution of the community to defining the distribution of a vulnerable species, the spotted-tailed quoll, *Dasyurus maculatus*. *Wildlife Research*, 28, 537–545.

Makinson, R.O. (2000). Grevillea. Proteaceae of New South Wales. Harden GJ, Hardin DW & Godden DC (Ed) UNSW Press.

Mahoney, J.A. & Posamentier, H. (1975). The occurrence of the native rodent *Pseudomys gracilicaudatus* (Gould 1845) Rodentia: Muridae in NSW. *Australian Mammalogy* 1: 333-346.

Mahony, M.J. (1999). Review of the declines and disappearances within the bell frog species group (*Litoria aurea* species group) in Australia. pp 81-93. In: Campbell A. (Ed.) declines and disappearances of Australian frogs. Biodiversity Group Environment Australia: Canberra.

Major, R., Christie, F. & Gowing, G. (1998). *The Value of Remnant Vegetation for Birds in the New South Wales Wheatbelt*. Australian Museum: Sydney.

Marchant, S. & Higgins, P. (Eds.) (1993). *Handbook of Australian, New Zealand & Antarctic Birds*. Volume 2: Raptors to Lapwings, Oxford University Press, Melbourne.

Martin, R.W.& Handasyde, K.A. (2002) Koala. *The Mammals of Australia.* Ronald Strahan (Ed) Reed New Holland.

Maynes, G. (1995). Parma Wallaby (*Macropus parma). The Mammals of Australia.* Ronald Strahan (Ed), Reed New Holland.

Maynes, G. (1977). Distrubution and Aspects of the biology of the Parma Wallaby (*Macropus parma) i*n New South Wales. *Australian Journal of Wildlife Research, 4, 109-25*.

Menkhorst, P. & Knight, F. (2001). *A Field Guide to the Mammals of Australia*. Oxford University Press.

Moore, B.D., & Foley, W.J. (2000) A review of feeding and diet selection in koalas (*Phascolarctos cinereus*), *Australian Journal of Zoology*, 48, 317–333.

Murray, M., Bell, S. & Hoye, G. (2002a). Flora and fauna survey guidelines: Lower Hunter and Central Coast Regional Environmental Management Strategy, Callaghan, Volume 1.

Murray, M., Bell, S. & Hoye, G. (2002b). Flora and fauna survey guidelines: Lower Hunter and Central Coast Regional Environmental Management Strategy, Callaghan, Volume 2.

NPWS (1999). Threatened Species Information, Glossy Black-Cockatoo *Calyptorhynchus lathami,* NSW National Parks and Wildlife Service.

NPWS (2000). Threatened Species of the Lower North Coast of New South Wales. NPWS, Sydney.

NPWS (2002). Threatened Species of the Upper North Coast of NSW: Fauna. NPWS, Coffs Harbour.

Noske, R.A. (1991). A demographic comparison of cooperatively breeding and non-cooperative treecreepers (Climacteridae). *Emu* 91, 73-86.

Oliver, D.L. (1998). Breeding behaviour of the endangered Regent Honeyeater *Xanthomyza phrygia* near Armidale, N. S. W. *Australian Journal of Zoology* **98**:97-103.

Oliver, D.L. (2000). Foraging behaviour and resource selection of the Regent Honeyeater *Xanthomyza phrygia* in northern New South Wales. *Emu* **100**:12-30.

Oliver, D.L., Ley, A.J., Ford, H.A. & Williams, B. (1999). Habitat of the Regent Honeyeater *Xanthomyza phrygia* and the value of the Bundarra-Barraba region for the conservation of avifauna. *Pacific Conservation Biology* **5**:224-239.

Olsen, P. & Doran, B. (2002). Climatic modelling of the Australian distribution of the grass owl (*Tyto capensis*): is there an inland population? *Wildlife Research*, 29: 117 – 125.

Parnaby, H. (1992). An interim guide to identification of insectivorous bats of south-eastern Australia. Technical Reports of the Australian Museum No. 8. Australian Museum, Sydney.

Parry-Jones, K.A. & Augee, M. (1991). Food selection in Grey-headed flying foxes (*Pteropus poliocephalus*) occupying a summer colony site near Gosford, NSW. *Wildlife Research* **18**: 111-124.

Pepper, J.W. (1996). The behavioural ecology of the Glossy Black-Cockatoo *Calyptorhynchus lathami halmaturinus*. PhD thesis. University of Michigan, Ann Arbour.

Pepper, J.W., Male, T.D. & Roberts, G.E. (2000). Foraging ecology of the South Australian glossy black cockatoo *Calyptorhynchus lathami halmaturinus*. *Austral Ecology*, 25: 16-24.

Phillips, W. (1995). Eastern False Pipistrelle *Falsistrellus tasmaniensis*. *The Mammals of Australia*. Ronald Strahan (Ed). Reed New Holland.

Phillips, S. & Callaghan, J. (1995). The Spot Technique for Determining the Significance of Habitat Utilisation by Koalas. Australian Koala Foundation: Brisbane.

Phillips, S. & Callaghan, J. (2000) Tree species preferences of koalas (*Phascolarctos cinereus*) in the Campbelltown area South-west of Sydney, New South Wales. *Wildlife Research* 27: 509-516.

Phillips, S., Callaghan, J. & Thompson, V. (2000). The tree species preferences of koalas (*Phascolarctos cinereus*) inhabiting forest and woodland communities on Quaternary deposits in the Port Stephens area, New South Wales. *Wildlife Research* 27: 1-10.

Poore M.E.D. (1955) *The use of Phtosociological Methods in Ecological Investigations: The Braun Blanquet System*. Botany School, University of Cambridge.

Quinn, D.G. (1995). Population Ecology of the Squirrel Glider (*Petaurus norfolcensis*) and the Sugar Glider (*Petaurus breviceps*) (Marsupiala: Petauridae) at Limeburners Creek on the Central North Coast of New South Wales. *Wildlife Research* 22:471-515.

Read, D.G., and Fox, J.B. (1991) Assessing the Habitat of the Parma Wallaby, *Macropus parma* (Marsupialia : Macropodidae). *Wildlife Research,* 18, 469-78.

Read, J.L. (1994). The diet of three species of firetail finches in temperate South Australia. *Emu,* 94:1-8.

Redhead, T. D. (2002). Common Planigale *Planigale maculata*. *The Mammals of Australia.* Ronald Strahan (Ed) Reed New Holland.

Reid, J. (1999). 'Threatened and Declining Birds in the New South Wales Sheep-wheatbelt: Diagnosis, Characteristics and Management'. Report to NSW NPWS: Sydney.

Richards, G.C. (1995). Large-footed Myotis *Myotis adversus* (Morsefield, 1824). *The Mammals of Australia*. Ronald Strahan (Ed). Reed New Holland.

Richards, G. C. (1995). Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (Peters, 1867) *The Mammals of Australia*. Ronald Strahan (Ed) Reed New Holland.

Robinson, D. & Traill, B.J. (1996). Conserving woodland birds in the wheat and sheep belts of southern Australia. *RAOU Conservation Statement* 10.

Robinson, M. (1998). A Field Guide to Frogs of Australia. Reed New Holland: Sydney.

Rowston, C. (1998a). '*The Squirrel Glider: An Autecological Study in a Fragmented Landscape*' PhD Thesis, Faculty of Environmental Sciences, Griffith University, QLD.

Rowston, C. (1998b). Nest- and refuge-tree usage by squirrel gliders, *Petaurus norfolcensis*, in south east Queensland, *Wildlife Research*, **25:** 157-164.

Russell, R. (1995). Yellow-bellied Glider, *Petaurus australis* Shaw (1791). *The Mammals of Australia*, Ronald Strahan (Ed) Reed New Holland.

Schodde, R. & Mason, I.J. (1999). *The Directory of Australian Birds: Passerines*. CSIRO, Collingwood, Victoria.

Shields, J. & Chrome, F. (1992). Parrots and Pigeons of Australia. Angus and Robertson: Sydney.

Smith, A. (2002). Squirrel Glider (*Petaurus norfolcensis*) Conservation Management Plan: Wyong Shire. Report to Wyong Shire Council, November 2002.

Soderquist, T. (1995). Brush-tailed Phascogale *Phascogale tapoatafa* (Meyer, 1793). *The*
*Mammals of Australia.*Ronald Strahan (Ed) Reed New Holland.

Suckling, G.C. (1995). Squirrel Glider (*Petaurus norfolcensis*) Kerr, (1792). *The Mammals of Australia*. Ronald Strahan (Ed) Reed New Holland.

Swan, G., Shea, G. & Sadlier, R. (2004). *A Field Guide to Reptiles of New South Wales.* Reed New Holland, Sydney.

SWC (1996). Eleebana Local Squirrel Glider Study: Report to Lake Macquarie City Council by SWC Wetland and Ecological Management Consultancy.

Tidemann, C.R. (1995). Grey-headed flying fox, *Pteropus poliocephalus* (Temminck, 1825). *The Mammals of Australia*. Ronald Strahan (Ed) Reed New Holland.

Tzaros, C. (1996). Nesting and ecology of the Speckled Warbler. Aust. Birdwatcher, 16:221-225.

Traill, B.J. & Duncan, S. (2000). *Status of birds in the New South Wales temperate woodlands region*. Report to the New South Wales National Parks and Wildlife Service, Dubbo.

Triggs, B. (1996). *Tracks, Scats and Other Traces: A Field Guide to Australian Mammals*, Oxford University Press.

Turner, V. & Ward S.J. (2002). Eastern Pygmy-possum (*Cercatetus nanus*). *The Mammals of Australia*. Ronald Strahan (Ed), Reed New Holland.

van der Ree, R., Soderquist, T.R., & Bennett, A.F. (2001). Home-range use by the Brush-tailed Phascogale (*Phascogale tapoatafa*) (Marsupialia) in high-quality, spatially limited habitat. *Wildlife Research*, 28, 517–525.

Walters, J., Ford, H. and Cooper, C. (1999). The ecological basis of sensitivity of Brown Treecreepers to habitat fragmentation: a preliminary assessment. Biological Conservation 90, 13-20.

Watkins, D. (1993). A National Plan for shorebird conservation in Australia. RAOU Report **90**:1-162.

Webber, P. (1996). Herpetological survey of the proposed Duralie Coal Mine via Gloucester, NSW. Report prepared for Duralie Coal Pty Ltd, January 1996.

Webster, R. & Menkhorst, P. (1992). The Regent Honeyeater (*Xanthomyza phrygia*): population status and ecology in Victoria and New South Wales. *Arthur Rylah Inst. Tech. Rep. Ser.* 126, Department of Conservation and Environment, Melbourne.

White, H.M. & Pyke, G.H. (1996). Distribution and conservation status of the green and golden bell frog, *Litoria aurea*, in New South Wales. *Australian Zoology*, 30, pgs. 177-189.

Woodside, D.P. (1995). Golden-tipped Bat *Kerivoula papuensis* (Dobson, 1878) *The Mammals of Australia*. Ronald Strahan (Ed) Reed New Holland.

Woodward-Clyde (1996a). Summer flora report for proposed Duralie Coal Mine. Report prepared for Duralie Coal Pty Ltd.

Woodward-Clyde (1996b). Summer fauna report for proposed Duralie Coal Mine. Report prepared for Duralie Coal Pty Ltd.

Appendix 1: Species Profiles

The following section provides summary information on the habitat requirements and distribution of threatened flora and fauna that were listed in the threatened species preliminary assessment.

Asperula asthenes

Asperula asthenes is a small herb with weak straggling stems, small leaves in whorls of four separated by internodes of 4-7 cm. The plant has small white flowers and grows in damp places often at the edge of streams or river banks and is recorded from Taree to Bulahdelah (Harden 1992). There are also records for the species in the NPWS Atlas database for the Booral region.

Eucalyptus glaucina

This is a member of the Redgum group of eucalypts (e.g. *E. tereticornis, E amplifolia*) with the distinguishing feature being a blue-grey coating (glaucous) over the leaves buds and fruit. The species can be locally abundant but these occurrences are scattered across its range within the North Coast bioregion of NSW. The tree is generally found in grassy woodland on deep, moderately fertile and well-watered soil (Harden 2002).

Grevillea guthrieana

Previously included under *Grevillea obtusifolia* subsp. *granulifera,* this plant is one of the 'Spider Flowers'. It is found only in the Booral-Bulahdelah area of NSW growing on creek lines in moist eucalypt forest. It prefers to grow on sandy soils derived from sandstone (Makinson 2000).

Syzygium paniculatum

A small tree commonly known as Magenta Lilly Pilly that grows to about 15m tall and can be found in littoral rainforest growing on sand or in subtropical rainforest and growing on sandy soil derived from sandstone (Floyd 1989) from Jervis Bay to Bulahdelah.

Litoria aurea (Green and Golden Bell Frog)

The Green and Golden Bell Frog is a large frog with a robust body form ranging from 45-110mm in size. This species was once one of the most common frog species on the east coast of Australia. It inhabited many lentic freshwater habitats throughout its distribution which occurred predominately along the coast but also extending as far inland as Bathurst and along the highlands in the north and south of the state (White and Pyke, 1996). The Green and Golden Bell Frog has undergone a widespread and unexplained range contraction since the mid 1970's and the species is now listed as endangered under the NSW *Threatened Species Conservation Act* 1995, and as vulnerable under the federal *Environmental Protection and Biodiversity Conservation Act* 2000. Its distribution today is restricted to isolated pockets along the coast at various scattered locations throughout its former range with only one known remaining highland population at Queenbeyan.

The habitat preference and requirements of the Green and Golden Bell Frog are not well understood and difficult to define (Mahony 1999) resulting in some disagreement and confusion between biologists studying the species. Some of the differing views on Green and Golden Bell Frog ecology between biologists may be due to a failure to take into account the role of disease (a pathogenic fungus) that is probably primarily responsible for changes in its distribution and abundance in the last two decades. The species uses different habitat components throughout the various stages of its life cycle including different breeding, foraging and refuge habitats and has been known to disperse distances of up to several kilometres between these various habitats. Generally large, permanent water bodies containing high levels of emergent vegetation such as *Typha*, *Baumea* and the introduced *Juncus acutus* are favourable for the detection of the Green and Golden Bell Frog, however it has been observed utilising a wide range of natural and man-made water bodies including coastal swamps, marshes, dune swales, lagoons, lakes, estuary wetlands, riverine floodplain wetlands, billabongs, storm water retention basins, farm dams, bounded areas, storage tanks, water troughs, drains, ditches and other excavation areas capable of capturing water such as quarries and brick pits (DEC, 2005). Terrestrial habitat attributes that appear to favour the species include large grassy areas associated with adjacent cover from logs, rocks or tussock forming vegetation that provide shelter. There also appears to be a preference shown to habitat containing a complexity of terrestrial and aquatic vegetation structure (Hamer *et al*., 2002). The introduced mosquito fish, *Gambusia holbrooki*, is believed to feed on small tadpoles and habitat free of these fish is preferred (White & Pike 1996)

The Green and Golden Bell Frog is frequently active at day and night in the warmer months and can often be observed sitting in emergent vegetation well above the water level (0.5-1m). It has also been observed well away from water altogether. The breeding period generally occurs between September and March although reproductive behaviour has been noted to occur between late winter and early autumn (DEC, 2005). Breeding events occur most often during, and just after, heavy rain events with a peak around January/February when summer storms are common. Males call while floating in the water or from pond-side vegetation mostly at night but will occasionally call during the day. Individuals or small groups of males often respond to call play back or call imitation.

Litoria booroolongensis (Booroolong Frog)

Reaching around 55mm in length this frog is usually dull grey or reddish-brown above with paler spots and mottling and slightly warty texture. The abdomen is white and fairly granular and there is a thin black line that passes through the eye from the snout and over the small, distinct tympanum to the shoulder. The fingers are free from webbing while the toeas are strongly webbed to the disks (Barker & Grigg, 1977). This frog is strongly associated with flowing rocky streams on the slopes and tablelands of the Great Dividing Range and can often be seen on rocks and next to streams throughout the day. This frog has had a large and widespread range contraction and is now only know in two locations in NSW (Barnard River and Tamworth) and various locations throughout Victoria (M Mahony pers comm). It often occurs in very similar locations to *L. lesueuri* and *L. wilcoxi* and can strongly resemble these two species (M Mahony pers comm.). It may be distinguished by the greater webbing present between its toes.

Litoria brevipalmata (Green-thighed Frog)

This frog was only discovered in 1970, originally at Wauchope, NSW and later in the Gosford area (Barker & Grigg 1977). It reaches around 40mm in length and is chocolate brown on the dorsum with yellowish lower flanks. A dark stripe runs from the snout, through the eye and tympanum and ends in the flank. The groin and backs of thighs are a distinct bright blue-green with black flecks throughout and the belly is pale cream (Robinson 1998).

It is distributed in forests along the coast from the corner of south-east Queensland to Ourimbah in NSW. Its habitat requirements remain highly cryptic with breeding noted to take place after heavy summer rains in rainforest and wet sclerophyll forest but also around temporary and semi-permanent ponds, flooded ditches and swamps including areas such as roadsides and power easements. It has also been noted to occur in flooded paddocks and cleared land that lies adjacent to forested areas.

Mixophyes balbus (Stuttering Frog)

The Stuttering Frog *Mixophyes balbus*, is among the largest amphibians in Australia. The species is yellow-grey above and finely granular with a dark irregular mid-dorsal band extending to the rear from between the eyes. The limbs have narrow dark cross-bars that may be incomplete or indistinct (not to be confused with *Lechriodus fletcheri*) (Cogger 2000). Individuals grow to a length of approximately 80mm. The historical distribution of the Stuttering Frog was from east of the Great Divide and extended from south eastern Queensland through NSW to Victoria (Barker & Griggs 1977). The preferred habitat of the Stuttering Frog is rainforest, Antarctic beech and wet sclerophyll forests (Cogger 2000). The species depends on freshwater streams and riparian vegetation for breeding and habitation. It makes use of riffle zones along creeks and streams and attaches its eggs to shallow rocks at very precise times when the flow is correct (M Mahony pers comm.). The tadpoles then get washed into deeper pools where they grow and metamorphose. The best time to detect naturally calling males therefore is after heavy rains when the creeks and streams have filled up and are beginning to recede, forming ideal riffle zones. The males will however respond readily to call playback most of the time through spring and summer when it is known to breed.

Mixophyes iteratus (Giant Barred Frog)

This frog was commonly seen in coastal rainforest twenty years ago (Barker & Grigg 1977) and has since become listed as endangered. Its present range is from coastal southern Queensland to the central coast of NSW (Cogger 2000) and they are dependant on running streams for breeding. Lemckert & Brassil (2000) monitored the movement of the species and found that during their foraging they remained within 20 metres of a stream. The largest of Australia's frogs this species ranges up to 115mm in length and is finely granular with colour ranging from dark olive to black. It has distinct irregular spots and mottling over its back and sides and a broad headstripe that passes over the distinct tympanum. The fingers, as with all the species in the genus, are free from webbing while the toes are nearly completely webbed. Studies on this species have shown that adults of the species can live for well over a decade (M Mahony pers comm). Breeding occurs throughout spring and summer at which time the adults attach eggs to the roofs of small caves along the stream or creek (M Mahony pers comm.).

Hoplocephalus bitorquatus (Pale-headed Snake)

This snake has a patchy distribution in a range along the east coast from Sydney to north Queensland. The habitat preference appears to be variable from rainforest through to dry forest and it is often found near watercourses (Swan *et al.*, 2004). It is nocturnal and largely arboreal in habit and can often be found sheltering under loose bark or in tree hollows (Gow 1976). The Pale-headed Snake's diet consists mostly of frogs and lizards (Cogger 2000).

Hoplocephalus stephensii (Stephens' Banded Snake)

This snake is limited to a range along the east coast from Sydney to just north of Brisbane. It is mostly arboreal living under the bark of trees or in tree hollows. It can also be found in crevices under rocks. Its diet is comprised mainly of geckos, skinks small birds and mammals (Gow 1976, Cogger 2000).

This species is known to be highly arboreal and is restricted to mesic-forested areas, including rainforest and eucalypt forest, around rocky areas. Its range is limited along the east coast of Australia from Sydney to just north of Brisbane. It shelters between loose bark on trees, under slabs of sandstone, and in rock crevices or tree hollows. There are two major influences on the movements of Stephen's Banded snake: the distribution of large hollow bearing trees, and the avoidance of conspecifics (Fitzgerald *et al*, 2002). Individuals may remain sedentary inside tree hollows for periods averaging 8 days during the active season with occasional long nocturnal movements to other shelter trees (mean = 124m). During June to August virtually all individuals of the taxon overwinter in large trees involving an inactivity period of 132 days (SE=12.4) for females and 105 days (SE=8.6) for males (Fitzgerald *et al*, 2002). Individuals generally use between 5 and 30 shelter trees and have been calculated to occupy an average home range of 11 ha using minimum convex polygon (MCP) estimates. The large spatial scale of the specie's movements and limited overlap between individuals indicates that a viable population of this species requires a large area of contiguous forest. It has been noted that this requirement may explain why the species has not persisted in small forest fragments (Fitzgerald *et al.* 2002). Although spatial overlaps in home ranges occur (mean = 27%) this species avoids the presence of conspecifics (Fitzgerald *et al*, 2002).

Phylogenetic evidence suggests that the species occurring in the south of its distribution has a large genetic split from those occurring in the north (1.7% sequence divergence), whereas southern populations display much less molecular divergence from one another (maximum 0.6%) (Keogh *et al*, 2003). It is argued therefore that when managing this species it is important to view the Queensland and NSW populations of *H. stephensi* as separate conservation units. Its diet throughout the entirety of its range consists mainly of geckos, skinks, small birds and mammals (Gow 1976, Cogger 2000).

Burhinus grallarius (Bush Stone-curlew)

Bush Stone-curlews require sparsely grassed, lightly timbered, open forest or woodland. In southern Australia, they persist most often where there is a well-structured litter layer and fallen timber debris (Blakers *et al.* 1984, Marchant & Higgins 1993, Johnson & Baker-Gabb 1994). Bush Stone-curlews feed on a range of invertebrates and small vertebrates, as well as seeds and shoots (Marchant & Higgins 1993). Nesting is on the ground in a shallow depression and generally in the open away from the vegetation line, which often leaves the eggs vulnerable to trampling by cattle (Johnson & Baker-Gabb 1994). Other threats include predation by introduced foxes, habitat clearance for agriculture, habitat degradation by pastoralism, and removal of leaf litter and fallen timber debris from habitat remnants (Johnson & Baker-Gabb 1994). Bush stone-curlews are listed as endangered in the *NSW Threatened Species Conservation Act* 1995.

The species has been recorded from all but the most arid parts of mainland Australia, as well as on many offshore islands (Blakers et al. 1984, Marchant & Higgins 1993). Although the species is still relatively common in the north and on islands, Bush Stone-curlews have suffered major declines and a contraction of their range across southern Australia (Gates & Paton 2005). The size of the current Australian population is estimated at 15,000 individuals (Watkins 1993).

Callocephalon fimbriatum (Gang-gang Cockatoo)

The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern NSW (Shields & Crome 1992). The species formerly occurred on King Island, Tasmania, but is now locally extinct. A small introduced population occurs on the western tip of Kangaroo Island, South Australia (Higgins 1999). In NSW, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. Isolated records are known from as far north as Coffs Harbour and as far west as Mudgee (Chambers 1995).

In summer, the Gang-gang Cockatoo occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. The species may also occur in sub-alpine Snow Gum *Eucalyptus pauciflora* woodland and occasionally in temperate rainforests (Forshaw 1989). In winter, the Gang-gang Cockatoo occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (Shields & Crome 1992). At this time the species may be observed in urban areas including parks (Harden 1981). Gang-gang Cockatoos feed on the seeds of native and introduced trees and shrubs, including Eucalyptus, Acacia, as well as berries, nuts, fruits, insects and insect larvae. The birds will return to a single site each day until the food supply is exhausted, leaving debris littered beneath the tree (Forshaw 1981). The breeding season is from October to January when the species generally nests in a hole in the trunk or dead branch of a tall tree (Forshaw 1981). This species is adversely affected by clearing of old growth vegetation, which support hollow bearing trees.

Calyptorhynchus lathami (Glossy Black-Cockatoo)

The Glossy Black-cockatoo is an obligate granivore, feeding exclusively on the seeds of *Allocasuarina* (Cleland & Sims 1968; Joseph 1982; Clout 1989; Pepper 1996, Pepper *et al.* 2000). The breeding season is through the cooler months of February to July with one egg only being laid (Garnett & Crowley 2000). Habitat includes woodlands dominated by *Allocasuarina*, open sclerophyll forests and woodlands with a midstorey of *Allocasuarina* that are dominated by Eucalyptus or Angophora species (Higgins 1999). Consequently this bird requires a forest habitat containing these trees in sufficient numbers (NPWS 1999; Garnett & Crowley 2000) along with old-growth trees having suitable nesting hollows.

The species occurs primarily in southeastern Australia, from Shoalwater Bay in central-southern Queensland to the Victorian border region. In NSW, the distribution of the Glossy Black-cockatoo occurs near-continuously east of the Great Dividing Range from the NSW North Coast/Queensland border to the NSW South East Corner/Victorian border, extending west to the South Western Slopes (Ekert 2000).

Climacteris picumnus (Brown Treecreeper – eastern subsp.)

The Brown Treecreeper is a temperate forest and woodland bird species occupying Eucalypt woodland and adjoining vegetation in subcoastal environments and the slopes of the Great Dividing Range (Garnett & Crowley 2000). It is sedentary within permanent territories, breeding in pairs or communally in small groups (Noske 1991). The Brown Treecreeper is an obligate insectivore and forages for insects on the trunks of live trees as well as fallen logs. The species nests most often in hollows (Noske 1991; Blakers *et al.* 1984). The Brown Treecreeper requires mature Eucalypt vegetation with the presence of fallen logs (for foraging) and hollows (for nesting) in dry open forest comprised of fairly sparsely distributed native understorey grasses. The species is generally absent from sites with a dense understorey (Noske 1991; Ekert 2004).

The Brown Treecreeper is listed as vulnerable in the *NSW Threatened Species Conservation Act 1995*. Reasons for the decline in the distribution of the Brown Treecreeper are the fragmentation and simplification, and the subsequent isolation of remaining remnant vegetation (Reid 1999). In particular, studies by Cooper *et al.* (2002) concluded that isolation of remnants was the single-most important factor affecting the recruitment of female Brown Treecreepers.

Lathamus discolor (Swift Parrot)

The Swift Parrot is small migratory parrot (25cm) that breeds in Tasmania and migrates to south-eastern Australia for the winter months. The species is listed as endangered on the TSC Act and EPBC Act. In Tasmania, the species is dependant on Blue Gums *E. globulus* for both flower nectar and for nesting hollows, of which there has been large scale clearing of these trees in Tasmania over many years (Brereton 1997). On the mainland, the Swift Parrot feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis* (Brown 1989). Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum (Barrett *et al.* 2003).

Lophoictinia isura (Square-tailed Kite)

The Square-tailed Kite is a large raptor that occurs in temperate and tropical forest and woodlands including the coastal regions across Australia. The bird has been recorded in most parts of Australia with the exception of the extremely arid centre (Barrett *et al.* 2003). The species prefers ridge and gully forests dominated by *Eucalyptus*, *Angophora* and *Acacia* scrub and patches of low open eucalypt woodland and coastal heath. The Square-tailed Kite usually nests along or near watercourses or in forest gullies. Nests are large platforms of sticks usually situated in the fork or limb of a large tree. The species prefers to hunt singly in *Eucalypt* open forest and woodland (Debus and Czechura 1989), where it feeds on small birds, foliage insects and sometimes on small mammals and lizards.

In NSW, records for the Square-tailed Kite occur across a wide area of the state with most of the records in the coastal zones of the south (i.e. south of Wollongong) and north coast (north of Taree). Scattered records occur west of the divide on the northern tablelands, north-west slopes and plains as well as in the far west mainly along major watercourses. In the Sydney Basin Bioregion the species is rare with only eight records during the second Birds Australia Atlas (Garnett *et al.* 2001). Similarly, in the Hunter region, the Square-tailed Kite has previously been reported well north of Newcastle at Cundletown, Purfleet and Crowdy Head NP (HBOC 1997,1998) and only two records in the lower Hunter.

Melanodryas cucullata cucullata (Hooded Robin)

The Hooded Robin is an uncommon medium-sized (16cm) ground insect-eating resident bird of woodlands and shrublands. The male Hooded Robin is a distinct black and white, while the female is a plain grey-brown bird. The species prefers structurally complex woodlands greater than 100ha in size (Freudenberger 1999; Ekert 2004). The Hooded Robin, like other robin species, exhibits typical perch and pounce behaviour in that it perches and pounces on prey on the ground or on vegetation (Schodde & Mason 1999). Important habitat components are therefore, stumps, posts or fallen timber which enables it to perch. The diet of the Hooded Robin comprises mostly insects (Arthropods) and occasionally seeds. The species breeds from August to December, usually nesting in pairs in cup-shaped nests located in the horizontal fork or branch of a tree or shrub (Schodde and Mason 1999).

Hooded Robins are distributed throughout South-eastern Australia from about Mundubbera, Qld, to Spencer Gulf, SA intergrading with the other subspecies through the northern Murray-Darling basin (Blakers *et al.* 1984; Schodde & Mason 1999). The southeastern subspecies *Melanodryas cucullata cuculatta* is considered as vulnerable due to the continuing contraction of its preferred woodland habitat (Schodde & Mason 1999) and is listed as vulnerable in the *NSW Threatened Species Conservation Act 1995*. The species, like many other woodland birds, is threatened by land clearing, habitat fragmentation, inappropriate fire regimes, rural tree decline, increased competition from other avifauna, predation and the reduction in habitat complexity via the removal of understorey from processes such as grazing and firewood collection (Ford *et al.* 2001).

Melithreptus gularis gularis (Black-chinned Honeyeater – eastern subsp.)
The Black-chinned Honeyeater is a medium-sized green and white passerine bird with a black head. The species builds compact, cup-shaped nests and feeds on arthropods, nectar and lerp from eucalypt foliage and bark (Reid 1999). The eastern form of the Black-chinned Honeyeater is found predominantly west of the Great Dividing Range in a narrow belt through NSW into southern Queensland, and south into Victoria and South Australia where it occupies eucalypt woodlands within an approximate annual rainfall range of 400-700mm (Blakers *et al.* 1984). In NSW, the species is mainly found in woodlands containing box-ironbark associations and River Red Gum.

Garnett & Crowley (2000) note that clearing and fragmentation of the favoured woodland and forest habitat are the main threats to the species. Black-chinned Honeyeaters are also likely to experience high levels of competition from aggressive honeyeater species such as Noisy Miners or White-plumed Honeyeaters, both of which occur at high densities in small remnants of Red Gum and box-ironbark associations. In addition, increased nest predation is expected from increasing populations of predators such as Pied Currawongs and Australian Ravens, particularly in small remnants (Major *et al.* 1998).

Neophema pulchella (Turquoise Parrot)
The Turquoise Parrot is a small (20cm) temperate woodland species that occurs from south-east Queensland through NSW to east and north-east Victoria. Generally, the distribution of the Turquoise Parrot is patchy, determined by areas of suitable habitat. Such habitat is usually steep, rocky ridges and gullies, rolling hills, valleys and river-flats comprised of eucalypt woodland and open forests with a ground cover of grasses and low understorey of shrubs. The Turquoise Parrot is an obligate granivore feeding on the seeds of grasses, herbaceous plants and shrubs and requires a reliable supply of water (Higgins 1999). Breeding occurs from August to January, usually nesting less than two metres above the ground. Nests are located in the hollows of small trees, dead eucalypts or in holes or stumps.

The Turquoise Parrot is a resident or partially nomadic species with movements usually a result of seasonal fluctuations in the distribution and availability of food. The species mostly occurs as pairs or small parties of 6-8 birds. In NSW, the species mainly occurs on or at the foothills of the Great Divide from Moree south to Dubbo, Griffith and Wagga Wagga. The species is listed as vulnerable under the *NSW Threatened Species Conservation Act 1995* (Blakers *et al.* 1984; Barrett *et al.* 2003). Threats to the Turquoise Parrot include loss of habitat through clearing, intensive logging, burning and grazing; the destruction of nest sites; and, inappropriate fire regimes which remove nesting and feeding resources (Garnet and Crowley 2000).

Ninox connivens (Barking Owl)
The Barking Owl is a medium-sized brown hawk-like owl, spotted white on the wings, with barring in the wings and tail, and coarsely streaked brown on white underneath. It has prominent yellow eyes in a flat face and fully feathered legs with large yellow feet. It is approximately 35-45 cm in length with a wingspan of 85-100cm and weighs between 425-510g.

Its voice is extremely characteristic; a loud and remarkably dog-like double bark, 'wuf wuf' or 'wuk wuk' (Hollands 1991, Higgins 1999). This bark is always preceded by a short, low groan but this is audible only at close quarters (Hollands 1991). The Barking Owl takes a wide range of prey including diurnal bird species, rabbits, gliders, small possums, bats, rodents and insects (Kavanagh *et al.* 1995).

Its habitat is typically dominated by eucalypts, often red gum species and, in the tropics, paperbarks *Melaleuca* species (Higgins 1999). It usually roosts in or under dense foliage in large trees including rainforest species and typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands (Kavanagh *et al.* 1995). This large Owl is now sparsely distributed through its historic range from Victoria through New South Wales to Cooktown in Queensland.

The Barking Owl is listed as vulnerable under the *NSW Threatened Species Conservation Act 1995*. The main threats to the Barking Owl include habitat loss and degradation; loss of native hollow bearing trees and coarse woody debris; removal of dead wood, dead trees and logs; competition from feral honeybees; and possibly, predation by the fox and feral cat (Garnett & Crowley 2000).

Ninox strenu (Powerful Owl)

The Powerful Owl is a large (60cm) forest owl that inhabits forest and woodlands of the coastal, escarpment, tablelands and western slopes in NSW (Kavanagh 2002b). Habitat for the Powerful Owl comprises tall, moist productive eucalypt forests and a mosaic of wet and dry sclerophyll occurring on undulating, gentles terrain near the coast. Optimal habitat includes a tall, shrub layer and abundant hollows supporting high densities of arboreal mammals (DEC 2005). The Powerful Owl preys on arboreal mammals, particularly the Common Ringtail Possum in the lowlands and the Greater Glider in the highlands. These two species comprise more than 80% of the species' diet. Other prey species include the Sugar Glider, the Common Brushtail Possum, Grey-headed Flying Fox as well as some diurnal bird species such as the Pied Currawong (DEC 2005).

The Powerful Owl roosts in dense mid-canopy trees or tall shrubs in sheltered gullies, while nesting occurs in hollows of old eucalypts in unlogged, unburnt gullies and lower slopes within 100m of streams or minor drainage lines (DEC 2005). The species is faithful to nesting hollows (Kavanagh 1997; Higgins 1999; Kavanagh 2002b). The home range of the Powerful Owl is variable, depending on habitat productivity, however, is generally between 300 and 1500ha (Kavanagh 1997). The species systematically 'farms' this territory rather than regularly hunting across the entire home range. The breeding season of the Powerful Owl is from mid-May to mid-July (Kavanagh 1997; Kavanagh 1998; Kavanagh 2002a, 2000b; Kavanagh & Stanton 2002).

Pomatostomus temporalis temporalis (Grey-crowned Babbler)

The Grey-crowned Babbler is a temperate forest and woodland and tropical woodland bird species (Garnett & Crowley 2000). The Grey-crowned Babbler inhabits open forests and woodlands, requiring an open shrub layer with sparse ground cover and fallen timber and leaf litter (Blakers *et al.* 1984). The species builds communal nests although occasionally nests will be built in the open branches of taller trees.

The birds are primarily invertebrate feeders but include the occasional small lizard in their diet. They feed by turning litter on the ground or by lifting pieces of bark on trees and fallen logs (Blakers *et al.* 1984). Their dependence on the insect and arthropod fauna within the litter layer, branches and logs makes these birds vulnerable to frequent fire or firewood collection (Adam & Robinson 1996).

In NSW, the Grey-crowned Babbler occurs mostly west of the Great Divide, in suitable habitat on the edges of State Forests and in the Liverpool Plains region (Ekert 2002, 2004). In the Hunter Region, the Grey-crowned Babbler mostly occurs in the central, western and northern parts of the region including Clarencetown, Gloucester, Seaham, Cessnock, Maitland, Branxton, Kurri Kurri, Singleton, Paterson, Dungog and Wingen (HBOC 1997, 1998). The species is listed as vulnerable in the *NSW Threatened Species Conservation Act 1995*.

Ptilinopis magnificus (Wompoo Fruit-dove)

This species occurs in much of the lowlands of New Guinea and adjacent islands and in Torres Strait. Within Australia, the species historically occurs from the Illawarra district of New South Wales, north to the tip of Cape York Peninsula. There are consistent although limited numbers of reports of the Wompoo Fruit-dove from the southern parts of its range (Garnett *et al.* 2000). The preferred habitat of this species is sub-tropical and tropical rainforest; however, the species has also been reported in low elevation moist eucalypt forest and brush box forests (Frith 1982). Wompoo Fruit-doves feed on a diverse range of tree and vine fruits and are locally nomadic, following ripening fruits. Threats to this species include: Clearing, fragmentation and weed invasion of low to mid-elevation rainforest due to coastal development and grazing; Logging and roading in moist eucalypt forest with well-developed rainforest understorey, and; Burning, which reduces remnant rainforest habitat patches (NPWS 2000, 2002).

Chthonicola sagittata (Speckled Warbler)

Speckled Warblers can be found in a wide range of eucalypt-dominated vegetation that has a grassy understorey, often on rocky ridges or in gullies (Garnett & Crowley 2000). This species inhabits forested areas of south-eastern Australia, from south-west Victoria through eastern New South Wales to central Queensland, mainly on the western slopes and tablelands of the Great Dividing Range (Garnett & Crowley 2000). The Speckled Warbler is a small finch-sized bird that forages amongst ground litter for invertebrates and seeds. It is dependant on fallen logs and low ground and shrub cover for foraging and nest building and has been shown to be absent from habitat where few or no fallen logs were present (Barrett *et al.* 2003). Domed nests are made of grass and bark and are built on the ground in a small depression made by the bird and located under cover such as a log or low dense shrub (Beruldsen 1980, Tzaros 1996).

This species has declined in density over much of its range and is listed as vulnerable in the TSC Act. Traill and Duncan (2000) reported a decline of 40% in the last decade in places where no habitat fragments larger than 100ha have been left. Birds in fragments are particularly susceptible to nest predation, with reports of nest failure rates of up to 80% for this species (Traill & Duncan 2000). Other threats include grazing by stock, kangaroos and rabbits, which result in the loss of moderately dense ground cover that this species requires (Traill & Duncan 2000).

Stagonopleura guttata (Diamond Firetail)

The Diamond Firetail is a small finch that can be found sporadically across south-eastern Australia (Barret *et al.* 2003) with preferred habitat being eucalypt-dominated vegetation communities that have a grassy understorey, including woodland, forest and mallee (Garnett & Crowley 2000). Most Diamond Firetails occur on the inland slopes of the Great Dividing Range, with only small pockets near the coast (Blakers *et al.* 1984). They feed on seeds, mostly of grasses (Read 1994), build a bottle-shaped nest, and have a usual clutch size of 4-5 eggs (Immelmann 1982).

Barrett *et al.* (2003) found that this finch is more common where understorey shrubs are present and where the forest borders sheep rather than cattle grazing. The Diamond Firetail is one of a suite of species that have declined from woodlands in south-eastern Australia (Robinson & Traill 1996; Reid 1999). Much of its habitat has been cleared, and remaining fragments are gradually becoming unsuitable. Factors that have been suggested to be adversely affecting Diamond Firetails include loss of key food plants and habitat as a result of invasion by exotic grasses that are more suitable for flock-foraging Red-browed Finches *Neochmia temporalis*, whose expansion in some areas may have disadvantaged Diamond Firetails (Read 1994).

Tyto longimembris (Eastern Grass Owl)

The Grass Owl is a small ground-dwelling owl 32-38 cm long with males generally smaller and more slender than females (Hollands 1991). The species generally inhabits tussocky grasslands but can also be found in heaths, swamps, coastal dunes, tree-lined creeks and grassy areas in open forest. Grass Owls nest on the ground among dense clumps of tall grasses or sedges, and produce a clutch size of 3 – 8 chicks (Schodde & Mason 1981, Higgins 1999). It is thought that laying usually occurs somewhere between March and June (Hollands 1991). Grass Owls feed predominately on small rodents but also take insects and birds when their preferred food is scarce (Schodde & Mason 1981).

The Grass Owl's distributional range within Australia is still incompletely known but is often suggested to be discontinuous, with two centres of distribution: a scattered inland population based in the arid inland drainage system (Lake Eyre Basin), extending to the northern Murray-Darling Basin; and a subtropical-tropical population spanning north-eastern NSW and eastern Queensland, within about 70km of the coast (Schodde & Mason 1981, Hollands 1991, Higgins 1999). In NSW most sightings are in a narrow coastal strip from around Nelson Bay up to the Queensland border (Garnet & Crowley 2000, Olsen & Doran 2002). The Grass Owl is listed as vulnerable under the *Threatened Species Conservation Act 1995.* Threats include: loss of suitable habitat due to grazing, agriculture and development; disturbance and habitat degradation by stock; use of pesticides to control rodent populations thereby reducing food sources for owls, and potentially poisoning owls; and, frequent burning which reduces ground cover (Garnett & Crowley 2000).

Tyto novaehollandiae (Masked Owl)

The Masked Owl is a medium to large sized (40-50cm) owl that inhabits eucalypt forests and woodlands from the coast, where it is most abundant, to the western plains (Kavanagh 2002b). The preferred habitat is open woodland and forest with an open understorey and sparse ground cover (Kavanagh 2002a, 2002b; Kavanagh & Stanton 2002). Potential habitat for the species is mostly in conservation areas and state forests, although the species is often found in large tracts of forest or woodland on public and private lands, including suburban bushland (DEC 2005).

The diet of the Masked Owl consists almost entirely of small terrestrial mammals and some birds (Higgins 1999). The species roosts in hollows in live or occasionally dead eucalypts; dense foliage in gullies; and caves or cliffs. Hollows can be located in a variety of topographic positions from gully to upper slope. The Masked Owl is a sedentary (resident) species that occupies a large home range, estimated as 400-1000ha. The estimated population size in NSW is 1,500 pairs (Debus 1994; Kavanagh 1997). Threats to the Masked Owl include habitat clearing and fragmentation, logging, fire, and predation, human hazards (e.g. road kills, fences, wires etc) (DEC 2005).

Tyto tenebricosa (Sooty Owl)

This is one of the Barn Owls with a mask-shaped face. It has a coastal range from southern Queensland to southern Victoria with a preferred habitat of closed and tall open forests and in particular gullies (Kavanagh 1997). It roosts by day on branches in dense trees, in hollows or in caves and at night it feeds through the tree canopy with its prey being medium sized marsupials such as the Ring-tailed Possum or the gliding possums. The Sooty Owl has a more diverse diet than the other large owls and includes both arboreal marsupials and a substantial numbers of terrestrial mammals such as bandicoots.

Anthochaera phrygia (Regent Honeyeater)

This bird was once widespread through southeast Australia. Now it is mainly found in limited areas of northeast Victoria and central-east NSW. It is has been observed breeding in several areas in north-eastern Victoria (Chiltern district, Killawarra State Forest, Benalla district), and along the western slopes of the Great Dividing Range in NSW (Bundarra-Barraba district, Capertee Valley). Regent Honeyeaters are nomadic feeders and can be found elsewhere throughout its previous range where there is suitable blossom occurring (Franklin *et al.* 1989). This species is mostly recorded in box-ironbark eucalypt associations. They prefer the wettest, most fertile sites within these associations, such as along creek flats, broad river valleys and foothills. In NSW, riparian forests of River Oak *Casuarina cunninghamiana*, those with Needle-leaf Mistletoe *Amyema cambagei*, are also important for feeding and breeding. Mugga Ironbark *E. sideroxylon*, White Box *E. albens*, Yellow Box *E. melliodora* and Yellow Gum *E. leucoxylon* are particularly important food trees. At times of food shortage the birds also use other woodland types and wet lowland coastal forest dominated by Swamp Mahogany *Eucalyptus robusta* or Spotted Gum *E. maculata* (Franklin *et al.* 1989; Ley and Williams 1992; Webster and Menkhorst 1992; Geering and French 1998; Oliver *et al.* 1999). Nectar is the principal food, but sugary exudates from insects are also used, and insects are essential for breeding (Oliver 1998, 2000). Regent Honeyeaters build cup nests, and usually lay 2-3 eggs.

Clearance has destroyed about 75% of the Regent Honeyeater's habitat, particularly the most-favoured vegetation communities. The remainder is fragmented, and continues to be degraded by removal of the larger trees for posts, sleepers and firewood, and by ongoing declines in tree health (Robinson & Traill 1996; Oliver *et al.* 1999). Fragmentation has apparently advantaged more aggressive honeyeaters, particularly the Noisy Miner *Manorina melanocephala* which may be displacing the Regent Honeyeater (Franklin *et al.* 1989; Grey *et al.* 1998).

Dasyurus maculatus (Spotted-tailed Quoll)

Historically this marsupial occupied a large range throughout eastern Australia. Following European settlement, however, the species has undergone a dramatic decline as a result of habitat clearance, disease, and competition with the introduced fox and feral cat. Currently, the Spotted-tailed Quoll occupies a disjunct distribution along the coast and ranges of eastern Australia, from southern Queensland to Victoria, and into Tasmania. Small populations of a north Queensland sub-species also occur in the vicinity of Bundaberg. These animals are secretive and difficult to detect in their large home range. A community survey throughout NSW including the Port Stephens area, added almost 12% of additional records for this animal.

An opportunistic hunter of a variety of prey, including domestic poultry, the Spotted-tailed Quoll has been reported from a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, woodland, coastal heathland, as well as along riparian forests in the inland. Spotted-tailed Quolls are generally solitary, nocturnal, and semi-arboreal species, occupying home-ranges of between 500 and 1000 hectares, with figures in southern Queensland of 580ha for males, and less for females being reported. Den and nest sites for the Spotted-tailed Quoll have been recorded in caves, rock crevices, tree hollows, and hollow logs (Edgar & Belcher 1995; Lunney & Matthews 2001).

Macropus parma (Parma Wallaby)

This small wallaby was presumed extinct in Australia by 1932 and was rediscovered near Gosford in 1967. Further sightings resulted in the Parma Wallaby being considered as secure by 1985 (Archer *et al.* 1985). Clearing and fragmentation of suitable habitat resulted in the wallaby being listed as vulnerable (NSW TSC Act 1995). Preferred habitat is wet sclerophyll forest with a dense understorey and scatterd grassy patches where it is primarily a nocturnal feeder (Maynes 1995).

Cercatetus nanus (Eastern Pygmy-possum)

This small nocturnal marsupial has a coastal range from southern Queensland to eastern South Australia and in Tasmania. It was thought to be common until recently and it was listed as Vulnerable under the NSW TSC Act 1995 in 2001. It can be found in a wide range of habitat from rain forest, dry forest, woodland and tree-heath and it is largely dependant on a diet of nectar and pollen. Habitat requirements are suitable hollow bearing trees (although with very small entrances to hollows) and the nectar bearing flowering plants such as banksia, bottlebrush and eucalypts (Turner & Ward 1995, Menkhorst & Knight 2001).

Petaurus australis (Yellow-bellied Glider)

This is the largest of the Petaurid gliders and can be found in mid dense to closed forest in which the trees are of sufficient age to have developed suitable hollows for the gliders to nest in. In undisturbed habitat these gliders will maintain their presence in the same area for many years; for example one population has been observed in the same area of the Watagan National Park for over 25 years (Driscoll pers obs).

The diet of the Yellow-bellied Glider consists of invertebrates, nectar and pollen from blossoming eucalypts in particular, although they are primarily exudate feeders feeding on sap from selected trees, which they obtain by gnawing grooves in the bark of the tree. The home range of these gliders has been estimated at 35 hectares and they will travel up to 2 kilometres in a night of foraging (Carthew *et al.* 1999; Russell 1995).

Petaurus norfolcensis (Squirrel Glider)

Occurs on the coast and ranges of eastern Australia, from northern Queensland to the Victorian/ South Australian border, and also extends into the western slopes and plains. The Squirrel Glider inhabits dry sclerophyll forest and woodland, and is generally absent from the more densely vegetated coastal ranges. More recently, however, the species has been recorded in a number of coastal locations and confusion with the similar Sugar Glider is attributed as the main reason for the apparent lack of historical coastal records. One of the reasons that the Squirrel Glider has been considered vulnerable in NSW is that its diet is specialised. It will eat insects and the occasional birds egg, however, the greater part of the diet is nectar, pollen and gum exudates particularly from wattles. The amount of habitat that supports these food resources has been significantly reduced. The Squirrel Glider requires hollows in standing trees for roosting and nesting purposes and home ranges from 2-3ha to 13ha have been reported. (Quinn 1995; SWC 1996; Rowston 1998; Suckling 2000; Holland 2001; Smith 2002).

Petrogale penicillata (Brush-tailed Rock-wallaby)

Historically an abundant species the Brush-tailed Rock Wallaby could be found in suitable rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forests, woodlands and semi arid country. Northerly facing sites with numerous ledges, caves and crevices are favoured by the species which provide daytime rest areas with multiple escape routes (Short, 1982; Bulinski *et al*, 1997). *Petrogale penicillata* feeds mainly on grasses and forbs but is also known to consume a significant amount of browse which can form anywhere up to 30% of its diet. Seeds, fruit and flowers are also eaten opportunistically (Short, 1989). The species remains relatively common in the upper reaches of many of the east-flowing rivers of the Great Dividing Range, particularly in south-eastern Queensland and northern New South Wales.

Populations in the southern and western parts of the range have declined and must be considered particularly vulnerable (Short & Milkovits, 1990). Introduced predators such as the Fox (Lunney *et al.*, 1997), feral Cats (Spencer, 1991) and wild Dogs (Department of Environment and Conservation, 2005) are believed to have had a major impact on the Brush-tailed Rock Wallaby. Hunting and competition with introduced herbivores (Goat & Rabbit) have also been widely suggested as contributing to the species' decline (Eldridge & Close, 2002). More recently disease has been implemented in the decline of the Brush-tailed Rock Wallaby including

hydatidosis, lumpy jaw and toxoplasmosis infection carried by cats (Department of Conservation, 2005).

Phascogale tapoatafa (Brush-tailed Phascogale)

The Brush-tailed Phascogale is a rat-sized marsupial of the Dasyurid group that also contains the Antechinus, Spotted Quoll and Tasmanian Devil. As its name implies the Brush-tailed Phascogale has a flamboyant 'bottle-brush' style black tail which is attached to a grey body. It also has the distinction of being the largest of the Dasyurids where the male only lives for one year, dying shortly after mating. The males are also prone to stress induced stomach ulcers that weaken them so that they fall prey to other forest predators. This species is found in patches around the forested edge of Australia where it generally occupies very large home ranges for such a small animal with females occupying about 40 hectares and males about 100 hectares. Their food is anything that moves from spiders and centipedes to baby birds in nests along with the nectar and pollen of flowering eucalypts (van der Ree *et al.* 2001, Soderquist 1995).

Phascolarctos cinereus (Koala)

The Koala generally occurs from the Townsville district in northern Queensland, south along the coast and ranges into Victoria and part of South Australia. Within New South Wales and Queensland, this distribution extends into the western slopes and plains. The Koala lives entirely on a diet of leaves of both eucalypt and non-eucalypt trees and it has been shown that within its range there are local and regional preferences for the tree species used for feeding from. Examples of eucalypts used as feed trees are *E. camuldulensis*; *E. viminalis*; *E. ovata*; *E. teretecornis*; *E. microcorys*; *E. punctata*. Non eucalypts recorded have been *Allocasuarina torulosa*; *Melaleuca quinquenervia*; and *Lophostemon confertus*. Throughout its range the Koala suffers from either a lack of numbers or severe over-population where problems such as eye disease and reproductive tract bacterial disease caused by *Chlamydia psittaci* become prevalent. (Martin & Handasyde 2000; Moore & Foley 2000; Phillips & Callaghan 2000; Phillips, Callaghan & Thompson 2000).

Planigale maculata (Common Planigale)

The Common Planigale occupies a range of habitats from rainforest, sclerophyll forest and grasslands to marshlands and rocky areas. It is also known to inhabit some outer suburbs in low densities. It preys on a wide variety of insects and it is thought that breeding occurs throughout the year (Redhead, 2002).

Pseudomys gracilicaudatus (Eastern Chestnut Mouse)

The Eastern Chestnut Mouse has been recorded from northern Queensland to northern NSW. Its distribution is patchy, with existing populations being isolated by great distances. Habitat is typically open woodland with a grassy understorey, and heath. In NSW the Eastern Chestnut Mouse has been recorded in heathland and is more often found in dense wet heath and swampy areas. Optimal habitat for the species is young and regenerating heath vegetation (Mahoney 1975).

The species is usually found in low densities and show strong attachments to a site. The home range is less than 0.5 hectares, where a system of routes is maintained. The Eastern Chestnut Mouse nests can be constructed of grass above ground or be part of a burrow complex. Its diet consists of predominantly seeds, but also other plant material, fungi and insects (Lou *et al.* 1994).

Pteropus poliocephalus (Grey-headed Flying-fox)

This species occurs along the eastern seaboard of Australia roosting in communal colony sites, which are used permanently, annually, or occasionally depending on food availability (Tidemann 2000). Colonies can vary considerably in size from hundreds to many thousands of individuals, and fluctuate according to food resources (Parry-Jones & Augee 1991; Tidemann 2000). Fruits from numerous rainforest trees and other myrtaceous species form a large component of their diet, and consequently mass nomadic movements occur throughout their range in response to fruit availability. Large colonies are very vocal even during the day, and can significantly damage roost trees by their sheer weight of numbers.

> "The Grey-headed flying fox must be acknowledged as being highly significant to the health and maintenance of many ecosystems in eastern Australia. The species performs the ecosystem services of pollination and seed dispersal for a wide range of native trees, including commercially important hardwood and rainforest species. It thus contributes directly to reproduction, regeneration and the evolutionary processes of forest ecosystems. Flying-foxes are unique in the large distances they disperse pollen and seeds. The population of Grey-headed flying fox must be of sufficient size for this to continue. If numbers were reduced to small or localised groups, then rainforest seed dispersal and hardwood pollination processes would be severely curtailed (Eby 2000)".

Chalinolobus dwyeri (Large-eared Pied Bat)

Hoye & Dwyer (1995) have indicated that the Large-eared Pied Bat occurs in scattered localities in central southern Queensland, and on the western slopes of the Great Dividing Range in New South Wales. Parnaby (1992) extends this range to the coast in both states. The species inhabits moderately well-wooded habitats, where daytime roosts have been recorded in caves, mine tunnels and the abandoned mud nests of Fairy Martins (*Cecropis ariel*) (Hoye & Dwyer 1995). Hoye (1995) found that this species occupies both moist and dry hardwood forest types within the Morisset Forestry District, but suggests that the species is less prone to habitat disturbance due to its cave-roosting habit.

Falsistrellus tasmaniensis (Eastern False Pipistrelle)

This bat occurs from coastal southeast Queensland to western Victoria and through Tasmania. Very little is known of this bat. Preferred habitat appears to be sclerophyll forests (Churchill 1998). It is a bat that hibernates in the colder winter period of the southern part of its range (Phillips 1995). Preferred roosting sites are large hollow trees and caves.

Kerivoula papuensis (Golden-tipped Bat)

This bat occurs from the tip of Cape York, along the coastal strip to the southern highlands of New South Wales. The rarity of this bat can be attributed in part to difficulties in capturing the species (Woodside 1995). These difficulties relate to the bat preferring to feed in heavily vegetated areas where it has a diet of mostly spiders that have been plucked from their webs. From a small number of captures, habitat preferences have been determined to be moist closed lowland forest with high summer rainfall. Roost location is opportunistic and the abandoned nests of the Gerygone and Scrubwren have been used (Churchill 1998).

Miniopterus australis (Little Bentwing-bat)

This species occurs along the east coast of Australia from Cape York south to coastal northern NSW. The species also occurs in New Caledonia, New Guinea, the Philippines, and the Indo-Malayan archipelago. The Little Bent-wing Bat generally occupies well-wooded habitats throughout its range, roosting during the day in caves and similar locations. As with other Bentwing-bats, this species depends on specific nursery sites in which to raise its young, and only five of these sites were known of in 1983. In central Queensland one of these nursery colonies numbers 100,000 adult bats. They forage for insects in generally well-wooded habitat of a variety of forms from swamp forest, dry forest to rain forest (Churchill 1998; Dwyer 2001).

Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)

This species is widely distributed on the coast and ranges of eastern Australia, from Cape York Peninsula, south to Victoria and eastern South Australia. The species is also present in northern Western Australia and the Northern Territory. Within New South Wales, it extends from the coast to the western slopes of the Great Dividing Range. These bats roost in caves and man-made structures such as culverts, mine shafts and farm sheds. They are territorial, moving within a 300 km radius of a maternity cave. They forage for insects in generally well-wooded habitat of a variety of forms from swamp forest, dry forest to rain forest (Churchill 1998; Dwyer 2001).

Mormopterus norfolkensis (Eastern Freetail-bat)

While this bat is regarded as a separate species, the taxonomy is yet to be resolved. It can be found along the eastern seaboard from central Victoria to north Queensland and can only be found in Australia. The bat can be found in a wide range of forest and woodland habitats where it forages for insects. It prefers tree and limb hollows for denning (Churchill 1998; Allison & Hoye 2000).

Myotis macropus (Large-footed Myotis)

Also known as the Fishing Bat, this bat is the only confirmed Australian representative of the most widely spread genus of Microchiropteran bat worldwide. It can be found within 100 km of the coast from the Kimberly in Western Australia to southeastern South Australia. Foraging is commonly over water with the bats skimming the surface and using their large hind feet to scoop aquatic insects and even small fish. They can be found roosting in a variety of locations that include caves, bridges, tree hollows, and even dense foliage (Churchill 1998, Richards 1995).

Saccolaimus flaviventris (Yellow-bellied Sheathtail Bat)

This bat is to be found in a wide range throughout Australia only being absent from the southwest quarter of SA to southern WA and throughout this range it inhabits a similarly wide range of vegetative habitat. They are an adaptive roosting species and have been found under eaves of houses, in animal burrows in the ground and in tree hollows for example. Its reported rarity may be in part due to the fact that it flies high and fast and is not often captured (Churchill 1998, Richards 2000).

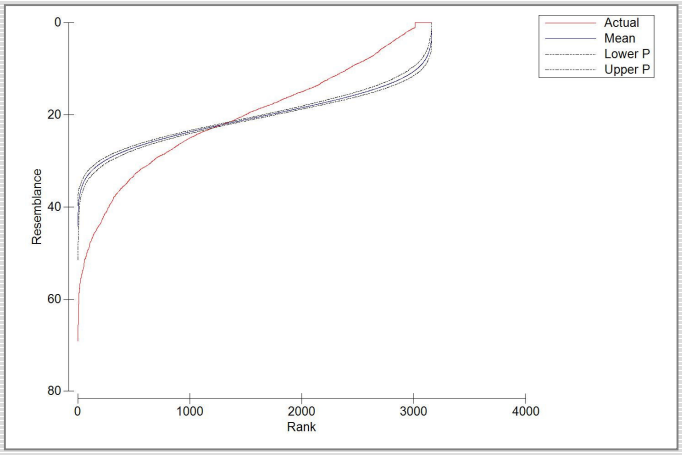
Scoteanax rueppellii (Greater Broad-nosed Bat)

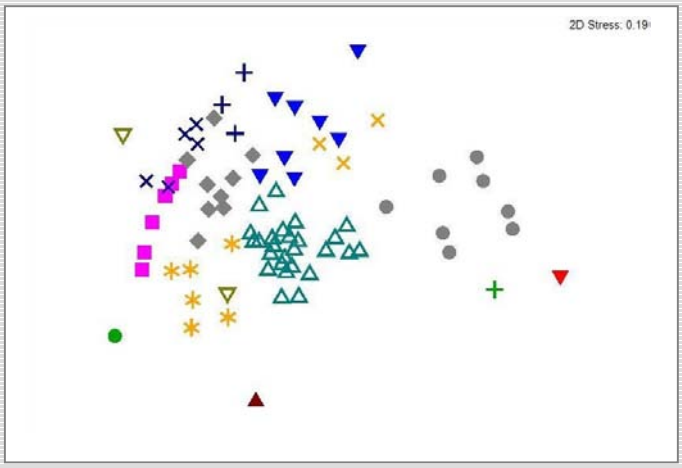
This species occurs along the coast and ranges of eastern Australia, from northern Queensland to the New South Wales/Victorian border. This bat appears to be most frequent in the river systems draining the Great Dividing Range. Tree-lined creeks, and the junctions of woodland and cleared paddocks, are favoured hunting areas for the Greater Broad-nosed Bat, although it may also forage in rainforest environments, flying as low as one metre above the surface of a creek. The species normally roosts in tree hollows, but roosting records in the ceilings of old buildings also exist (Churchill 1998; Hoye & Richards 2000).

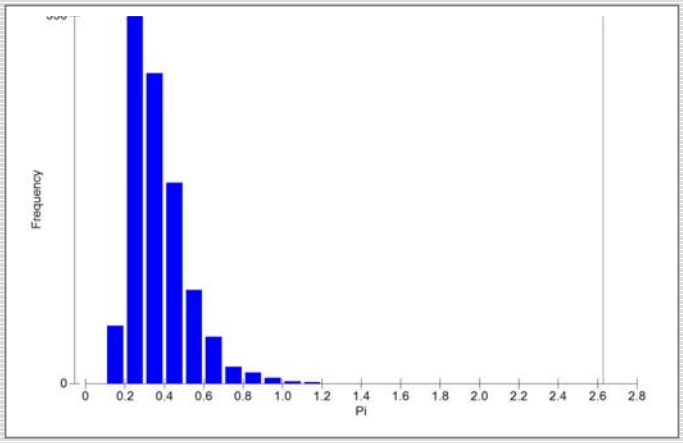
Appendix 2: Revised Vegetation Data Analysis: Gloucester Coal Project (Bell 2009)

Revised Vegetation Data Analysis:

Gloucester Coal Project







Report to:

EcoBiological
PO Box 585
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May 2009

Stephen A.J. Bell

Eastcoast Flora Survey
PO Box 216
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Summary

A revised classification of vegetation data has been undertaken for the Gloucester Coal project, on behalf of *EcoBiological Pty Ltd*. Multivariate cluster analysis and ordination of eighty-nine 0.04ha floristic plots from the project area provided a sound classification for defining vegetative patterns. It is likely that past land-use of the site (agricultural grazing) has impacted upon species diversity in some areas, however with adequate sampling the potential problems this may have caused have been overcome. Woody weed invasion in some of the moister environments, although evident in the data, did not overly impact on the classification.

Fifteen vegetation communities have been defined using the supplied data (weeds removed) with the CLUSTER routine in *Primer*, at a similarity level of 28%. Defined communities were supported in the nMDS ordination, at a stress level of 0.19. Vegetation present included 1 grassland, 1 sedgeland, 1 thicket, 3 rainforests/moist forests, 3 floodplain forests, 2 grassy woodlands, and 4 dry forests. The fifteen defined communities are:

1. Sedgeland/Heath
2. Paperbark Thicket
3. Riparian Closed Forest
4. Dry Gully Rainforest
5. Blue Gum Moist Forest
6. Cabbage Gum Floodplain Forest
7. White Stringybark/Cabbage Gum/Paperbark Forest
8. Redgum/Apple Riparian Forest
9. Redgum/Box Grassy Woodland
10. Grey Ironbark Grassy Woodland
11. Spotted Gum/Thick-leaved Mahogany Open Forest
12. Spotted Gum/Red Ironbark/Thick-leaved Mahogany Forest
13. White Stringybark Shrubby Forest
14. Smooth-barked Apple/White Stringybark Forest
15. Grassland

Tests of significance and analysis of similarity using SIMPER, SIMPROF and ANOSIM showed strong support for most defined communities. Less well defined communities included Paperbark Thicket, White Stringybark/ Cabbage Gum/ Paperbark Forest, and Spotted Gum/ Thick-leaved Mahogany Forest, and it is possible that some undetected diversity (variation) is present in some of these communities, possibly a result of disturbance history. Five communities possessed too few samples for significance testing to be run adequately. The Global R value generated through ANOSIM was 0.914 ($p<0.001$), and 89 of the possible 105 pairings (6 were indefinable due to low sample size) returned R values above 0.7 in the pair-wise comparisons, while 46 pairings were at unity.

Table of Contents

1.0 Background

EcoBiological are finalising work on the flora and fauna of a proposed extension to two mines operated by Gloucester Coal, near Gloucester in the Hunter Valley of New South Wales. In an effort to better understand the vegetation patterns present in this area, as well as to provide a stronger basis for vegetation community definition, *Eastcoast Flora Survey* has been commissioned to analyse systematic quadrat data collected from the sites by *EcoBiological* staff. Such analysis is to be carried out using techniques and software widely used by conservation agencies in Australia.

In 2007-8, analysis of data from 39 sample sites was undertaken, resulting in the definition of ten floristic vegetation communities (Bell 2008). Certain limitations were evident in the dataset at that stage, which it was suggested may be overcome with additional sampling. This has now be undertaken, in addition to further sampling in an increased study area, resulting in a new dataset of 89 sample plots.

This report presents the results of a revised data analysis, including:

- Cluster analysis of 89 quadrats using, with and without weed species;
- Non-metric Multi Dimensional Scaling (nMDS) ordination;
- Generation of diagnostic species lists for each of the communities defined.

2.0 Study Area and Supplied Data

Gloucester Coal proposes to extend existing mines in the Gloucester area, at Stratford and Duralie. Both of these locations occur in fragmented landscapes of agricultural lands and remnant native bushland. Since acquisition by the mining company, regrowth of previously grazed lands has occurred.

EcoBiological have supplied the quadrat data collected from both sites, in an Excel spreadsheet. All data was collected within 20 x 20m survey plots (0.04ha), and all recorded plant species were attributed an estimated cover abundance code based on the modified Braun-Blanquet system (Poore 1955) widely used in New South Wales (Table 1). A total of 389 plant taxa (including 25 weeds) have been identified across 89 survey plots.

Table 1 Modified Braun-Blanquet cover abundance scale.

Code	Estimated Cover (within 0.04ha plot)
1	less than 1% cover
2	cover between 1-5%
3	cover between 6-25%
4	cover between 26-50%
5	cover between 51-75%
6	cover between 76-100%

Figure 1 provides a graphical breakdown of this data (excluding weeds). Plots prefaced '07' represent those collected and analysed for the 2007-8 report, while '08' represent the additional data. Variation in the number of species recorded is quite marked, ranging from a minimum of 10

species to a maximum of 76 species (overall mean 32.58, StDev 15.17). This variation most likely reflects overall vegetation community diversity. Interestingly, there is an obvious increase in mean species diversity per plot in the 08 subset of data (mean 40.86, StDev 14.26) when compared to the 07 data (mean 29.97, StDev 8.08).

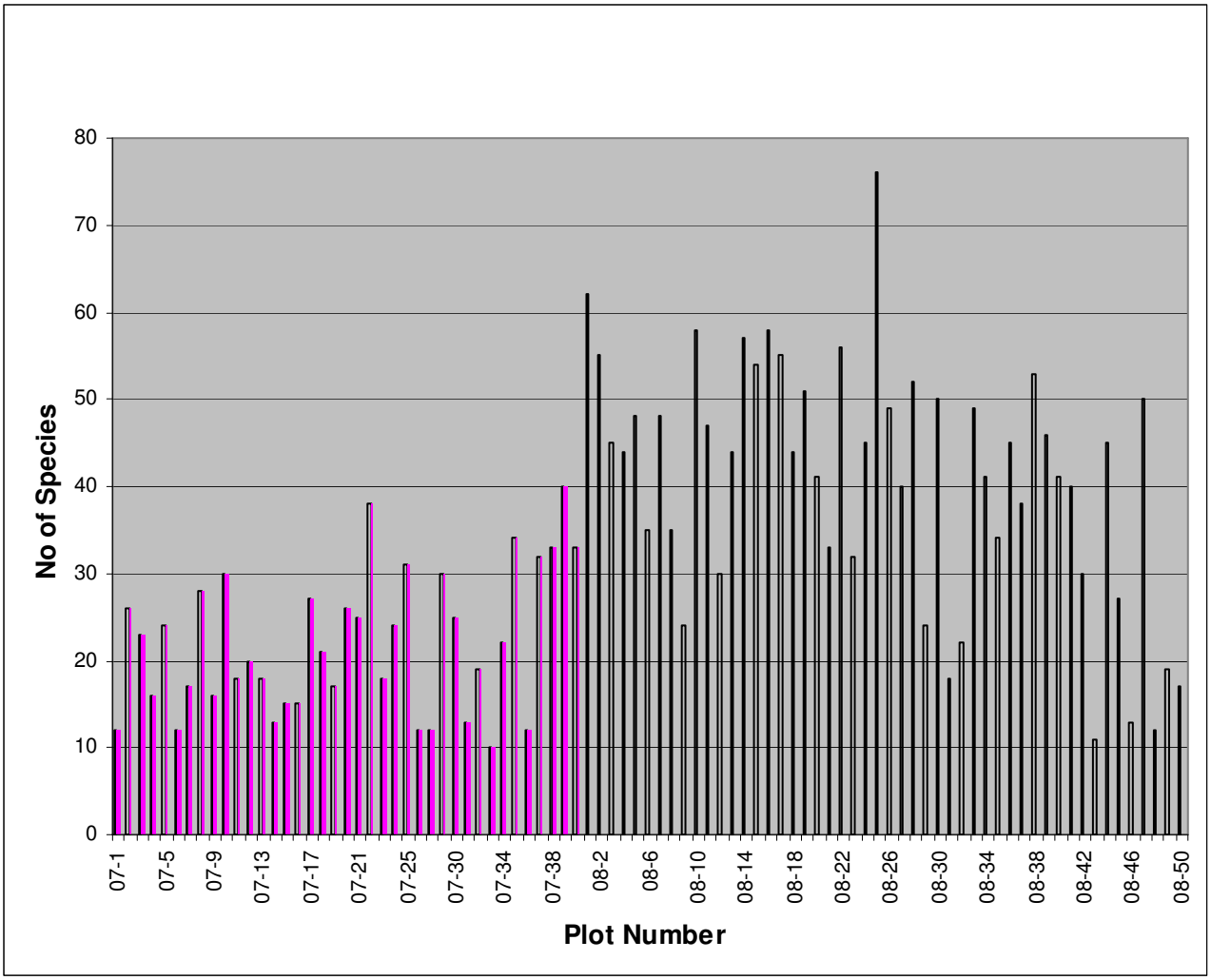


Figure 1 Gloucester Coal quadrat data breakdown.

3.0 Data Analysis Methods

Data analysis undertaken on the 2007 data used the *PATN* program of Belbin (1995a,b), the *PAST* program of Hammer et. al. (2001), and purpose-built software developed by the NSW Department of Environment and Climate Change to profile each community (Bell 2008). The current analysis uses a different software package (*Primer v6*: Clarke & Gorley 2006), which undertakes all of the same procedures but in a single program.

3.1 Cluster Analysis

Hierarchical cluster analysis was undertaken on the supplied data, to assist in defining groups of samples supporting similar suites of plant species. Cluster analysis of data was undertaken using

the CLUSTER routine in *Primer* (Clarke & Gorley 2006). A taxonomic review was undertaken on the data prior to analysis, which resulted in some minor changes (eg: merging duplicate species).

The Bray-Curtis association measure was utilised, and other default *Primer* settings were employed. An unweighted pair-group arithmetic averaging clustering strategy (UPGMA) was applied to the data matrix to derive a hierarchical classification. Dissimilarity between individual sites and groups of sites were illustrated through the generation of dendrograms, which trace the relationship of all sites.

Two separate data analysis were undertaken to assist in defining and categorising the vegetation:

1. all supplied data, including weed species present;

2. all supplied data, but with weed species excluded.

The SIMPROF routine in Primer was used to test for structure within the dataset, both on all plots combined and on individual communities ultimately defined. This procedure constructs a resemblance profile of the data by ranking the resemblance data matrix, then calculates a mean profile by randomising the order of the value of each variable, and re-calculates the profile. The deviation of the actual data profile from the mean profile is calculated using the pi statistic. The pi statistic is then compared with the deviations of further randomly generated profiles to test for significance.

3.2 nMDS Analysis

Non-metric Multi Dimensional Scaling (nMDS) was undertaken on the data using the Bray-Curtis similarity measure in the MDS routine of *Primer*. This was completed to graphically depict the relationships between all plots within 2-dimensional space, which assists vegetation community definition. A Shepard plot of the data (obtained vs observed) was also computed to test the quality of the data.

3.3 Analysis of Similarity

The ANOSIM routine in *Primer* was used to test for differences between pairs of samples within and between communities. Global R values were calculated for pair-wise comparisons, and a matrix of values produced. Values at or close to unity represent comparisons where within group variation is significantly less than between group comparisons.

3.4 Community Profiles

In order to prepare brief profiles of the vegetation communities delineated, lists of diagnostic species for each defined community were generated using the SIMPER routine in *Primer*. This procedure examines the contribution of each variable (species) to average resemblances between sample groups. For Bray-Curtis similarities, it determines the contributions to the average Bray-Curtis dissimilarity between pairs of groups or groups of samples, and also determines the contributions to the average similarity within a group.

Such species lists are used in the field to attribute specific areas to a vegetation community, but are reliant on the quality and extent of sample data available.

4.0 Results

4.1 Cluster Analysis

The similarity profile generated through SIMPROF for the entire dataset of 89 plots showed marked deviation from the mean (Figure 2). This indicates that as a whole, the supplied dataset comprises significant variation in floristic composition which can be examined further through clustering and ordination techniques. If there were no internal structure within the data, then the line showing the actual (observed) data would fall within the upper and lower probability bounds.

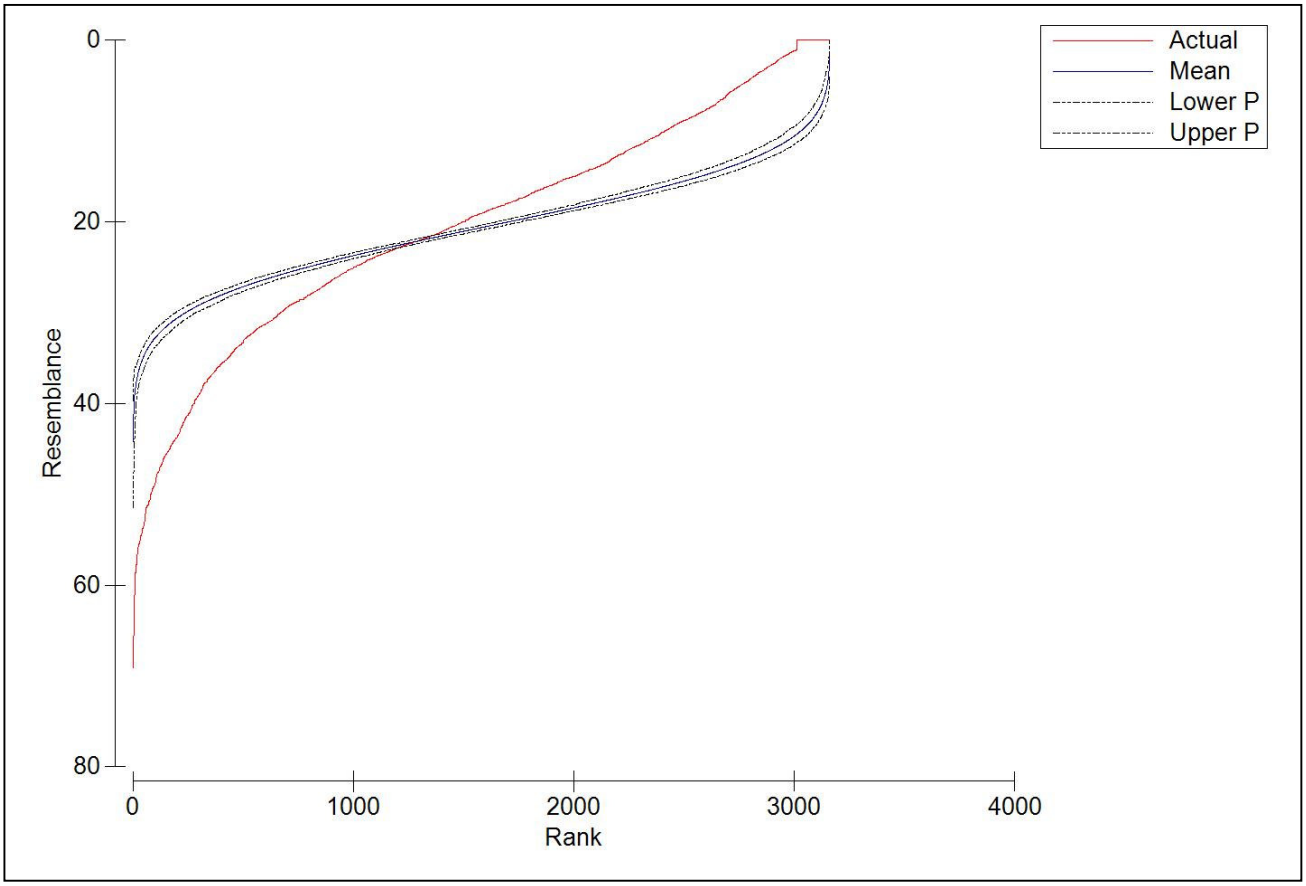


Figure 2 Similarity profile of the Gloucester Coal sample data, as generated through SIMPROF.

Using the CLUSTER routine in *Primer*, two cluster analyses were then undertaken on the data to assist in defining vegetation communities. The first of these used the complete dataset, including weed species, with the Bray-Curtis association measure and flexible UPGMA. The second used the same process but filtered out weed species. Analysis without weed species presented the most meaningful result, and was therefore used for all subsequent analyses.

Figure 3 shows the dendrogram of sample sites produced through the cluster analysis. Sixteen groups (communities) have been defined at 28% similarity (72% or 0.72 dissimilarity). This analysis proved to be robust, with few misclassified sites evident. The two sites representing the Spotted Gum/ Red Ironbark/ Thick-leaved Mahogany Forest (07-36, 07-37) were sampled by two

different observers, which may help to explain the internal variation present at this level of delineation. Sample site 08-38 was in an area heavily infested by the woody weed *Lantana camara*, hence the diversity of native species was low. Despite this, it grouped reasonably well with other samples in the Blue Gum Moist Forest community.

Section 4.3 briefly describes each community in more detail, including the provision of diagnostic species lists.

4.2 nMDS Analysis

The nMDS data analysis, using the Bray-Curtis similarity measure on weed-free data, provided a good indication of all sample plots in 2-dimensional space, with a stress level of 0.19 (Figure 4). This result supported the groups identified in the cluster analysis well. The Shepard plot generated as part of this analysis produced a reasonably well defined linear relationship (Figure 5).

There is a general trend in the nMDS plot moving from floodplain and grass-dominated vegetation in the left, through shrubby vegetation in the centre, to moister riparian and rainforest vegetation on the right. Again, the two plots comprising the Spotted Gum/ Red Ironbark/ Thick-leaved Mahogany Forest are well separated and hence this community is not well defined.

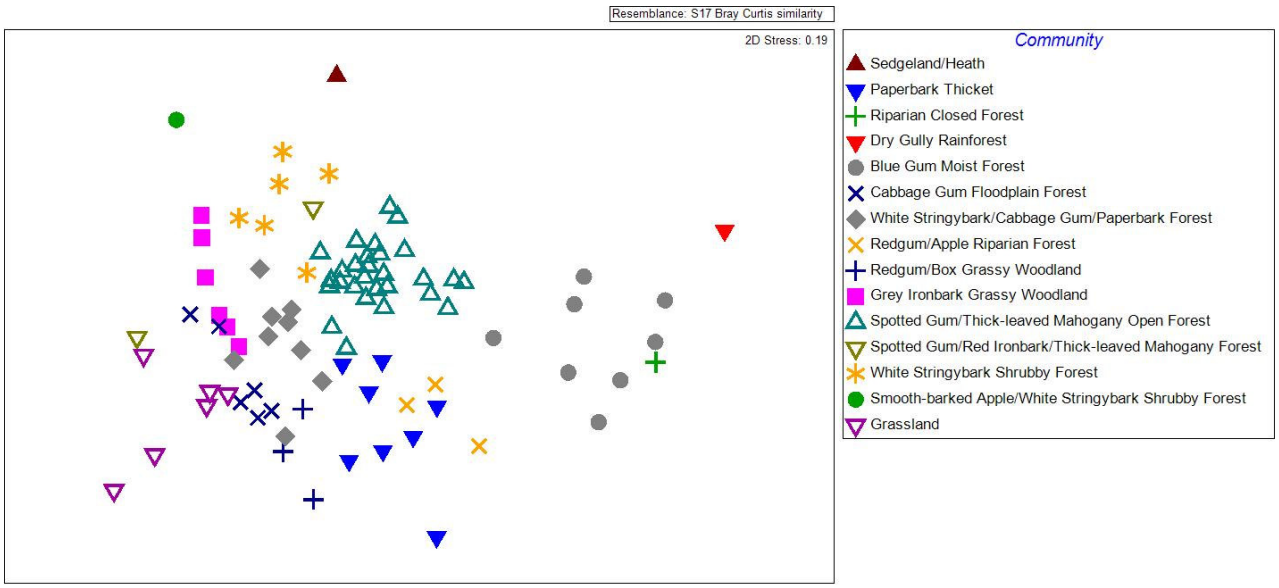


Figure 4 2-dimensional nMDS ordination of plot data, showing spatial distribution of defined vegetation communities.

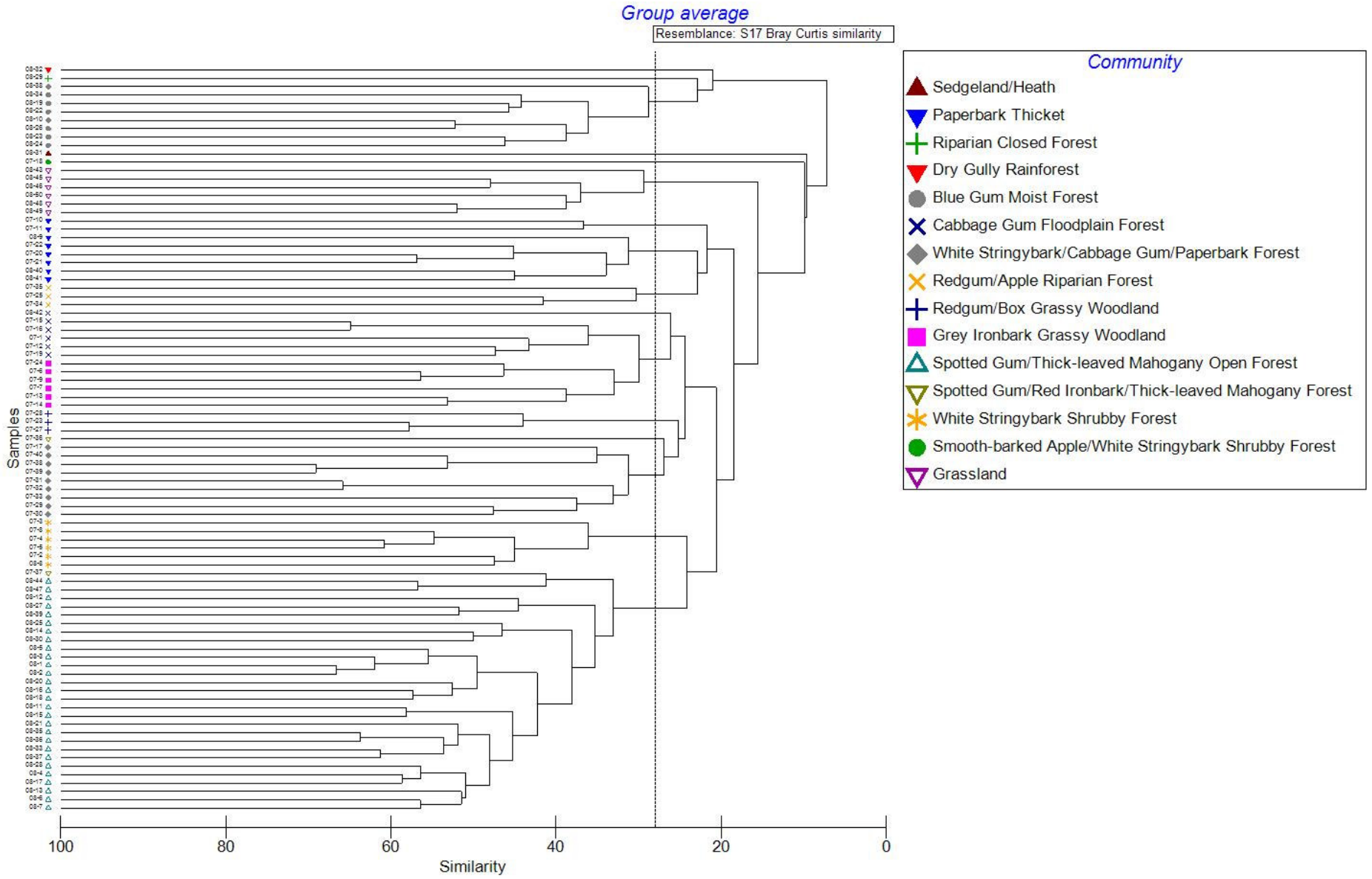


Figure 3 Site dendrogram of 89 plots defined at 16 groups and 28% similarity (72% dissimilarity), with no weeds and using the Bray-Curtis association measure.

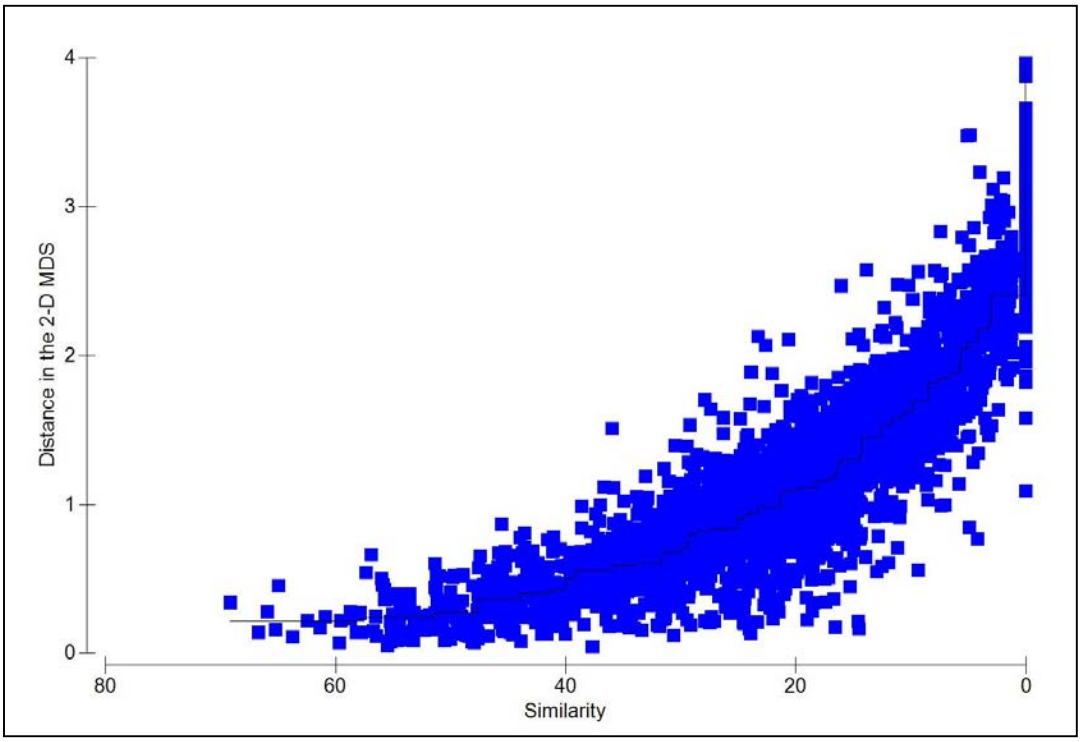


Figure 5 Shepard diagram from the nMDS ordination of plot data, showing relatively even departures in stress (blue symbols) from the best-fitting regression line (black).

4.3 Analysis of Similarity

The analysis of similarity of species composition (ANOSIM) between defined groups of sample plots revealed an overall Global R value of 0.914 ($p < 0.001$). Significant differences were also evident between most defined communities in the pairwise analysis (Table 2). Comparisons from several groups returned R values at or close to unity, indicating within group similarity to be greater than between group similarity. Low values evident for Spotted Gum/ Red Ironbark/ Thick-leaved Mahogany Forest with White Stringybark/ Cabbage Gum/ Paperbark Forest (0.49), Paperbark Thicket and Redgum/ Apple Riparian Forest (0.51), Paperbark Thicket and Redgum/Box Grassy Woodland & Redgum/ Apple Riparian Forest (both 0.51), and Grey Ironbark Grassy Woodland and Cabbage Gum Floodplain Forest (0.50), suggest poorer resolution of these communities when based on floristic differences alone. The single samples within the Smooth-barked Apple/ White Stringybark Shrubby Forest, Sedgeland/ Heath, Riparian Closed Forest and Dry Gully Rainforest precludes assessment of similarities between these communities.

4.4 Community Profiles

Similarity percentages where compared using the SIMPER routine in *Primer* to provide diagnostic species lists for the 15 defined communities. This procedure examines the contribution of each species to the average resemblances between sample groups, resulting in lists of those species that have the strongest input into the definition of a community, truncated to the top 90% of species contributions. It also calculates the average Bray-Curtis similarity value for all pairs of samples comprising each community, expressed as a percentage value. The higher the average similarity value, the better defined the community.

Table 2 ANOSIM results (Global R values) for pair-wise comparisons of *aprior* vegetation groups.

Community	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Cabbage Gum Floodplain Forest															
2. White Stringybark Shrubby Forest	0.94														
3. Grey Ironbark Grassy Woodland	0.50	0.71													
4. Paperbark Thicket	0.69	0.78	0.84												
5. White Stringybark/ Cabbage Gum/Paperbark Forest	0.67	0.73	0.68	0.67											
6. Smooth-barked Apple/White Stringybark Shrubby Forest	1	0.91	0.91	0.92	0.99										
7. Redgum/Box Grassy Woodland	0.57	1	0.75	0.51	0.62	1									
8. Redgum/Apple Riparian Forest	0.98	1	0.97	0.51	0.76	1	0.85								
9. Spotted Gum/ Red Ironbark/ Mahogany Forest	0.98	0.94	0.95	0.83	0.49	1	0.92	1							
10. Spotted Gum/ Mahogany Open Forest	0.98	0.85	0.97	0.92	0.83	1	0.97	0.98	0.89						
11. Blue Gum Moist Forest	1	1	1	0.93	1	1	1	0.92	1	0.97					
12. Riparian Closed Forest	1	1	1	1	1	indef	1	1	1	1	0.79				
13. Sedgeland/Heath	1	1	0.98	1	0.99	indef	1	1	1	1	1	indef			
14. Dry Gully Rainforest	1	1	1	1	1	indef	1	1	1	1	0.90	indef	indef		
15. Grassland	0.74	0.98	0.88	0.90	0.78	1	0.90	0.98	0.89	0.99	1	1	1	1	

indef = indefinable due to limited samples

The SIMPROF routine was also run on each of the 15 defined communities, as an additional method of examining within-group variability and soundness of classification. In this case, it is expected that the true value for pi (π, the test statistic) will lie within the distribution of the null hypothesis for pi (or within the 95% confidence limits), inferring a well defined community. If it does not, the p value will be very small (<0.01) and it is possible that the defined community supports high internal variation.

Table 3 summarises significance values for the 15 defined communities. The more robust communities defined through the SIMPER analysis include Redgum/Box Grassy Woodland (average similarity of 48.59) and White Stringybark Shrubby Forest (44.57). The test statistic calculated in the SIMPROF procedure in three communities (Paperbark Thicket, White Stringybark/ Cabbage Gum/ Paperbark Forest, and Spotted Gum/ Thick-leaved Mahogany Forest) resulted in P values of <0.01, suggesting less robust communities. Five communities possessed too few samples for these two procedure to be run.

Brief profiles of the 15 defined communities follow, showing those species contributing the top 90% of diversity to that community from the SIMPER analysis, together with a graphical depiction of the true value of π (vertical dotted line) within the null hypothesis (histogram) from the SIMPROF analysis. Note that this information is presented based only on the dataset originally provided by *EcoBiological*, without any field reconnaissance. For those communities represented by a single sample only, the full species list is provided.

Table 3 Summary of average similarities and significance values from SIMPER and SIMPROF analyses.

Community	SIMPER		SIMPROF	
	No. Samples	Average similarity	Pi	P value
1. Sedgeland/Heath	1	-	-	-
2. Paperbark Thicket	8	30.59	3.38	<0.01
3. Riparian Closed Forest	1	-	-	-
4. Dry Gully Rainforest	1	-	-	-
5. Blue Gum Moist Forest	8	36.57	1.77	0.020
6. Cabbage Gum Floodplain Forest	6	37.52	1.95	0.473
7. White Stringybark/Cabbage Gum/Paperbark Forest	9	35.95	3.62	<0.01
8. Redgum/Apple Riparian Forest	3	34.10	2.04	0.490
9. Redgum/Box Grassy Woodland	3	48.59	3.16	0.130
10. Grey Ironbark Grassy Woodland	6	38.44	2.70	0.055
11. Spotted Gum/Thick-leaved Mahogany Open Forest	28	41.76	2.49	<0.01
12. Spotted Gum/Red Ironbark/Thick-leaved Mahogany Forest	2	27.37	-	-
13. White Stringybark Shrubby Forest	6	44.57	2.67	0.040
14. Smooth-barked Apple/White Stringybark Forest	1	-	-	-
15. Grassland	6	36.47	1.41	0.810

1. Sedgeland/ Heath

No. of samples: 1
Average similarity: n/a

Species list of all species recorded, in order of decreasing cover abundance code.

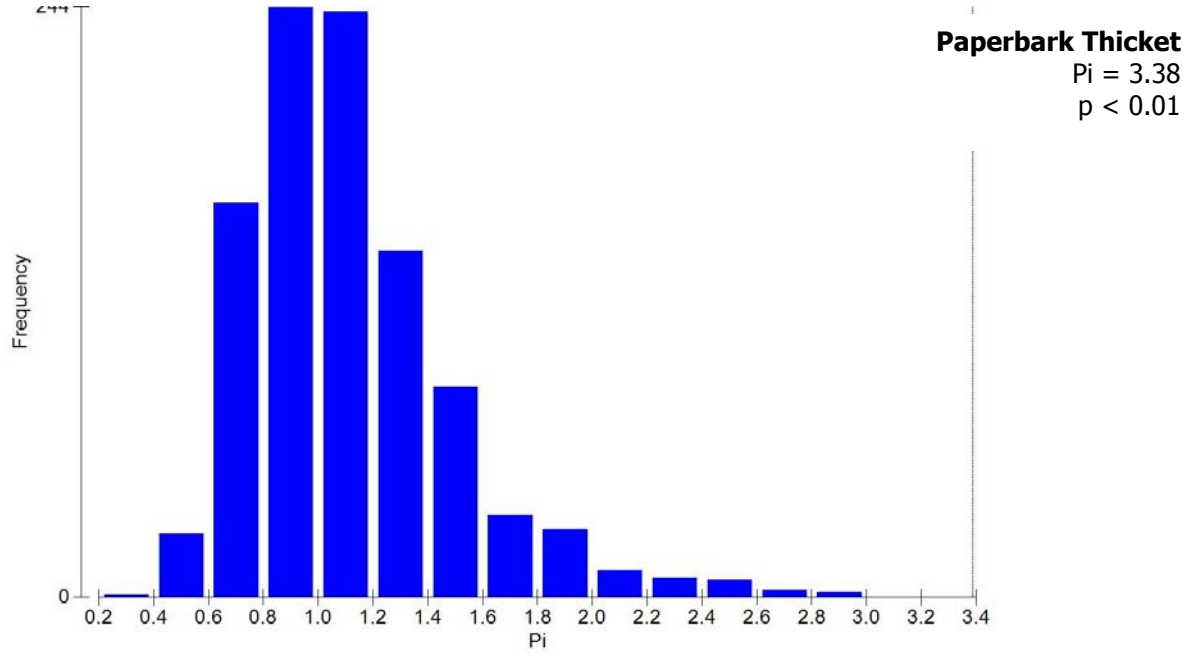
Species	Cover abundance
Hibbertia riparia	4
Leptospermum trinervium	4
Schoenus brevifolius	4
Themeda australis	3
Allocasuarina littoralis	2
Bursaria spinosa subsp. spinosa	2
Dendrobium speciosum var. hillii	2
Dodonaea triquetra	2
Entolasia stricta	2
Helichrysum elatum	2
Lomandra confertifolia subsp. rubiginosa	2
Notelaea longifolia	2
Plectranthus argentatus	2
Pomaderris lanigera	2
Pomax umbellata	2
Rulingia dasyphylla	2
Stypandra glauca	2
Corymbia maculata	1

Too few samples to generate a histogram and probabilities.

2. Paperbark Thicket

No. of samples: 8
Average similarity: 30.59

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Imperata cylindrica	2.75	2.81	1.50	9.18	9.18
Parsonsia straminea	2.50	2.73	1.45	8.93	18.11
Lomandra longifolia	2.25	2.70	3.31	8.82	26.93
Pratia purpurascens	2.00	2.23	1.64	7.29	34.22
Melaleuca nodosa	3.13	2.21	0.67	7.22	41.44
Oplismenus imbecillis	1.75	1.57	1.03	5.13	46.57
Entolasia marginata	2.13	1.53	0.87	5.00	51.57
Carex appressa	1.75	1.23	0.68	4.02	55.59
Dichondra repens	1.38	1.07	0.72	3.48	59.07
Gonocarpus teucrioides	1.25	1.02	0.72	3.34	62.41
Eucalyptus acmenoides	1.88	0.92	0.50	3.00	65.41
Breynia oblongifolia	1.25	0.89	0.95	2.91	68.32
Viola hederacea	1.13	0.87	0.66	2.83	71.15
Pteridium esculentum	1.38	0.85	0.64	2.79	73.94
Leucopogon juniperinus	1.13	0.85	0.69	2.77	76.71
Melaleuca linariifolia	1.75	0.68	0.44	2.24	78.95
Glycine microphylla	1.00	0.66	0.65	2.14	81.09
Hydrocotyl peduncularis	1.00	0.34	0.33	1.10	82.19
Entolasia stricta	0.88	0.32	0.34	1.04	83.23
Hibbertia diffusa	0.75	0.31	0.34	1.01	84.24
Notelaea longifolia	0.63	0.30	0.51	0.99	85.23
Zieria smithii	0.88	0.29	0.34	0.94	86.17
Themeda australis	0.88	0.26	0.29	0.86	87.03
Ozothamnus diosmifolius	0.75	0.26	0.34	0.86	87.89
Echinopogan caespitosus	0.63	0.24	0.32	0.79	88.68
Acacia ulicifolia	0.63	0.23	0.32	0.74	89.42
Poa affinis	0.63	0.21	0.33	0.70	90.12



3. Riparian Closed Forest

No. of samples: 1
Average similarity: n/a

Species list of all species recorded, in order of decreasing cover abundance code.

Species	**Cover abundance**
Waterhousea floribunda	5
Casuarina cunninghamia	3
Doryphora sassafras	3
Adiantum hispidulum	2
Backhousia myrtifolia	2
Callistemon salignus	2
Cryptocarya microneura	2
Doodia aspera	2
Elattostachys nervosa	2
Eucalyptus microcorys	2
Ficus coronata	2
Lomandra longifolia	2
Pellaea falcata	2
Ripogonum album	2
Rubus parvifolius	2
Streblus brunonianus	2
Urtica urens	2
Eucalyptus siderophloia	1
Guioa semiglauca	1
Maytenus silvestris	1
Pandorea pandorana	1
Smilax australis	1
Wilkiea huegeliana	1

Too few samples to generate a histogram and probabilities.

4. Dry Gully Rainforest

No. of samples: 1
Average similarity: n/a

Species list of all species recorded, in order of decreasing cover abundance code.

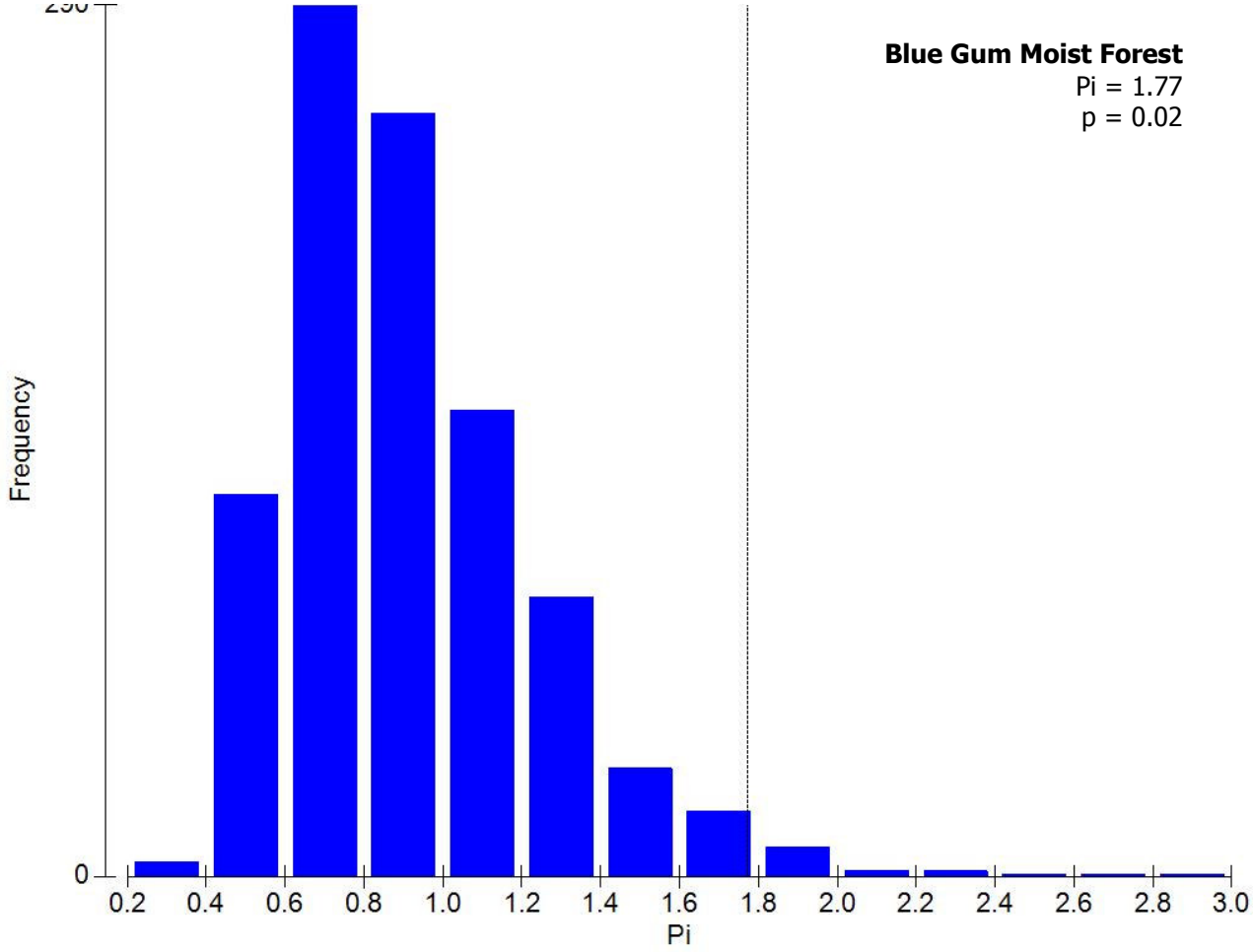
Species	Cover abundance
Ficus rubiginosa	5
Cissus antarctica	3
Doodia aspera	3
Rhysotoechia bifoliolata subsp. bifoliolata	3
Smilax australis	3
Synoum glandulosum	3
Aphanopetalum resinosum	2
Asplenium australasicum	2
Calochlaena dubia	2
Eucalyptus microcorys	2
Litsea australis	2
Marsdenia suaveolens	2
Platycerium bifurcatum	2
Scolopia braunii	2
Toona ciliata	2
Wilkiea huegeliana	2
Alphitonia excelsa	1
Dendrobium sp.	1
Dioscorea transversa	1
Gymnostachys anceps	1
Ripogonum fawcettianum	1
Stephania japonica	1

Too few samples to generate a histogram and probabilities.

5. Blue Gum Moist Forest

No. of samples: 8
Average similarity: 36.57

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Backhousia myrtifolia	3.50	2.89	1.35	7.91	7.91
Doodia aspera	3.38	2.71	1.64	7.41	15.32
Eucalyptus saligna	2.63	1.92	1.42	5.24	20.56
Smilax australis	2.00	1.89	5.05	5.17	25.73
Cissus antarctica	2.50	1.87	1.58	5.12	30.85
Pandorea pandorana	1.75	1.67	3.37	4.57	35.42
Pittosporum spinescens	2.00	1.60	1.31	4.38	39.80
Dioscorea transversa	1.63	1.42	1.46	3.89	43.69
Adiantum hispidulum	1.63	1.22	1.04	3.34	47.03
Pittosporum revolutum	1.50	1.15	1.41	3.15	50.18
Lomandra longifolia	1.63	1.06	0.92	2.89	53.07
Pellaea paradoxa	1.38	1.00	0.95	2.74	55.81
Geitonoplesium cymosum	1.38	0.99	1.01	2.70	58.52
Oplismenus imbecillis	1.50	0.82	0.72	2.23	60.75
Aphanopetalum resinosum	1.38	0.73	0.73	2.00	62.75
Calochlaena dubia	1.75	0.70	0.62	1.91	64.66
Notelaea longifolia	1.00	0.67	0.98	1.83	66.49
Eustrephus latifolius	1.13	0.66	0.67	1.81	68.31
Clematis aristata	1.13	0.66	0.68	1.81	70.11
Neolitsea dealbata	1.00	0.52	0.69	1.41	71.52
Ficus coronata	1.00	0.48	0.68	1.30	72.83
Lophostemon confertus	1.50	0.48	0.44	1.30	74.13
Eupomatia laurina	1.00	0.47	0.66	1.30	75.42
Breynia oblongifolia	0.88	0.46	0.70	1.26	76.69
Pseuderanthemum variabile	1.00	0.46	0.51	1.26	77.94
Cryptocarya microneura	1.13	0.44	0.51	1.19	79.14
Cissus hypoglauca	0.88	0.39	0.47	1.05	80.19
Gymnostachys anceps	0.88	0.37	0.50	1.00	81.19
Parsonsia straminea	1.00	0.36	0.47	0.98	82.18
Blechnum cartilagineum	1.00	0.31	0.48	0.85	83.03
Maytenus silvestris	0.75	0.31	0.48	0.85	83.88
Wilkiea huegeliana	0.75	0.29	0.49	0.79	84.67
Melicope micrococca	0.75	0.28	0.49	0.77	85.44
Callistemon salignus	0.88	0.27	0.34	0.73	86.17
Guioa semiglauca	1.13	0.27	0.33	0.73	86.90
Adiantum aethiopicum	0.88	0.24	0.34	0.66	87.56
Asplenium australasicum	0.63	0.23	0.51	0.63	88.19
Clerodendrum tomentosum	0.63	0.23	0.51	0.63	88.82
Sarcomelicope simplicifolia	0.75	0.23	0.34	0.62	89.43
Alphitonia excelsa	0.75	0.22	0.51	0.60	90.03


Blue Gum Moist Forest
Pi = 1.77
p = 0.02
Frequency
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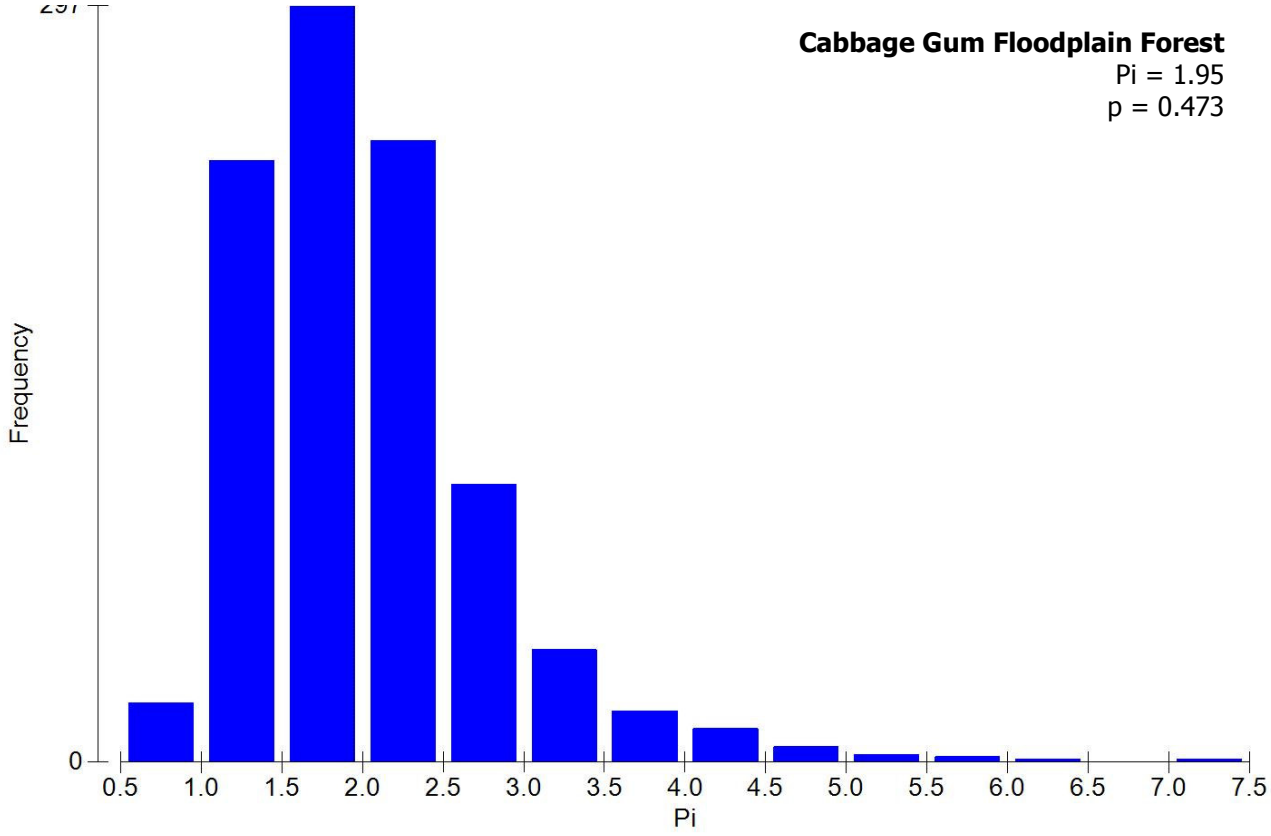
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
Pi

6. Cabbage Gum Floodplain Forest

No. of samples: 6
Average similarity: 37.52

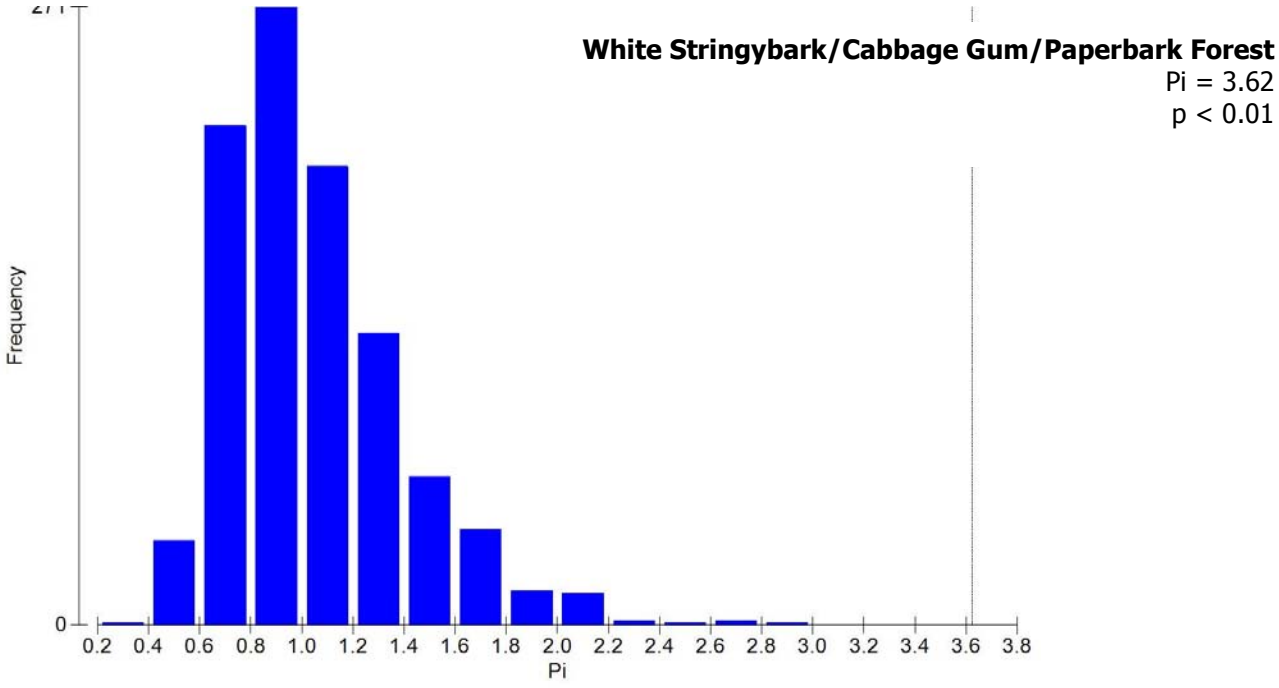
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Eucalyptus amplifolia subsp. amplifolia	3.67	6.60	2.77	17.60	17.60
Themeda australis	3.17	5.88	1.35	15.68	33.28
Imperata cylindrica	2.83	3.50	0.76	9.32	42.60
Pratia purpurascens	2.00	3.36	1.34	8.95	51.56
Glycine clandestina	1.67	3.08	1.33	8.22	59.77
Aristida vagans	2.17	2.77	0.79	7.39	67.16
Microlaena stipoides var stipoides	1.83	1.82	0.75	4.85	72.01
Eragrostis brownii	1.33	1.78	0.78	4.73	76.74
Angophora subvelutina	2.33	1.66	0.40	4.43	81.17
Entolasia marginata	1.67	1.27	0.48	3.38	84.55
Acacia ulicifolia	1.00	1.20	0.72	3.21	87.76
Dichondra repens	1.00	0.95	0.48	2.54	90.30



7. White Stringybark/ Cabbage Gum/ Paperbark Forest

No. of samples: 9
Average similarity: 35.95

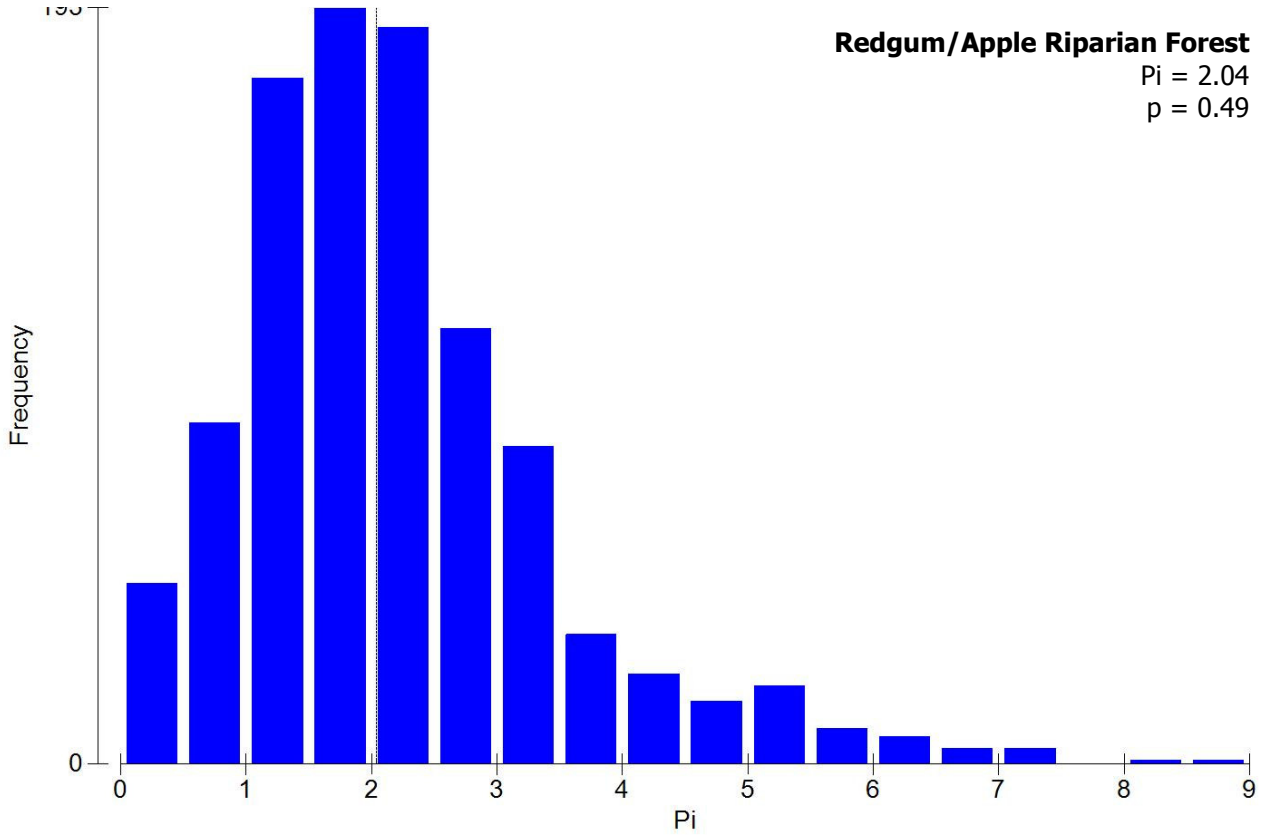
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Themeda australis	3.56	5.16	2.37	14.35	14.35
Imperata cylindrica	3.33	4.94	3.81	13.74	28.09
Glycine clandestina	1.78	2.72	1.68	7.58	35.67
Echinopogan caespitosus	1.67	1.89	1.13	5.27	40.94
Panicum simile	1.67	1.88	1.13	5.23	46.17
Leucopogon juniperinus	1.89	1.57	0.78	4.37	50.54
Microlaena stipoides var stipoides	1.56	1.46	0.78	4.07	54.61
Billardiera scandens var. scandens	1.33	1.39	0.81	3.87	58.48
Pratia purpurascens	1.33	1.20	0.83	3.33	61.81
Eucalyptus fibrosa	1.44	1.17	0.56	3.25	65.06
Eucalyptus tereticornis	2.00	1.05	0.43	2.91	67.97
Eucalyptus carnea	1.89	1.04	0.42	2.90	70.87
Aristida vagans	1.67	1.04	0.60	2.89	73.76
Desmodium varians	1.11	0.77	0.61	2.15	75.91
Entolasia stricta	1.33	0.69	0.37	1.92	77.84
Corymbia maculata	1.56	0.63	0.29	1.76	79.60
Eucalyptus globoidea	1.33	0.55	0.43	1.52	81.12
Pomax umbellata	0.89	0.54	0.43	1.50	82.62
Eucalyptus acmenoides	1.33	0.49	0.30	1.36	83.97
Cheilanthes sieberi subsp. sieberi	0.89	0.45	0.44	1.26	85.24
Oxalis exilis	0.78	0.34	0.42	0.96	86.20
Dichondra repens	0.67	0.34	0.30	0.95	87.15
Austrodanthonia tenuior	0.78	0.33	0.42	0.92	88.07
Tricoryne simplex	0.78	0.33	0.42	0.92	88.99
Clematis aristata	0.78	0.30	0.24	0.85	89.84
Eucalyptus siderophloia	0.78	0.29	0.30	0.81	90.64



8. Redgum/ Apple Riparian Forest

No. of samples: 3
Average similarity: 34.10

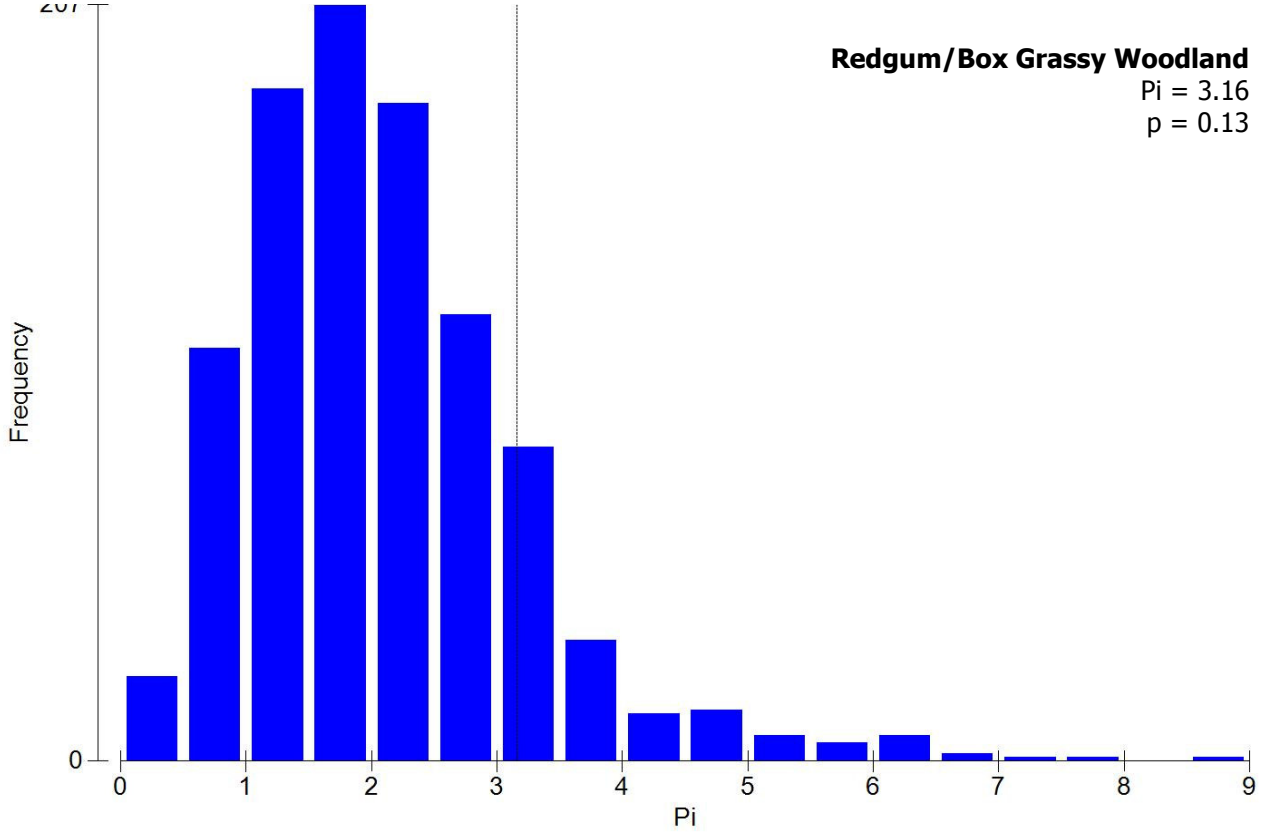
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Adiantum aethiopicum	3.33	3.26	6.03	9.57	9.57
Clematis aristata	2.00	2.83	11.41	8.30	17.87
Geitonoplesium cymosum	2.00	2.83	11.41	8.30	26.17
Opercularia diphylla	2.00	2.83	11.41	8.30	34.48
Pandorea pandorana	2.00	2.83	11.41	8.30	42.78
Pennisetum alopecuroides	2.33	2.83	11.41	8.30	51.09
Pratia purpurascens	2.67	2.05	0.58	6.02	57.10
Acacia irrorata subsp irrorata	2.33	1.54	0.58	4.51	61.61
Oplismenus imbecillis	2.00	1.54	0.58	4.51	66.13
Imperata cylindrica	2.67	1.42	0.58	4.16	70.29
Angophora floribunda	2.33	1.29	0.58	3.78	74.07
Lomandra longifolia	1.67	1.03	0.58	3.01	77.08
Viola hederacea	1.33	1.03	0.58	3.01	80.09
Dichondra repens	1.67	0.95	0.58	2.77	82.86
Doodia aspera	1.33	0.95	0.58	2.77	85.63
Leucopogon juniperinus	1.67	0.95	0.58	2.77	88.40
Digitaria parviflora	1.67	0.86	0.58	2.52	90.93



9. Redgum/ Box Grassy Woodland

No. of samples: 3
Average similarity: 48.59

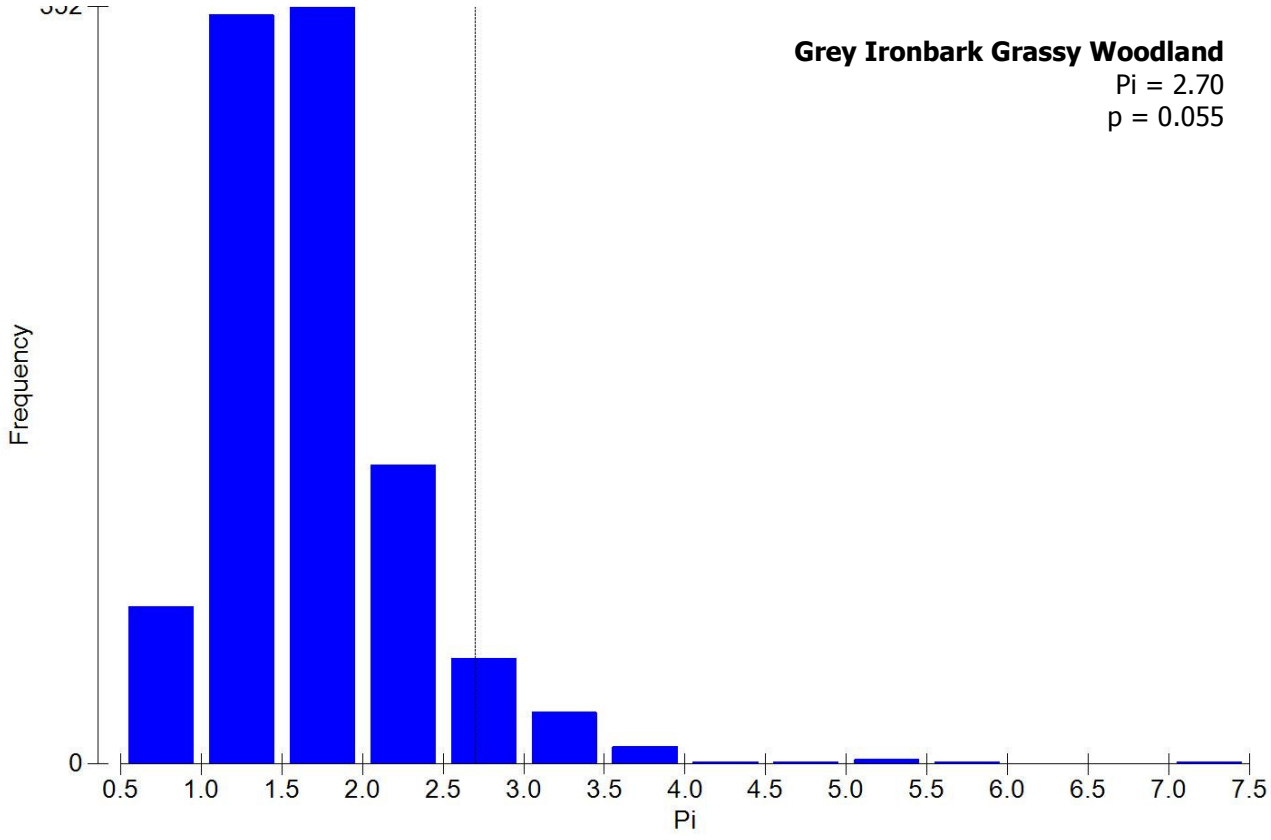
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Imperata cylindrica	5.67	13.28	4.82	27.34	27.34
Eucalyptus tereticornis	4.33	9.90	10.31	20.36	47.70
Themeda australis	3.33	7.42	10.31	15.27	62.97
Acacia irrorata subsp irrorata	2.67	4.95	10.31	10.18	73.16
Gonocarpus teucrioides	2.33	4.95	10.31	10.18	83.34
Eucalyptus molucanna	2.67	2.41	0.58	4.96	88.30
Pratia purpurascens	2.00	2.41	0.58	4.96	93.26



10. Grey Ironbark Grassy Woodland

No. of samples: 6
Average similarity: 38.44

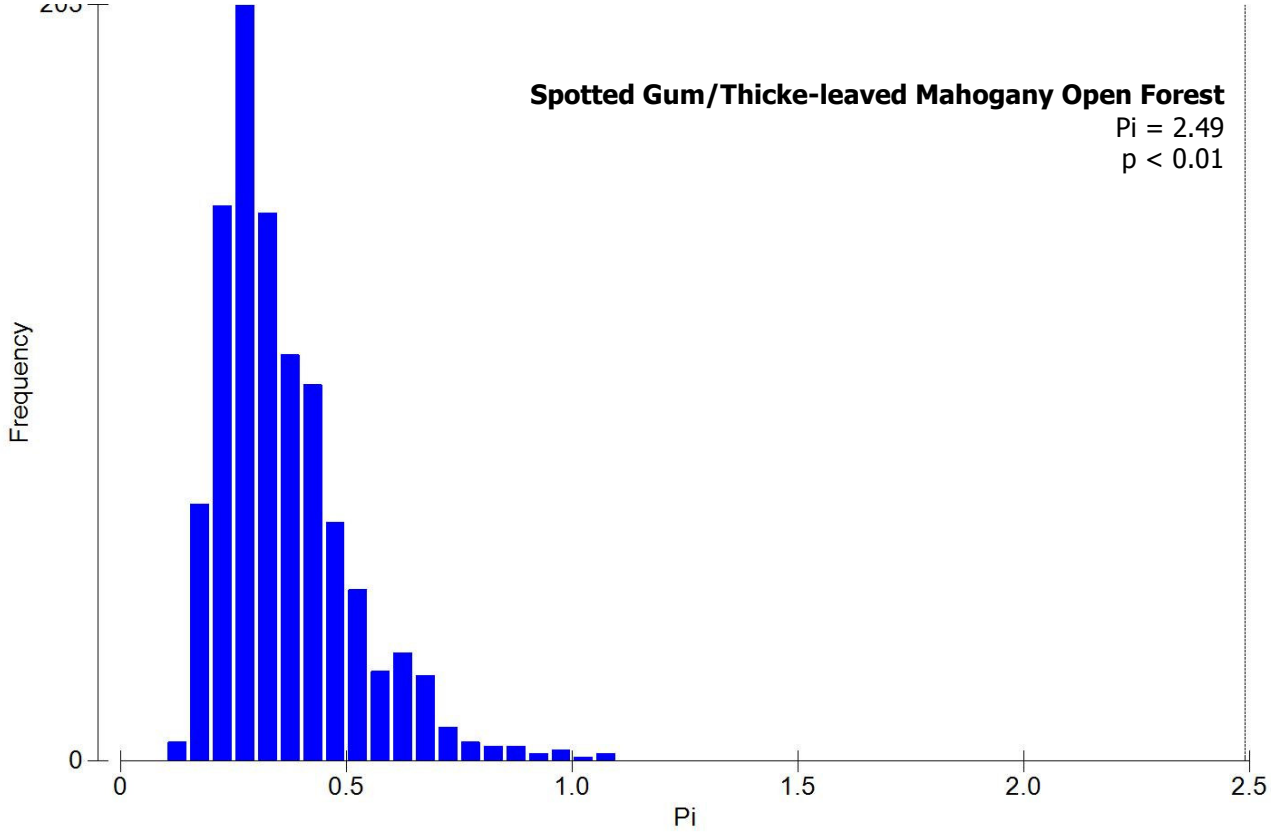
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Eucalyptus siderophloia	4.50	8.66	4.19	22.52	22.52
Themeda australis	4.00	7.40	2.62	19.26	41.78
Opercularia diphylla	2.00	4.48	7.73	11.66	53.44
Microlaena stipoides var stipoides	2.67	2.85	0.71	7.43	60.86
Acacia ulicifolia	1.67	2.33	1.19	6.06	66.92
Imperata cylindrica	1.83	2.27	0.76	5.90	72.83
Aristida vagans	2.00	2.22	0.75	5.77	78.60
Entolasia stricta	1.67	1.35	0.48	3.51	82.11
Pratia purpurascens	1.50	1.32	0.48	3.44	85.56
Pultenaea villosa	1.33	1.02	0.48	2.66	88.21
Cymbopogon refractus	1.00	0.76	0.48	1.98	90.19



11. Spotted Gum/ Thick-leaved Mahogany Open Forest

No. of samples: 28
Average similarity: 41.76

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Themeda australis	3.25	2.76	1.37	6.62	6.62
Eucalyptus carnea	2.86	2.57	1.47	6.16	12.77
Imperata cylindrica	2.43	2.09	1.46	5.01	17.79
Allocasuarina torulosa	2.32	2.01	1.48	4.82	22.61
Corymbia maculata	2.57	1.87	0.93	4.47	27.08
Podolobium ilicifolium	1.96	1.70	1.49	4.08	31.15
Pratia purpurascens	1.64	1.63	1.63	3.91	35.06
Hardenbergia violacea	1.46	1.26	1.06	3.02	38.09
Entolasia stricta	1.61	1.24	1.06	2.96	41.05
Dianella caerulea	1.39	1.19	1.42	2.85	43.90
Desmodium varians	1.36	1.16	1.19	2.77	46.67
Breynia oblongifolia	1.43	1.11	1.38	2.66	49.32
Persoonia linearis	1.39	1.09	1.00	2.61	51.93
Eucalyptus microcorys	1.86	0.99	0.72	2.37	54.30
Desmodium rhytidophyllum	1.21	0.98	1.09	2.34	56.65
Pseuderanthemum variabile	1.21	0.92	1.13	2.21	58.85
Dichondra repens	1.32	0.91	0.79	2.17	61.02
Eucalyptus siderophloia	1.39	0.83	0.66	1.99	63.02
Acacia longissima	0.89	0.76	1.19	1.81	64.83
Billardiera scandens var. scandens	1.07	0.73	0.89	1.75	66.57
Cheilanthes sieberi subsp. sieberi	1.00	0.66	0.82	1.57	68.15
Cymbopogon refractus	1.18	0.64	0.62	1.53	69.68
Aristida vagans	1.07	0.63	0.69	1.51	71.19
Pandorea pandorana	0.96	0.62	0.83	1.48	72.67
Hibbertia diffusa	0.93	0.53	0.69	1.26	73.94
Lomandra multiflora	0.86	0.47	0.62	1.12	75.06
Opercularia diphylla	0.75	0.42	0.64	1.01	76.06
Lomandra longifolia	0.86	0.41	0.64	0.97	77.03
Lomandra confertifolia subsp. rubiginosa	0.93	0.36	0.40	0.85	77.89
Polyscias sambucifolia	0.79	0.34	0.53	0.82	78.71
Glycine microphylla	0.71	0.33	0.53	0.79	79.49
Lagenifera stipitata	0.75	0.32	0.48	0.76	80.25
Syncarpia glomulifera	0.96	0.30	0.37	0.71	80.96
Rubus parvifolius	0.64	0.28	0.48	0.66	81.62
Panicum simile	0.82	0.27	0.38	0.64	82.26
Hibbertia scandens	0.61	0.26	0.49	0.63	82.89
Geitonoplesium cymosum	0.57	0.24	0.44	0.58	83.47
Goodenia heterophylla subsp. heterophylla	0.64	0.24	0.43	0.58	84.05
Jacksonia scoparia	0.68	0.24	0.31	0.57	84.62
Oplismenus imbecillis	0.61	0.24	0.44	0.57	85.19
Phyllanthus gunnii	0.61	0.24	0.43	0.56	85.75
Hibbertia aspera	0.61	0.22	0.39	0.52	86.27
Eustrephus latifolius	0.64	0.21	0.35	0.50	86.77
Maytenus silvestris	0.54	0.21	0.45	0.49	87.26
Joycea pallida	0.75	0.20	0.29	0.49	87.75
Asteraceae sp.	0.50	0.20	0.40	0.47	88.22
Glycine clandestina	0.54	0.19	0.40	0.46	88.68
Dodonaea triquetra	0.75	0.19	0.27	0.45	89.13
Eucalyptus globoidea	0.93	0.19	0.23	0.44	89.58
Digitaria ramularis	0.46	0.19	0.41	0.44	90.02


Spotted Gum/Thicke-leaved Mahogany Open Forest
Pi = 2.49
p < 0.01
Frequency
0
0
0.5
1.0
1.5
2.0
2.5
Pi

12. Spotted Gum/ Red Ironbark/ Thick-leaved Mahogany Forest

No. of samples: 2
Average similarity: 27.37

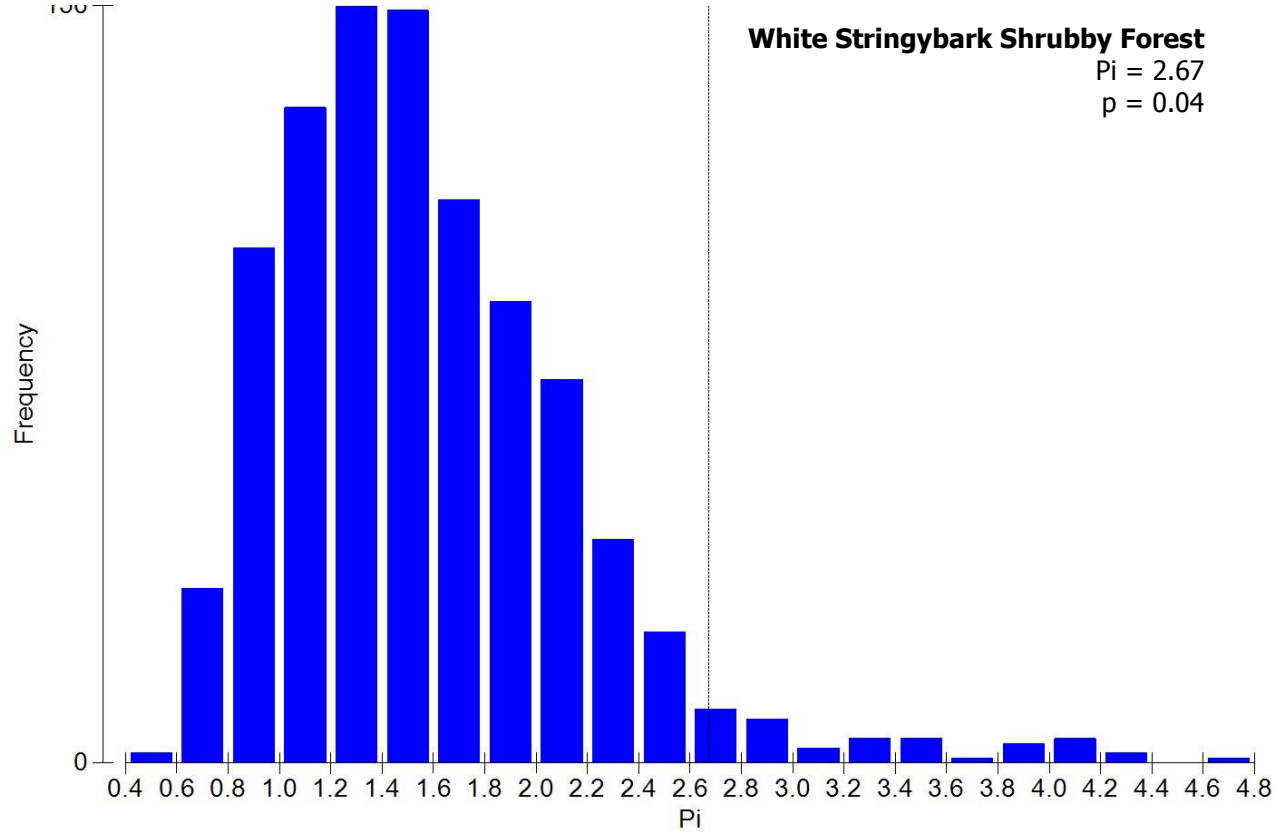
Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Eucalyptus fibrosa	4.00	8.42	####	30.77	30.77
Entolasia stricta	3.00	6.32	####	23.08	53.85
Aristida vagans	3.50	4.21	####	15.38	69.23
Imperata cylindrica	3.50	4.21	####	15.38	84.62
Leucopogon juniperinus	2.50	4.21	####	15.38	100.00

Too few samples to generate a histogram and probabilities.

13. White Stringybark Shrubby Forest

No. of samples: 6
Average similarity: 44.57

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Eucalyptus globoidea	4.33	6.90	2.63	15.47	15.47
Entolasia stricta	3.17	5.06	3.74	11.35	26.82
Dichondra repens	1.67	2.52	1.35	5.65	32.47
Pratia purpurascens	1.67	2.52	1.35	5.65	38.11
Vittadenia cunneata	1.67	2.52	1.35	5.65	43.76
Hardenbergia violacea	1.67	2.45	1.35	5.51	49.26
Melaleuca nodosa	2.67	2.25	0.68	5.05	54.31
Billardiera scandens var. scandens	1.50	1.97	1.17	4.42	58.73
Pultenaea villosa	1.83	1.95	1.20	4.38	63.11
Aristida vagans	1.83	1.72	0.76	3.85	66.96
Melaleuca sieberi	1.50	1.56	0.78	3.51	70.47
Opercularia diphylla	1.33	1.41	0.79	3.15	73.63
Lagenifera stipitata	1.17	1.14	0.71	2.55	76.18
Daviesia ulicifolia	1.17	1.13	0.72	2.54	78.72
Cheilanthes sieberi subsp. sieberi	1.50	1.06	0.72	2.38	81.10
Phyllanthus hirtellus	1.00	0.79	0.48	1.78	82.89
Themeda australis	1.67	0.77	0.47	1.73	84.61
Hibbertia diffusa	1.67	0.72	0.48	1.61	86.23
Acacia ulicifolia	1.00	0.66	0.48	1.48	87.71
Joycea pallida	1.00	0.66	0.48	1.48	89.19
Ozothamnus diosmifolius	1.00	0.66	0.48	1.48	90.66



14. Smooth-barked Apple/ White Stringybark Forest

No. of samples: 1
Average similarity: n/a

Species list of all species recorded, in order of decreasing cover abundance code.

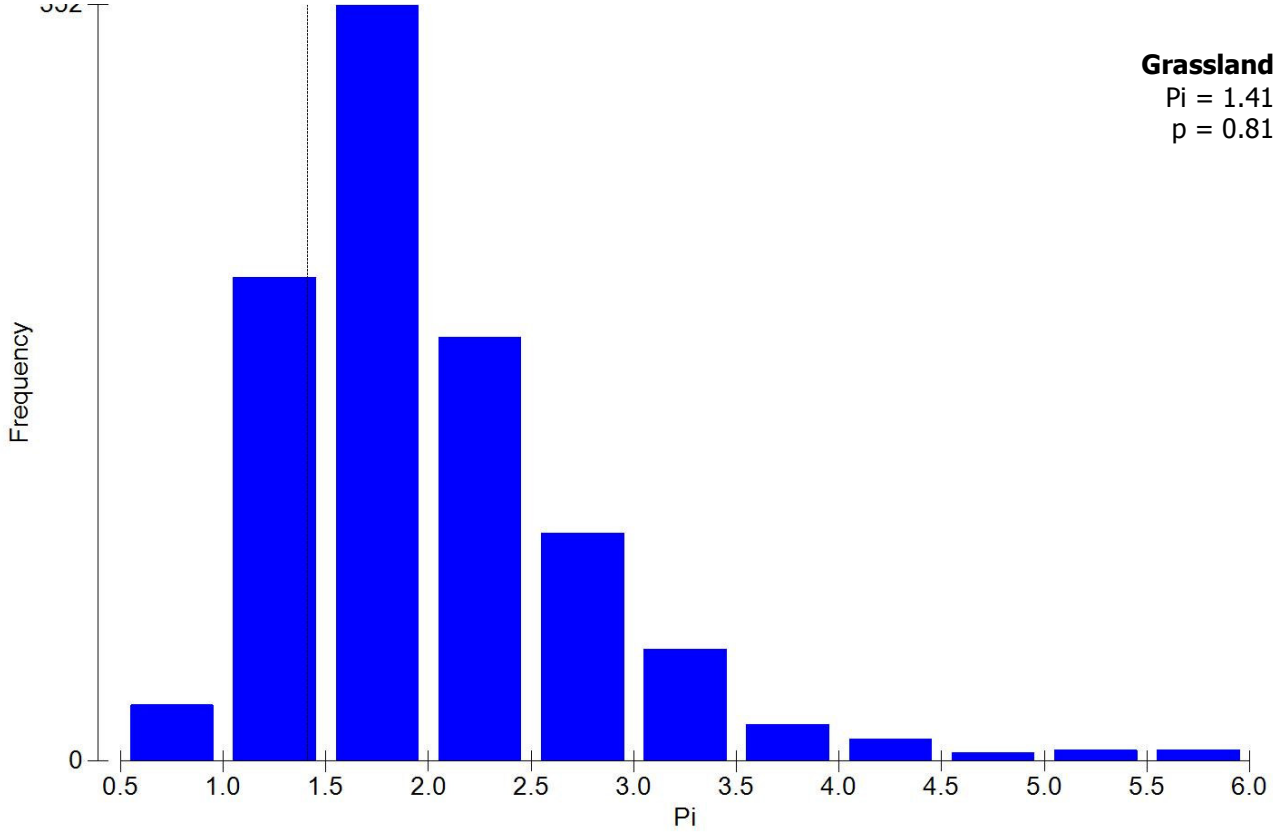
Species	**Cover abundance**
Eucalyptus globoidea	5
Angophora costata	4
Entolasia stricta	4
Ptilothrix deusta	4
Banksia spinulosa var. collina	3
Gahnia clarkii	3
Leptospermum polygalifolium subsp. polygalifolium	3
Melaleuca decora	3
Xanthorrhoea glauca	3
Acacia ulicifolia	2
Daviesia ulicifolia	2
Dillwynia retorta	2
Gahnia radula	2
Gompholobium pinnatum	2
Joycea pallida	2
Ozothamnus diosmifolius	2
Persoonia linearis	2
Pimelea linifolia subsp. linifolia	2
Platylobium formosum subsp parviflorum	2
Pteridium esculentum	2
Monotoca scoparia	1

Too few samples to generate a histogram and probabilities.

15. Grassland

No. of samples: 6
Average similarity: 36.47

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Sporobolus elongatus	2.83	7.28	1.28	19.96	19.96
Themeda australis	2.33	6.38	2.80	17.48	37.44
Imperata cylindrica	2.17	4.69	1.01	12.86	50.31
Glycine clandestina	1.33	2.51	0.78	6.89	57.19
Fimbristylis dichotoma	1.17	1.99	0.74	5.45	62.64
Eragrostis brownii	1.00	1.74	0.72	4.76	67.40
Tricoryne simplex	1.00	1.50	0.75	4.13	71.53
Entolasia stricta	0.67	1.31	0.77	3.60	75.13
Capillipedium parviflorum	1.00	1.12	0.44	3.08	78.21
Acacia ulicifolia	0.83	0.78	0.46	2.15	80.36
Cymbopogon refractus	0.83	0.78	0.46	2.15	82.51
Dichondra repens	0.83	0.78	0.46	2.15	84.66
Hypericum gramineum	0.67	0.76	0.48	2.09	86.74
Juncus usitatus	0.67	0.64	0.47	1.76	88.50
Panicum simile	0.67	0.59	0.48	1.61	90.11



5.0 Discussion

Analysis of eighty-nine 0.04ha floristic plots from the Gloucester Coal project provided a sound classification for defining vegetative patterns. It is likely that past land-use of the site (agricultural grazing) has impacted upon species diversity in some areas, however with adequate sampling the potential problems this may have caused have been largely overcome. Woody weed invasion in some of the moister environments, although evident in the data, did not overly impact on the classification.

Fifteen vegetation communities have been defined using the supplied data (weeds removed) with the CLUSTER routine in *Primer*, at a similarity level of 28%. Defined communities were supported in the nMDS ordination, at a stress level of 0.19. Vegetation present included 1 grassland, 1 sedgeland, 1 thicket, 3 rainforests/moist forests, 3 floodplain forests, 2 grassy woodlands, and 4 dry forests. The fifteen defined communities are:

1. Sedgeland/Heath
2. Paperbark Thicket
3. Riparian Closed Forest
4. Dry Gully Rainforest
5. Blue Gum Moist Forest
6. Cabbage Gum Floodplain Forest
7. White Stringybark/Cabbage Gum/Paperbark Forest
8. Redgum/Apple Riparian Forest
9. Redgum/Box Grassy Woodland
10. Grey Ironbark Grassy Woodland
11. Spotted Gum/Thick-leaved Mahogany Open Forest
12. Spotted Gum/Red Ironbark/Thick-leaved Mahogany Forest
13. White Stringybark Shrubby Forest
14. Smooth-barked Apple/White Stringybark Forest
15. Grassland

Tests of significance and analysis of similarity using SIMPER, SIMPROF and ANOSIM showed strong support for most defined communities. Less well defined communities included Paperbark Thicket, White Stringybark/ Cabbage Gum/ Paperbark Forest, and Spotted Gum/ Thick-leaved Mahogany Forest, and it is possible that some undetected diversity (variation) is present in some of these communities, possibly a result of disturbance history. Five communities possessed too few samples for significance testing to be run adequately. The Global R value generated through ANOSIM was 0.914 ($p<0.001$), and 89 of the possible 105 pairings (6 were indefinable due to low sample size) returned R values above 0.7 in the pair-wise comparisons, while 46 pairings were at unity.

Following data analysis, it is apparent that the dataset supplied for this classification presents a good representation of the vegetation diversity evident within the study area. Although four communities are represented by only a single sample site, the geographical distribution of these communities within the study area is unlikely to present substantial additional sampling opportunities. Three of these communities are readily discernible in the field (Sedgeland/ Heath; Riparian Closed Forest; Dry Gully Rainforest), and it may be argued that further sampling is unnecessary.

6.0 References

Belbin, L. (1995a) *PATN Pattern Analysis Package: Users Guide*. CSIRO Division of Wildlife Rangelands Research: Canberra.

Belbin, L. (1995b) *PATN Pattern Analysis Package: Reference Manual*. CSIRO Division of Wildlife Rangelands Research: Canberra.

Bell, S.A.J. (2008) *Vegetation data analysis: Gloucester Coal Project*. Unpublished Report to EcoBiological Pty Ltd. Eastcoast Flora Survey. January 2008.

Clarke, K.R. & Gorley, R.N. (2006) *PRIMER v6: User Manual/ Tutorial*. PRIMER-E: Plymouth.

Hammer, Ø., Harper, D.A.T., & Ryan, P.D. (2001) PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica* 4(1): 9pp.

Poore M.E.D. (1955) *The use of Phytosociological Methods in Ecological Investigations: The Braun-Blanquet System.* Botany School, University of Cambridge.

7.0 Appendix: Supplied Dataset

7.1 2007 Data

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
Acacia falcata		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
Acacia floribunda		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia implexa		0	0	0	0	0	0	0	0	0	0	0	0	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	4	0
Acacia irrorata subsp irrorata		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	4	1	3	2	2	0	0	0	0	2	4	0	0	0	0	2	4
Acacia linifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia longifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia longissima		0	0	0	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	2	0	0	0	0	0	0	0	0	0	0
Acacia maidenii		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia melanoxylon		0	0	0	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	2	0	0	0	0	0	0
Acacia myrtifolia		0	0	0	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
Acacia ulicifolia		1	2	0	0	0	3	0	2	1	0	0	1	2	2	2	2	0	2	0	1	2	0	0	2	0	0	0	2	2	0	0	0	2	0	0	2	0	0	0
Acianthus fornicatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adiantum aethiopicum		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	2	5	0	0	0	0	0
Adiantum formosum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adiantum hispidulum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Ageratina adenophora**		0	0	0	0	0	0	0	0	0	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
*Ageratina riparia**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alectryon subcinereus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allocasuarina littoralis		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allocasuarina torulosa		0	0	0	0	0	0	0	0	0	4	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
Alphitonia excelsa		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	2	0	0	0	0	0
Amyema miquelii		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
**Anangallis arvensis*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Andropogon virginicus**		2	0	0	0	0	0	0	0	2	0	2	2	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
Aneilema acuminatum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Angophora floribunda		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	0	0	3	0	4	0	0	0	0	0	0	4	0	0	0	0	0
Angophora subvelutina		0	0	0	0	0	0	4	0	0	3	0	0	0	0	6	6	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aphananthe philippinensis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aphanopetalum resinosum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aristida ramosa var. ramosa		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
Aristida vagans		0	3	0	0	3	2	2	3	0	2	0	4	4	4	3	3	4	0	3	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	5	2	3	3	0
Arthropodium milleflorum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asplenium australasicum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asteraceae 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	0	0	0	0	0	0	0	0	0	0	0	0	0
Austrodanthonia tenuior		0	0	0	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	2	0	2	2	2
*Axonopus fissifolius**		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	3	0	0	2	0	0	0	0	0	0	0	0	0	0
Backhousia myrtifolia		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
Backhousia sciadophora		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baloghia inophylla		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
Banksia spinulosa var. collina		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	0	0	0	0	0	0	0	0	0	0

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
*Bidens pilosa**		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
Billardiera scandens var. scandens		0	2	2	2	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0	2	2	0
Blechnum cartilagineum		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
Boronia polygalifolia		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	2	0	0	0	0	0
Bossiaea prostrata		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
Brachycome multifida var multifida		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
Breynia oblongifolia		0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	2	1	0	0	1	2	2	0	0	0	0	0	1	0	0	0	0	0	3	0	0	2	2	0
Brunoniella australis		0	0	0	0	0	0	0	0	0	0	0	0	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	2	0
Bursaria spinosa subsp. spinosa		0	2	0	0	2	0	0	0	0	0	0	0	2	4	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
Caesia parviflora var. parviflora		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	1	1	0	0	0	0	0	0	0	0
Caldcluvia paniculosa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Callistemon linearis		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
Callistemon salignus		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	4	0	0	0	0	0
Calochlaena dubia		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
Capparis arborea		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex appressa		0	0	0	0	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	3	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex breviculmis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carex longebrachiata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Carex 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	0	0	0	0	0	0	0	0	0	0	0	0	0
Cassinia quinquefaria		0	0	0	0	0	0	0	0	0	0	0	0	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
Casuarina cunninghamia		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	0	0	0	0	0	0
Cayratia clematidea		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Centaurium erythraea**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cerastium glomeratum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilanthes distans		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cheilanthes sieberi subsp. sieberi		0	2	4	0	2	0	0	0	2	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2
*Chloris virgata**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chiloglottis diphylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Christella dentata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Cirsium vulgare**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cissus antarctica		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cissus opaca		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cissus hypoglauca		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
Citrus x taitensis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Claoxylon australe		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clematis glycinoides		0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Clerodendrum tomentosum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clematis aristata		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	3	3	0	2	2	0	0	0	0	0
Commelina cyanea		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	0	0	0	0
Commersonia fraseri		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Correa reflexa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
Corymbia maculata		0	0	0	0	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	6	3	0	0	0	3	0	0	0
Cryptocarya glaucescens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptocarya microneura		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbidium suave		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cymbopogon refractus		0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	5	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
*Cyperus eragrostis**		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	0	0	0	0
Cyperus 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	0	0	0	0	0	0	0	0	0	0	0	0	0
Dampiera purpurea		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daucus glochidiatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daviesia genistifolia		0	0	0	0	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
Daviesia ulicifolia		1	2	0	2	1	0	0	2	0	0	0	0	3	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Dendrobium speciosum var. hillii		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dendrobium 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	0	0	0	0	0	0	0	0	0	0	0	0	0
Dendrocnide excelsa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Desmodium brachypodum		0	0	0	0	0	0	0	0	0	0	0	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
Desmodium rhytidophyllum		0	0	0	2	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
Desmodium varians		2	2	2	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2	0	0	0	2	0	0	0	2	2	2
Dianella caerulea		0	0	2	2	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
Dianella longifolia		0	2	0	0	0	0	0	3	0	0	1	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
Dianella revoluta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dianella tasmanica		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	1	0	0	0
Dichelachne crinita		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichelachne micrantha		0	0	0	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	2	0	2	0	0
Dichondra repens		2	0	2	2	2	0	0	2	0	0	0	2	0	0	0	0	0	0	2	2	2	2	2	2	0	2	0	2	0	2	2	0	3	2	0	0	0	0	0
Digitaria ramularis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Digitaria parviflora		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2	2	0	0	2	0	2	0	0	3	0	0	0	0	0
Dillwynia retorta		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
Diploglottis cunninghamii		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dioscorea transversa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dodonaea triquetra		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dodonaea viscose subsp. angustifolia		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
Doodia aspera		0	0	0	0	0	0	0	0	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	2	0	0	0	0	0
Drosera auriculata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Doryphora sassafras		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Duboisia myoporoides		0	0	0	0	0	0	0	0	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
Dysoxylum rufum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinopogan caespitosus		0	0	0	0	0	0	0	0	2	2	2	2	2	0	0	0	2	0	2	1	0	0	0	2	0	0	0	2	0	2	2	0	0	0	0	0	2	2	3
Echinopogan ovatus		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
Einadia trigonos subsp. leiocarpa		0	0	0	0	0	0	0	1	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
Elaeocarpus obovatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elaeocarpus reticulatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elaeodendron australe var. australe		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elattostachys nervosa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
Entolasia marginata		0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	2	3	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0
Entolasia stricta		0	3	2	4	4	0	3	3	0	0	0	0	3	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	2	3	3	2	2	0
Eragrostis brownii		2	0	0	0	0	0	2	0	0	0	0	2	2	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Eragrostis leptostachya		0	0	0	0	0	0	0	0	0	0	0	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	3	0	0
Eucalyptus acmenoides		0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	4	0	0	5	0	3	0	0	0	3	0	0	5	0	3	0	0	4	0	0	0	0	0
Eucalyptus amplifolia subsp. amplifolia		4	0	0	0	0	0	0	0	5	0	0	5	0	0	2	2	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus canaliculata		0	0	0	0	0	0	0	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	5	0	0	0	0	0	2
Eucalyptus carnea		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	6	4	0	0	4	4	0	0	4	0	0	3
Eucalyptus crebra		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus eugenioides		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus fergusonii subsp. fergusonii		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus fibrosa		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	2	4	2	3	0	0	4	4	0	2	0
Eucalyptus globoidea		0	5	2	5	5	0	0	4	0	5	0	0	0	0	0	0	5	5	0	0	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	3	2	0
Eucalyptus microcorys		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
Eucalyptus molucanna		0	2	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0	0	5	4	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus propinqua		0	0	0	0	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	0	0	0	0	0
Eucalyptus resinifera		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus saligna		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus siderophloia		0	0	0	0	0	5	3	3	4	2	0	0	5	6	0	0	0	0	0	3	0	0	0	4	0	0	0	3	2	0	2	0	0	0	0	0	0	0	0
Eucalyptus tereticornis		0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	3	4	5	4	0	0	5	0	0	0	0	5	0	4	5	4
Euchiton gymnocephalus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eupomatia laurina		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eustrephus latifolius		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
Exocarpos cupressiformis		0	0	0	0	1	0	0	1	0	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	2	0	1
Exocarpos strictus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Facelis retusa**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ficus coronata		0	0	0	0	0	0	0	0	0	1	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
Ficus macrophylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ficus 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	0	0	0	0	0	0	0	0	0	0	0	0	0
Ficus rubiginosa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fimbristylis dichotoma		0	0	0	0	0	0	0	0	0	0	0	0	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
Gahnia aspera		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gahnia clarkii		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	0	0	0	0	3	0	0	0	0	0
Gahnia radula		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
Gahnia sieberiana		0	0	0	0	0	0	0	0	0	0	0	0	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	
Gahnia 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	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium binifolium		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium propinquum		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	0	0	0	0	0	0
Galium 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	0	0	0	0	0	0	0	0	0	0	0	0	0
*Gamochaeta spicata**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geijera salicifolia var. latifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geitonoplesium cymosum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	2	2	0	0	0	0	0
Geranium homeanum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Geranium potentilloides		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
Geranium solanderi var solanderi		0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glochidion ferdinandi var. ferdinandi		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
Glycine clandestina		2	0	2	0	0	0	0	0	0	0	1	2	0	0	2	0	2	0	2	0	0	0	0	0	2	0	0	0	2	2	2	2	0	0	0	1	2	2	2
Glycine microphylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	2	0
Glycine tabacina		0	0	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
Gomphocarpus fruticosus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gompholobium inconspicuum		0	0	0	0	0	0	0	0	0	0	0	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
Gompholobium pinnatum		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
Gonocarpus teucrioides		0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2	2	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	2
Goodenia heterophylla subsp. heterophylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guioa semiglauca		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnostachys anceps		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardenbergia violacea		0	2	0	2	2	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
Hedycarya angustifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helichrysum elatum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heritiera actinophylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibbertia aspera		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibbertia dentata		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
Hibbertia diffusa		0	2	6	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	2	0	0	0	0	2	2	2	0	0	0	0	1	0	0	0	0	0
Hibbertia linearis		0	0	0	0	0	0	0	0	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
Hibbertia pedunculata		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
Hibbertia riparia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Hibbertia scandens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibbertia serpyllifolia		0	0	0	0	0	0	0	0	0	0	0	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	1	0
Hibiscus heterophyllus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hybanthus monopetalus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrocotyl peduncularis		2	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	0	0	0	0	0	2
Hydrocotyle tripartita		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hymenosporum flavum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypericum gramineum		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	2	2	2
*Hypochaeris radicata**		2	0	0	0	0	0	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	2	2	0
Hypolepis grandulifera		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
Imperata cylindrica		6	0	0	0	0	3	2	0	3	4	2	0	0	0	4	3	2	0	0	3	2	5	5	3	0	6	6	3	5	3	3	3	5	3	5	2	4	3	4
Jacksonia scoparia		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
Jasminum volubile		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Joycea pallida		0	2	0	0	0	0	0	2	0	0	0	0	0	3	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
Juncus continuus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Juncus usitatus		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
Kennedia rubicunda		0	0	3	0	2	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	1
Lagenifera stipitata		0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	1	2	2	0
*Lantana camara**		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
Laxmannia gracilis		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	2	0
Lepidosperma concavum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
Lepidosperma elatius		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidosperma laterale		0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0
Lepidosperma 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	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptospermum trinervium		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptospermum polygalifolium subsp. cismontanum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptospermum polygalifolium subsp. polygalifolium		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucopogon juniperinus		0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	3	2	0	0	4	3	2	3	2	3	3	2
*Ligustrum sinense**		0	0	0	0	0	1	0	0	1	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
Lindsaea linearis		0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	2	0	0	0	2	0	3	0	2	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0
Lindsaea microphylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Litsea australis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Logania albiflora		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lomandra confertifolia subsp. rubiginosa		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	2	0	0	0
Lomandra cylindrica		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lomandra glauca		0	0	0	0	0	0	0	0	0	0	0	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	2	1
Lomandra filiformis subsp. filiformis		0	0	0	0	1	0	0	0	0	0	0	0	0	2	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
Lomandra longifolia		0	0	0	0	0	0	0	0	0	3	4	0	0	0	1	0	0	0	0	2	2	2	1	0	3	0	3	0	0	0	0	0	2	0	0	1	0	0	1
Lomandra multiflora		0	0	1	0	0	0	1	2	2	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	1	0	2	1
Lomatia silaifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lophostemon confertus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ludwigia peploides		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
Maclura cochinchinensis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsdenia rostrata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsdenia suaveolens		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
Maytenus silvestris		0	0	2	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	2	0	0	0	0	0
Melaleuca decora		3	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca linariifolia		0	0	0	0	0	0	0	0	0	3	6	5	0	0	0	0	0	0	0	0	0	4	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca nodosa		0	0	2	6	5	0	0	3	0	0	0	0	3	3	0	0	0	0	0	6	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca sieberi		0	0	2	2	3	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
Melaleuca styphelioides		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	5	0	0	0	0	0
Melia azedarach		0	0	0	0	0	0	0	0	0	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
Melicope micrococca		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Microlaena stipoides var stipoides		0	2	0	0	0	5	2	0	4	0	0	2	0	0	0	4	2	0	3	0	0	0	3	5	0	0	0	0	2	3	3	0	0	0	0	0	0	2	2
Microsorum scandens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monotoca scoparia		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
Morinda jasminoides		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myrsine howittiana		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
Myrsine variabilis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neolitsea australiensis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neolitsea dealbata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
Notelaea longifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	2	0	0	2	0	0	0	2	0	0	0	0	2	0	0	0	0	0
Notelaea venosa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olearia argophylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Opercularia diphylla		0	2	2	0	2	2	2	0	2	0	0	2	2	2	0	0	0	0	0	0	0	0	2	2	2	0	0	0	2	0	0	0	2	2	0	0	2	0	2
Oplismenus aemulus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oplismenus imbecillis		0	0	0	0	0	0	0	0	0	2	4	4	0	0	0	0	0	0	0	0	0	2	0	3	3	0	0	0	0	0	0	0	3	0	0	0	0	2	2
Oxalis exilis		0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	2	1	0	0	0	0	0	0	0	2	2	0
Oxalis perennans		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ozothamnus diosmifolius		0	2	0	0	0	0	3	2	0	0	0	1	3	0	0	0	2	2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Pellaea falcata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pellaea paradoxa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pandorea pandorana		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	2	2	0	0	0	0	0
Panicum simile		0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	3	2	2	2	0	0	0	0	0	2	2	2
Parsonsia straminea		0	0	0	0	0	0	0	0	0	2	4	2	0	0	0	0	0	0	0	2	3	4	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0
Parsonsia velutina		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Paspalum dilatatum**		2	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Passiflora cinnabarina		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patersonia glabrata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patersonia sericea		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pennisetum alopecuroides		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	3	2	0	0	0	0	0
Persicaria hydropiper		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
Persoonia linearis		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philydrum lanuginosum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus gunnii		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
Phyllanthus hirtellus		0	0	0	2	2	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	2	0	0	0
Pimelea linifolia subsp. linifolia		0	0	0	0	0	0	2	0	2	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	2	0	2	0
Pittosporum spinescens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pittosporum revolutum		0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Pittosporum undulatum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Plantago lanceolata**		1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platycerium bifurcatum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platylobium formosum subsp parviflorum		0	2	0	0	0	0	0	0	0	0	0	0	2	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
Plectranthus argentatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plectranthus graveolens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plectranthus parviflorus		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
Poa affinis		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa libillardieri		0	0	0	0	0	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
Podolobium ilicifolium		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podolobium scandens		0	0	0	0	0	0	0	0	0	0	0	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
Polymeria calycina		0	0	0	0	0	0	0	0	0	0	0	0	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	2	2
Polyscias sambucifolia		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
Pomaderris lanigera		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pomax umbellata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0	1	0	2	2
Poranthera microphylla		0	0	0	0	0	0	0	0	0	0	0	0	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
Pratia purpurascens		2	0	2	2	2	3	0	2	3	2	0	0	0	0	2	2	2	0	3	2	3	3	3	3	4	3	0	2	2	0	0	0	4	0	0	1	2	2	2

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
Pseuderanthemum variabile		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	2	0	0	2
Pteridium esculentum		0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	2	0	2	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Pterostylis curta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterostylis grandiflora		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterostylis nutans		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterostylis sp		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
Ptilothrix deusta		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	0	0	0	0	0	0	0	0	0	0	0	0	0
Pultenaea euchila		0	2	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
Pultenaea retusa		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
Pultenaea villosa		0	4	0	2	1	2	2	2	4	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	1	0	0	0
Pyrrosia confluens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyrrosia rupestris		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus inundatus		0	0	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	0	0	0	0	0	0	0
Ranunculus lappaceus		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
Ranunculus plebeius		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhodamnia rubescens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ripogonum album		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ripogonum fawcettianum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus fruticosus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus moluccanus var. trilobus		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
Rubus parvifolius		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus rosifolius		0	0	0	0	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	2	0	0	0	0	0
Rulingia dasyphylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhysotoechia bifoliolata subsp. bifoliolata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sarcochilus hillii		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sarcomelicope simplicifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sarcopetalum harveyanum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schoenoplectus mucronatus		0	0	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	0	0	0	0	0	0	0
Scolopia braunii		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Senecio madagascariensis**		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
Schizomeria ovata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schoenus apogon		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schoenus brevifolius		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Sida rhombifolia**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smilax australis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smilax glyciphylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Sonchus oleraceus**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Solanum mauritianum**		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
Solanum prinophyllum		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	2	0	1	0	0	0	0	0	0
Solanum stelligerum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Sporobolus africanus**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Plot	07-01	07-02	07-03	07-04	07-05	07-06	07-07	07-08	07-09	07-10	07-11	07-12	07-13	07-14	07-15	07-16	07-17	07-18	07-19	07-20	07-21	07-22	07-23	07-24	07-25	07-27	07-28	07-29	07-30	07-31	07-32	07-33	07-34	07-35	07-36	07-37	07-38	07-39	07-40
*Stachys arvensis**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stackhousia viminea		0	0	0	0	0	0	0	0	0	0	0	0	0	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
Stellaria flaccida		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stenocarpus salignus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stephania japonica		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streblus brunonianus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stypandra glauca		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syncarpia glomulifera		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synoum glandulosum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tetratheca thymifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Themeda australis		3	5	0	0	0	3	5	3	5	3	0	4	5	4	4	4	3	0	4	3	0	0	4	2	0	3	3	5	3	5	2	5	0	4	0	0	3	3	3
Toona ciliata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tradescantia albiflora		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trema tomentosa var. viridis		0	0	0	0	0	0	0	0	0	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
Tricoryne simplex		0	0	0	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	2	0	2	2	2
Tristaniopsis laurina		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trochocarpa laurina		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trophis scandens subsp. scandens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Typha orientalis		0	0	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	0	0	0	0	0	0	0
Urtica urens		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Verbena bonariensis**		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	2
*Verbena rigida**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vernonia cinerea		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veronica plebeia		0	0	2	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
Viola betonicifolia		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
Viola hederacea		0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	2	0	0	0	2	2	3
Vittadenia cunneata		0	2	2	2	2	0	2	2	0	0	0	0	0	0	0	2	2	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0
Waterhousea floribunda		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wahlenbergia gracilis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wahlenbergia planiflora		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wahlenbergia stricta subsp. stricta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wilkiea huegeliana		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xanthorrhoea glauca		0	0	0	0	0	0	0	0	0	3	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
Xanthorrhoea macronema		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xylomelum pyriforme		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zieria smithii		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0

7.2 2008 Data

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Acacia falcata		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia floribunda		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	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
Acacia implexa		0	0	0	0	0	0	0	0	0	0	3	1	1	0	3	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	1
Acacia irrorata subsp irrorata		0	0	0	0	0	1	1	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	2	3	0	1	0	0	0	0	0	0	0	0	0
Acacia linifolia		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	0	2	0	0	0
Acacia longissima		1	1	1	1	1	0	1	0	0	0	2	1	1	1	1	0	1	0	0	1	2	1	0	0	1	0	2	0	0	0	0	0	1	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0
Acacia maidenii		0	0	0	2	0	1	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	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Acacia myrtifolia		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia ulicifolia		1	0	1	0	2	0	0	2	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	2	0	0	0	2	2	0	1	0	1	2
Acianthus fornicatus		0	0	0	0	0	0	2	0	0	0	0	0	0	1	2	0	2	1	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
Adiantum aethiopicum		1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	0	0	0	0	0	0	0
Adiantum formosum		0	0	0	0	0	0	0	0	0	3	0	0	0	1	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
Adiantum hispidulum		0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	2	0	0	2	3	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
*Ageratina adenophora**		0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	1	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
*Ageratina riparia**		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Alectryon subcinereus		0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allocasuarina littoralis		0	0	0	0	0	0	0	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
Allocasuarina torulosa		3	4	2	3	2	3	2	0	0	0	1	0	2	2	1	3	3	4	0	3	4	0	0	0	2	0	2	3	0	3	0	0	3	0	3	3	3	0	1	0	0	0	0	0	0	0	0	0	0	0
Alphitonia excelsa		0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
*Anangallis arvensis**		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	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	1	0	0	2	0	0
*Andropogon virginicus**		2	1	0	0	0	0	0	1	3	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	1	0	2	0	1	0	0	0	4	4	3
Aphananthe philippinensis		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	0	0	0	0	0
Aphanopetalum resinosum		0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Aristida vagans		1	3	1	2	2	0	0	2	0	0	0	0	1	0	0	2	2	2	0	1	0	0	0	0	0	0	2	2	0	0	0	0	2	0	0	2	0	0	1	0	0	0	0	2	0	2	2	0	1	0
Arthropodium milleflorum		2	2	1	0	0	0	0	1	0	0	0	0	1	1	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
Asplenium australasicum		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aster subulatus*		0	0	0	0	0	0	0	0	0	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	1	0	2	0	0	0	0	1	0	2
Asteraceae sp.		0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	0	0	0	1	1	0	1	0	0	0	2	0	1	0	0	1	0	1	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0
Austrodanthonia fulva		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
*Axonopus fissifolius**		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	2	4	0	5	4	0	4	4	3
Backhousia myrtifolia		0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	4	0	0	5	5	4	0	2	0	0	2	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Backhousia sciadophora		0	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	0	0	0	0
Banksia spinulosa var. collina		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
*Bidens pilosa**		1	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Billardiera scandens var. scandens		2	2	2	2	2	0	2	1	0	0	0	1	2	1	1	2	1	2	0	2	0	0	0	0	1	0	1	1	0	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Blechnum cartilagineum		1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boronia polygalifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	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
Bothriochloa macra		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	0	0
Brachyscome		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Brachyscome angustifolia var. *heterophylla*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Breynia oblongifolia		2	2	1	2	1	1	2	0	0	0	2	1	1	3	2	1	3	1	2	2	1	1	1	2	2	0	3	1	0	2	0	0	2	1	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0
Bursaria spinosa subsp. spinosa		0	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caesia parviflora var. parviflora		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Caldcluvia paniculosa		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	0	0	0	0	0	0
Callistemon salignus		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	2	0	0	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
Calochlaena dubia		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4	0	0	4	0	0	0	1	0	0	0	6	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Capillipedium parviflorum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	1	0
Capparis arborea		0	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	0	0
Carex appressa		1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	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
Carex breviculmis		1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Carex brownii		0	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	1	0	0	0
Casuarina cunninghamia		0	0	0	0	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	0	0	0	0	0	0	0	0	0	0
Cayratia clematidea		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Centaurium erythraea**		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	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Cerastium glomeratum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Cheilanthes distans		0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	2	0	0	0	0
Cheilanthes sieberi subsp. sieberi		0	2	1	1	1	2	1	1	1	0	0	0	0	0	2	2	2	0	0	1	2	0	0	0	1	0	2	2	0	0	0	0	1	1	2	0	1	0	0	2	0	0	0	1	0	0	1	0	0	0
*Chloris virgata**		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	0	0	0
Christella dentata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
*Cirsium vulgare**		0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	0	0	0
Cissus antarctica		0	1	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	1	3	0	0	2	2	3	2	2	0	0	0	0	0	3	0	0	1	0	1	4	0	1	2	0	0	0	0	0	0	0	0	0
Cissus hypoglauca		0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	2	2	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cissus opaca		0	0	0	0	0	0	0	0	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Citrus x taitensis		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	0	0	0	0	0	0	0	0	0	0	0	0	0
Claoxylon australe		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	0	0	0	0	0	0	0
Clematis aristata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Clematis aristata		0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	2	2	2	1	0	0	0	0	0	0	0	1	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Clematis glycinoides		1	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	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Clerodendrum tomentosum		1	1	0	0	0	0	0	0	0	1	1	0	0	0	2	0	0	0	2	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Commelina cyanea		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	2	0	0	0	0	0	0	0
Commersonia fraseri		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	0	0	0	0	0	0
*Conyza bonariensis**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Conzya 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	0	1	1	1
Correa reflexa		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	0	0	0	0	0
Corymbia maculata		0	0	0	0	2	3	4	0	0	0	5	0	4	3	4	2	5	3	2	2	4	0	0	0	0	0	2	5	0	0	1	0	4	2	4	4	4	0	0	0	0	0	0	4	0	0	4	0	0	0
Cryptocarya glaucescens		0	0	0	0	0	0	0	0	0	0	0	0	0	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
Cryptocarya microneura		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Cymbidium suave		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	0	0	0	0
Cymbopogon refractus		1	1	0	1	0	2	2	0	0	0	0	0	3	0	2	0	2	0	0	3	0	0	0	0	0	0	0	2	0	0	0	0	2	0	3	3	0	0	2	0	0	1	0	2	2	2	2	0	1	0
Cynodon dactylon		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2
Cynosurus echinatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Cyperus brevifolius*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	3	2	0	3	2	2

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Cyperus congestus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	2
Cyperus sp.		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	0	0	0	0	0	0
Cyperus 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	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Dampiera purpurea		0	0	0	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	0	0	0	0	0	0	0	0	0	0	0
Daucus glochidiatus		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	2	1	0	2	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Daviesia ulicifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0
Dendrobium 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	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dendrobium speciosum var. hillii		0	0	0	0	0	0	0	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
Dendrocnide excelsa		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	3	0	0	0	0	0	0	0	0	0	0	0	0
Desmodium brachypodum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Desmodium rhytidophyllum		1	2	2	2	2	2	0	2	0	0	1	1	2	2	0	1	1	0	0	1	2	0	0	0	2	0	1	0	0	2	0	0	1	0	2	0	1	0	1	0	0	0	2	0	2	0	0	2	0	0
Desmodium varians		2	1	2	2	1	2	2	0	0	0	2	2	2	0	2	2	0	0	0	0	1	1	0	0	2	0	1	1	0	2	0	0	1	0	1	1	2	0	2	0	0	1	0	2	1	2	0	0	0	0
Dianella caerulea		2	2	2	2	0	1	2	1	0	0	2	1	2	2	2	1	2	1	2	1	1	2	0	0	2	0	1	2	0	1	0	0	0	0	2	2	2	0	1	1	0	0	0	0	0	0	0	0	0	0
Dianella longifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Dianella revoluta		1	1	1	2	2	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dianella tasmanica		0	0	0	0	0	0	0	0	0	0	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	1	0	0	1	0	0	0
Dichelachne crinita		0	0	0	0	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	1	0	0	1	0	0	0
Dichelachne micrantha		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	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
Dichondra repens		2	2	2	0	1	0	2	2	2	0	0	2	3	2	2	2	2	0	0	2	0	2	0	2	2	0	2	0	0	0	0	0	0	0	0	3	0	0	2	0	3	0	0	2	2	0	2	0	1	2
Digitaria ramularis		0	0	0	2	1	0	0	0	0	0	0	0	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0
Dioscorea transversa		0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	2	0	0	2	2	0	0	1	0	0	0	2	0	1	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Diploglottis cunninghamii		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	2	0	0	0	0	0	0	0	0	0	0	0	0
Dodonaea triquetra		0	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	2	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Doodia aspera		0	0	0	0	0	0	0	0	0	5	0	0	0	4	2	0	0	0	6	0	0	3	3	3	0	4	0	0	2	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Doryphora sassafras		0	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	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drosera auriculata		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	0	0	0	0
Duboisia myoporoides		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Dysoxylum rufum		0	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	0	0
Echinopogan caespitosus		2	2	1	0	2	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Echinopogan ovatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Einadia trigonos subsp. leiocarpa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Elaeocarpus obovatus		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elaeocarpus reticulatus		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elaeodendron australe var. australe		0	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	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Elattostachys nervosa		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	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Entolasia marginata		2	2	1	0	0	0	0	0	5	0	0	0	0	0	2	1	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	4	0	0	0	0	0	0	0	0
Entolasia stricta		3	2	3	3	3	3	3	3	3	0	2	0	2	0	0	1	1	2	0	2	2	2	0	0	1	0	0	0	0	0	0	2	0	1	0	2	2	2	0	1	2	2	2	0	2	1	0	2	1	1	1
Eragrostis brownii		0	0	0	0	0	0	0	1	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	2	0	2	0	2	0	2	1	1
*Eragrostis cilianensis**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	2	0	0
Eragrostis curvula*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	0	0	0	2
Eremophila debilis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Eucalyptus acmenoides		0	0	0	0	0	2	0	0	0	0	0	0	2	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	4	0	0	0	0	0	0	0	0	0	0

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Eucalyptus amplifolia subsp. amplifolia		0	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	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0
Eucalyptus canaliculata		0	2	0	0	0	0	0	0	0	0	0	0	2	2	4	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	2	0	0	0
Eucalyptus carnea		0	3	4	3	3	4	2	2	0	0	2	0	3	3	3	2	4	5	2	5	4	2	0	0	0	0	3	4	0	4	0	0	3	0	3	3	3	0	0	4	0	0	0	3	0	0	4	0	0	0
Eucalyptus crebra		0	0	0	0	0	2	0	0	0	0	3	0	3	2	3	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	1	0	0	0	0	0
Eucalyptus fergusonii subsp. fergusonii		0	0	0	0	0	0	0	0	0	0	0	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
Eucalyptus globoidea		5	2	5	0	3	0	0	5	0	0	0	0	0	0	0	5	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Eucalyptus microcorys		3	4	2	5	0	0	4	0	0	0	2	0	0	4	3	0	2	0	2	0	2	0	0	0	3	0	0	4	2	4	0	2	3	3	0	2	0	0	2	0	0	0	0	0	0	0	3	0	0	0
Eucalyptus propinqua		0	0	0	0	0	0	0	0	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	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus resinifera		0	0	0	0	0	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	2	2	0	0	0	0	0	0	0	0	0
Eucalyptus saligna		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	0	2	4	5	0	2	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Eucalyptus siderophloia		0	2	2	0	0	0	2	2	0	0	0	0	0	0	0	2	0	0	1	2	2	0	0	0	2	0	3	2	1	0	0	0	3	0	3	4	2	0	3	0	0	0	0	2	0	0	3	0	0	0
Eucalyptus tereticornis		0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Euchiton collinus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Euchiton gymnocephalus		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0
*Euchiton 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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
*Euchiton sphaericus**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	0	0	0
Eupomatia laurina		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	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
Eustrephus latifolius		2	2	0	0	0	0	2	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	2	2	0	2	1	0	0	0	2	0	0	1	2	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0
Exocarpos cupressiformis		0	0	0	2	1	0	1	1	0	0	1	1	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Exocarpos strictus		0	0	0	0	0	0	0	0	0	0	0	0	3	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
*Facelis retusa**		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	1	0	0	0	0	0	0	0	0	0	0
Ficus coronata		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	2	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Ficus macrophylla		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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ficus rubiginosa		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	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ficus 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	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fimbristylis dichotoma		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	1	0	2	2	0	2	0	0
Gahnia aspera		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	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Gahnia clarkii		0	0	0	0	0	0	0	0	0	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	2	0	0	0	0	0	0	0	0	0	0	0	0
Gahnia sieberiana		0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gahnia 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	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Galium binifolium		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	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Galium propinquum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	1	0	0	0	0	0	0	0	0	0
Galium sp.		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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Gamochaeta spicata**		0	0	0	0	0	0	0	1	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
Geijera salicifolia var. latifolia		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	0	0	0	0	0
Geitonoplesium cymosum		0	0	1	0	0	0	0	0	0	2	1	1	0	0	2	0	0	0	2	0	0	2	1	0	2	2	1	0	0	2	0	0	1	2	2	0	1	0	0	0	1	0	0	1	0	0	1	0	0	0
Geranium homeanum		0	0	0	0	0	0	0	0	0	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	2	2	0	0	1	0	0	1	0	0	0	0	0
Geranium potentilloides		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	0	0	0
Geranium solanderi var solanderi		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	0	0	0	0	0	0	0	2
Glochidion ferdinandi var. ferdinandi		2	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glycine clandestina		0	1	0	1	0	1	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	2	0	0	0	2	0	2	2	2	2	0	2	2
Glycine microphylla		2	0	2	1	1	0	2	2	0	0	0	1	2	0	0	0	1	0	0	1	0	2	0	0	1	0	0	2	0	1	0	0	0	0	0	0	2	0	0	1	1	1	0	0	0	0	0	0	0	0

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Gomphocarpus fruticosus		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	1	0	0	0	0	0	0	0	0	0	0	0
Gonocarpus teucrioides		2	2	2	0	1	0	0	0	2	0	0	0	0	0	0	2	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	2	0	0	0	0	0
Goodenia heterophylla subsp. heterophylla		1	1	0	1	1	0	0	2	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	2	0	2	0	0	2	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Goodenia paniculata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0
Guioa semiglauca		0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	3	1	4	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnostachys anceps		0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	1	2	0	2	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardenbergia violacea		2	2	2	2	2	2	2	2	0	0	2	2	2	2	2	0	2	0	0	0	2	0	0	0	1	0	0	0	0	2	0	0	2	0	0	2	2	0	0	0	0	0	2	0	0	2	0	0	0	0
Hedycarya angustifolia		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	0	0	0	0	0	0	0
Helichrysum elatum		0	0	0	0	0	0	1	0	0	0	0	0	0	2	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
Heritiera actinophylla		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	0	0	0	0	0	0	0
Hibbertia aspera		2	2	2	0	2	0	2	0	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0
Hibbertia dentata		0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibbertia diffusa		1	2	2	2	0	2	2	0	0	0	2	0	2	0	0	1	2	1	0	0	0	0	0	0	1	0	1	1	0	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Hibbertia linearis		0	0	0	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
Hibbertia obtusifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0
Hibbertia riparia		0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0
Hibbertia scandens		0	2	1	0	1	0	1	0	0	0	0	1	1	2	2	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	0
Hibiscus heterophyllus		0	0	0	0	0	0	0	0	0	1	0	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	3	0	0	0	0	0	0	0	0	0	0	0
Hybanthus monopetalus		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	0	0
Hydrocotyl peduncularis		0	0	0	0	0	0	0	0	3	0	0	0	0	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	2	0	0	0	0	2	0	0	0	0
Hydrocotyle tripartita		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Hymenosporum flavum		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	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
Hypericum gramineum		0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	2	1	1
*Hypochaeris radicata**		0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	1	1	2	2	2	0	2	2	1	2	2	2
Imperata cylindrica		3	3	5	3	5	2	3	2	4	0	2	3	0	2	2	2	3	0	0	2	0	3	0	0	3	0	0	2	0	3	0	0	3	0	3	3	3	0	4	2	0	4	2	2	1	0	2	3	4	3
Jacksonia scoparia		0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	2	0	2	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0
Jasminum volubile		0	0	0	0	0	0	0	0	0	0	0	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
Joycea pallida		0	0	0	0	4	0	2	2	0	0	0	0	0	3	0	2	0	3	0	2	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Juncus bufonius		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Juncus continuus		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	0	0	0	0	0	0	0
Juncus usitatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	0	1	0	0	2	1	0
Kennedia rubicunda		0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	1	0	0	1	0	2	2	0	2	1	1	2	0	0	1	0	0	0	0	0	0
Lagenifera stipitata		2	2	2	2	1	0	2	2	0	0	0	0	0	0	0	2	2	1	0	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	1	0	0	0
*Lantana camara**		1	1	1	1	1	2	1	0	0	1	0	3	2	3	2	1	1	0	2	1	0	0	0	2	1	0	2	0	0	1	0	0	0	2	0	0	1	5	3	0	0	0	0	0	0	0	1	0	0	0
Lepidosperma concavum		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	0	0	0	0	0	0	0
Lepidosperma elatius		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	0	0	0
Lepidosperma laterale		2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Lepidosperma sp.		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	0	0	0	0	0
Leptospermum polygalifolium subsp. cismontanum		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	0	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0
Leptospermum trinervium		0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0
Leucopogon juniperinus		1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	2	2	2	0	1	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	1	0	0	0
*Ligustrum sinense**		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	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Lilium formosanum*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Lindsaea microphylla		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	0	0
Litsea australis		0	0	0	0	0	0	0	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
Logania albiflora		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	0	0	0	0
Lomandra confertifolia subsp. rubiginosa		0	0	0	3	0	3	0	0	0	0	1	1	2	0	0	1	0	0	0	0	4	0	0	0	0	0	0	2	0	0	2	0	3	0	0	0	3	0	0	0	0	0	2	0	0	1	0	0
Lomandra cylindrica		1	2	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
Lomandra filiformis subsp. filiformis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Lomandra glauca		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0
Lomandra longifolia		2	1	0	2	1	0	2	1	1	0	1	0	1	2	2	2	1	1	2	1	0	3	3	1	3	0	0	1	2	1	0	0	0	2	0	0	0	2	0	2	2	0	0	0	0	0	0	0
Lomandra multiflora		2	0	1	1	0	2	0	1	0	0	1	0	2	0	1	1	0	2	0	1	0	0	0	0	1	0	2	2	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0
Lomatia silaifolia		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
Lophostemon confertus		0	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Lotus australis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Maclura cochinchinensis		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	0	0	0	0	0
Marsdenia rostrata		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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsdenia suaveolens		1	2	0	0	0	1	0	0	0	2	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maytenus silvestris		0	1	0	1	1	1	0	0	0	1	2	0	0	0	2	0	0	0	0	0	0	0	1	2	2	0	0	1	1	1	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Melaleuca decora		0	0	0	0	0	0	0	3	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	3	0	0	0	0	0	0
Melaleuca linariifolia		2	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
Melaleuca nodosa		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	5	0	0	0	0	0	0	0
Melicope micrococca		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Microlaena stipoides var stipoides		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	3	5	2	0	0	3	2	2	0	0	0
Microsorum scandens		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	0	0	0
Morinda jasminoides		0	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
Myrsine variabilis		0	0	0	0	1	0	3	0	0	0	3	0	0	3	2	0	0	0	2	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Neolitsea australiensis		0	0	0	0	0	0	0	0	0	0	0	0	0	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
Neolitsea dealbata		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notelaea longifolia		0	1	1	0	1	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	2	1	1	2	0	0	0	2	0	0	2	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0
Notelaea venosa		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	0	0
Olearia argophylla		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	0
Opercularia diphylla		1	0	1	1	0	0	0	2	0	0	1	0	2	0	1	0	1	0	0	1	2	0	0	0	0	0	1	2	0	0	0	0	0	0	1	1	0	0	1	0	0	2	0	2	0	0	2	0
Oplismenus aemulus		0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	1	0	0	2	0	0	2	0	0	0	0	0	2	0	0	1	0	0	0	0	2	0
Oplismenus imbecillis		2	0	0	0	0	0	0	0	2	2	1	1	0	1	2	0	2	0	0	0	0	3	0	3	1	2	0	0	0	1	0	0	0	2	2	2	1	0	0	2	2	0	0	1	0	0	0	0
Oxalis exilis		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	2	0	1	0	0	0	1
Oxalis perennans		1	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0
Ozothamnus diosmifolius		0	1	1	0	0	0	0	2	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0	0	0	0	0
Pandorea pandorana		2	1	1	0	1	2	2	0	0	2	2	0	2	1	1	0	1	0	2	0	2	1	1	2	2	2	0	0	1	1	0	0	1	2	1	0	1	2	1	0	1	0	0	0	0	2	0	0
Panicum capillare*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Panicum simile		1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	3	0	0	0	0	4	0	2	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1	2	1	0	0	1
Parsonsia straminea		0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	1	2	0	0	0	0	0	0	0	3	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Parsonsia velutina		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	0	0	0	0	0
*Paspalum dilatatum**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	1	0	2	4	3	0

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Passiflora cinnabarina		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	0	0	0
Patersonia glabrata		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	0	0
Patersonia sericea		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	0	0	0	0
Pellaea falcata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pellaea paradoxa		0	0	0	0	0	1	0	0	0	2	2	0	0	0	2	0	0	0	1	0	0	2	2	0	1	0	0	0	0	0	0	0	0	2	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Pennisetum villosum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	0	0	0	0	0
Persoonia linearis		1	2	2	2	2	2	2	0	0	0	3	0	2	0	0	1	2	2	0	0	2	0	0	0	1	0	1	2	0	2	0	0	2	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Philydrum lanuginosum		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	0	0	0	0
Phyllanthus gunnii		0	0	0	0	0	2	2	0	0	0	0	0	0	1	2	0	0	0	0	1	0	0	1	0	1	0	0	1	0	1	0	0	1	0	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus hirtellus		0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	1	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0
Pimelea linifolia subsp. linifolia		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	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Pittosporum revolutum		0	1	0	0	2	0	0	0	0	1	1	0	0	0	0	0	0	0	2	0	2	2	0	1	0	2	0	0	0	0	0	0	1	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Pittosporum spinescens		0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	3	3	2	2	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Pittosporum undulatum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
*Plantago lanceolata**		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	2	0	0	0	2	0	2	0	1	2	2	2
Platycerium bifurcatum		0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	1	0	0	1	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
Platylobium formosum subsp parviflorum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Plectranthus argentatus		0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	2	0	2	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0
Plectranthus graveolens		0	0	0	0	0	0	0	0	0	0	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	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa annua		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Poa libillardieri		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podolobium ilicifolium		1	2	3	2	3	4	3	0	0	0	3	0	2	2	3	2	2	2	0	0	2	0	0	0	2	0	0	2	0	2	0	0	2	0	3	2	2	0	0	0	0	0	0	2	0	0	2	0	0	0
Polymeria calycina		2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Polyscias sambucifolia		2	2	2	1	0	0	0	0	0	2	0	0	0	2	2	1	2	2	1	0	1	2	0	0	2	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pomaderris lanigera		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	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	0	0	0	0	0	0
Pomax umbellata		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	2	0	0	2	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Poranthera microphylla		0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0
Pratia purpurascens		2	2	2	2	2	2	2	2	2	0	2	2	1	2	0	1	2	2	0	2	0	2	0	1	2	0	2	1	0	2	0	0	2	0	1	2	0	0	2	2	2	3	0	2	1	0	2	0	1	0
Pseuderanthemum variabile		2	2	1	2	0	2	2	2	0	0	1	1	0	0	2	2	2	1	2	1	2	2	0	0	2	2	1	2	0	1	0	0	1	2	1	1	0	0	0	0	2	3	0	0	0	0	2	0	0	0
Pteridium esculentum		1	0	0	0	2	0	3	0	0	0	3	0	0	0	1	0	0	1	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	2	0	0	0	2	0	0	0	3
Pterostylis curta		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	0	0	0	0	0
Pterostylis grandiflora		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	0	0	0	0	0
Pterostylis nutans		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	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
Pterostylis 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	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pterostylis sp		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	0	0	0	0	0
Pultenaea retusa		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	0	0	0	0	0
Pultenaea villosa		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	2	0	0	0	0	0	0	0	0	0	0
Pyrrosia confluens		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	0	0	0	0	0	0	0
Pyrrosia rupestris		0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	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
Ranunculus inundatus		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	0	0	0	0	0	0	0
Ranunculus plebeius		0	0	0	0	0	0	0	0	0	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	2	0	0	0	0	0	0	0	0	0	0	0
Rhodamnia rubescens		0	0	0	0	0	0	0	0	0	1	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	2	0	0	0	0	0	0	0	0	0	0	0

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Rhysotoechia bifoliolata subsp. bifoliolata		0	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	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Richardia humistrata*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Richardia stellaris.*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Ripogonum album		0	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	2	0	0	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Ripogonum fawcettianum		0	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus fruticosus		0	0	0	0	0	0	0	0	0	0	0	0	0	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	0
Rubus moluccanus var. trilobus		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	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Rubus parvifolius		0	1	1	0	1	2	1	0	0	0	1	2	0	2	2	0	0	0	0	0	0	2	0	0	2	0	0	0	2	1	0	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	1	0	0
Rubus rosifolius		0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Rulingia dasyphylla		0	0	0	0	0	0	0	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
Sarcochilus hillii		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	0	0	0	0	0
Sarcomelicope simplicifolia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	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
Sarcopetalum harveyanum		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	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
Schizomeria ovata		0	0	0	0	0	0	0	0	0	0	0	0	0	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
Schoenus apogon		0	0	0	0	0	0	0	0	2	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
Schoenus brevifolius		0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0
Scolopia braunii		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	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Senecio madagascariensis**		0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	1	0	2	1	2	2	1	0	0	2	1	1	2	2
*Setaria pumila**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
*Setaria sphacelata**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1
Setaria viridis*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
*Sida rhombifolia**		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	0	1	1
Smilax australis		1	0	0	0	0	0	2	0	0	2	1	0	1	1	1	0	0	0	2	0	0	2	1	2	1	2	0	0	1	0	0	3	0	2	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0
Smilax glyciphylla		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	1	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
*Solanum mauritianum**		0	0	0	0	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	1	0	0	0	0	0	1	0	0
Solanum prinophyllum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0
Solanum stelligerum		0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	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	0	0	0	0
*Sonchus oleraceus**		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	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*Sporobolus africanus**		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	0	0	0
Sporobolus elongatus		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	3	4	0	3	3	0
*Stachys arvensis**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Stellaria flaccida		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	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Stenocarpus salignus		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	0	0	0	0	0
Stephania japonica		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	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
stinking roger		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Streblus brunonianus		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	4	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Stypandra glauca		0	0	0	0	0	0	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
Syncarpia glomulifera		4	4	0	2	3	0	0	0	0	0	0	0	0	2	1	3	0	3	0	2	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
Synoum glandulosum		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	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
*Taraxacum officinale**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Tetratheca thymifolia		0	0	0	0	0	0	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
Themeda australis		3	5	0	5	4	5	4	2	0	0	4	5	5	2	4	3	6	0	0	3	3	0	0	0	0	0	5	5	0	2	3	0	2	0	3	5	3	0	3	1	0	0	2	0	3	3	2	2	1	3

Species	Plot	08-01	08-02	08-03	08-04	08-05	08-06	08-07	08-08	08-09	08-10	08-11	08-12	08-13	08-14	08-15	08-16	08-17	08-18	08-19	08-20	08-21	08-22	08-23	08-24	08-25	08-26	08-27	08-28	08-29	08-30	08-31	08-32	08-33	08-34	08-35	08-36	08-37	08-38	08-39	08-40	08-41	08-42	08-43	08-44	08-45	08-46	08-47	08-48	08-49	08-50
Toona ciliata		0	0	0	0	0	0	0	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	2	0	0	0	0	0	0	0	0	0	0	0	0
Tradescantia albiflora		0	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	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trema tomentosa var. viridis		0	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	0	0	0	0	0	0	0
Tricoryne simplex		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	1	1
Trifolium dubium*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Trifolium fragiferum*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	2
Tripladenia cunninghamii		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	1	0	0	1	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Tristaniopsis laurina		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trochocarpa laurina		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	0	0	0	0	0	0	0	0	0
Trophis scandens subsp. scandens		0	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	0	0
Urtica urens		0	0	0	0	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
*Verbena bonariensis**		0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	2	1	2	0	2	2	2
*Verbena rigida**		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	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Vernonia cinerea		0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	0	0	0	0	1	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
Viminaria juncea		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
Viola betonicifolia		1	0	0	0	1	0	0	0	0	0	0	0	1	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	2	0	0	0
Viola hederacea		0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	1	0
Vittadenia cunneata		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	0	0
Wahlenbergia gracilis		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	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Wahlenbergia planiflora		0	0	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	1	0	0	0	0	0
Wahlenbergia stricta subsp. stricta		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	0	0	0
Waterhousea floribunda		0	0	0	0	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	0	0	0	0	0	0	0	0	0	0
Wilkiea huegeliana		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xanthorrhoea glauca		0	0	0	0	0	0	0	0	0	0	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	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xanthorrhoea macronema		0	0	0	0	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	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Xylomelum pyriforme		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	0	0
Zieria smithii		0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	2	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

Appendix 3: Fauna species recorded within the study area

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

Scientific Name	Common Name	Method of Detection	Relative Abundance
Amphibians			
Adelotus brevis	Tusked Frog	Heard	U
Crinia signifera	Common Eastern Froglet	Heard, sighted	A
Limnodynastes peronii	Striped Marsh Frog	Heard, sighted	A
Limnodynastes tasmaniensis	Spotted Marsh Frog	Heard, sighted	C
Litoria dentata	Bleating Tree Frog	Heard	U
Litoria fallax	Eastern Dwarf Tree Frog	Heard, sighted	A
Litoria latopalmata	Broad-palmed Frog	Heard, sighted	A
Litoria peronii	Peron's Tree Frog	Heard, sighted	C
Litoria phyllochroa	Leaf-tree Green Frog	Heard, sighted	C
Litoria tyleri	Tyler's Tree Frog	Heard	U
Litoria verreauxii	Verreaux's Tree Frog	Heard	C
Litoria wilcoxii	Rocky River Frog	Heard, sighted	C
Mixophyes iteratus#,+	Giant Barred Frog	Heard, sighted	U
Pseudophryne bibronii	Brown Brood Frog	Heard, sighted	U
Pseudophryne coriacea	Red-backed Toadlet	Heard, sighted	U
Uperoleia fusca	Dusky Toadlet	Heard, sighted	U
Uperoleia laevigata	Smooth Toadlet	Heard, sighted	U
Reptiles			
Ctenotus robustus	Robust Ctenotus	Funnel trap, reptile search	C
Chelodina longicollis	Eastern Long-necked Turtle	Spotlighting	C
Eulamprus quoyii	Eastern Water Skink	Reptile search	U
Furina diadema	Red-naped Snake	Reptile search	O
Lampropholis delicata	Garden Skink	Reptile search	C
Lampropholis guichenoti	Sun Skink	Reptile search	U
Physignathus lesueurii	Eastern Water Dragon	Opportunistic, reptile search	A
Pogona barbata	Eastern Bearded Dragon	Reptile search	U
Pseudechis porphyriacus	Red-bellied Black Snake	Opportunistic	U
Pseudonaja textilis	Eastern Brown Snake	Road kill	U
Saiphos equalis	Three-toed Skink	Reptile search	O
Varanus varius	Lace Monitor	Reptile search, opportunistic	C

Fauna species recorded on the study area cont.

Scientific Name	Common Name	Method of Detection	Relative Abundance
Terrestrial and Arboreal Mammals			
Antechinus stuartii	Brown Antechinus	Hair analysis, terrestrial trapping	C
Antechinus swainsonii	Dusky Antechinus	Terrestrial trapping, hair analysis	U
Lepus capensis *	Brown Hare	Opportunistic	A
Macropus giganteus	Eastern Grey Kangaroo	Spotlighting, hair analysis	C
Macropus robustus	Wallaroo	Opportunistic	U
Macropus rufogriseus	Red-necked Wallaby	Opportunistic	C
Oryctolagus cuniculus *	European Rabbit	Opportunistic	C
Petaurus breviceps	Sugar Glider	Arboreal trapping, spotlighting, hair analysis	C
Petaurus norfolcensis #	Squirrel Glider	Arboreal trapping, spotlighting, hair analysis	A
Phascogale tapoatafa #	Brush-tailed Phascogale	Spotlighting	U
Pseudocheirus peregrinus	Common Ringtail Possum	Spotlighting	U
Rattus fuscipes	Bush Rat	Terrestrial trapping	C
Rattus rattus *	Black Rat	Opportunistic	U
Tachyglossus aculeatus	Echidna	Opportunistic	O
Trichosurus vulpecula	Common Brushtail Possum	Arboreal trapping, spotlighting, hair analysis	C
Vulpes vulpes *	Red Fox	Opportunistic	U
Wallabia bicolor	Swamp Wallaby	Opportunistic	C
Bats			
Chalinolobus gouldii	Gould's Wattled Bat	Anabat	C
Miniopterus oceanensis #	Eastern Bentwing-bat	Anabat	C
Mormopterus norfolkensis #	Eastern Freetail-bat	Anabat	U
Mormopterus ridei (formally *Mormopterus sp.* 2)		Anabat	U
Myotis macropus #	Large-footed Myotis	Anabat	U
Nyctophilus spp.	Unidentified Long-eared Bat	Anabat	C
Nyctophilus gouldi	Gould's Long-eared Bat	Harp Trap	U
Austronomus australis	White-striped Freetail-bat	Spotlighting	U
Rhinolophys megaphyllus	Eastern Horseshoe Bat	Anabat	U
Vespadelus pumilis	Eastern Forest Bat	Anabat	C
Vespadelus vulturnus	Little Forest Bat	Anabat	A

* Introduced species,
# Listed as a threatened species under the NSW TSC Act
+ Listed as threatened under the EPBC Act

			Bird survey plots and transects																			
Scientific Name	Common Name	RA	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	T1	T2	T3	T4	T5	T6	T7	T8
Tachybaptus novaehollandiae	Australasian Grebe	C								+												
Alisterus scapularis	Australian King-Parrot	C						+	+			+							+			+
Gymnorhina tibicen	Australian Magpie	A		+	+	+	+	+	+	+	+	+	+	+	+		+		+	+	+	+
Corvus coronoides	Australian Raven	A	+	+	+			+			+	+	+	+	+			+	+	+		+
Chenonetta jubata	Australian Wood Duck	A								+	+											+
Alcedo azurea	Azure Kingfisher	U																	+			+
Geopelia humeralis	Bar-shouldered Dove	C																	+		+	+
Coracina novaehollandiae	^Black-faced Cuckoo-shrike	A	+	+	+	+					+	+	+	+	+			+			+	+
Macropygia amboinensis	Brown Cuckoo-dove	U																	+	+		+
Gerygone mouki	Brown Gerygone	C																	+		+	+
Acanthiza pusilla	Brown Thornbill	A	+		+			+			+				+		+	+	+	+	+	+
Melithreptus brevirostris	Brown-headed Honeyeater	C							+				+		+							
Acanthiza reguloides	Buff-rumped Thornbill	U																	+			
Scythrops novaehollandiae	^Channel-billed Cuckoo	U													+							
Phaps chalcoptera	Common Bronzewing	U													+							
Platycercus elegans	Crimson Rosella	C	+									+	+							+		+
Eurystomus orientalis	^Dollarbird	U													+							
Taeniopygia bichenovii	Double-barred Finch	C	+					+							+							
Platycercus eximius	Eastern Rosella	A	+			+	+	+	+	+	+	+	+	+	+	+			+	+		+
Acanthorhynchus tenuirostris	Eastern Spinebill	C															+	+		+		
Psophodes olivaceus	Eastern Whipbird	U																	+			
Eopsaltria australis	Eastern Yellow Robin	C	+	+		+				+							+	+	+	+	+	+
Cacomantis flabelliformis	^Fan-tailed Cuckoo	C												+	+							+
Lichenostomus fuscus	Fuscous Honeyeater	C					+	+	+	+			+		+		+					
Cacatua roseicapilla	Galah	C				+															+	
Cisticola exilis	Golden-headed Cisticola	C																				+
Pachycephala pectoralis	Golden Whistler	A	+	+	+		+	+	+	+	+		+					+	+	+	+	+
Cracticus torquatus	Grey Butcherbird	A	+		+		+		+		+	+	+	+	+		+	+		+	+	+
Rhipidura fuliginosa	Grey Fantail	A	+	+	+	+	+	+	+	+	+		+		+		+	+	+	+	+	+

			Bird survey plots and transects																			
Scientific Name	Common Name	RA	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	T1	T2	T3	T4	T5	T6	T7	T8
Accipiter novaehollandiae	Grey Goshawk	O																	+			
Colluricincla harmonica	Grey Shrike-thrush	C		+											+				+			+
Aythya australis	Hardhead	C								+												
Microeca fascinans	Jacky Winter	C							+	+			+		+		+					
Sericornis magnirostris	Large-billed Scrubwren	U																	+			
Dacelo novaeguineae	Laughing Kookaburra	A							+	+				+	+	+		+	+	+		+
Meliphaga lewinii	Lewin's Honeyeater	A			+	+									+				+	+	+	+
Grallina cyanoleuca	^Magpie-lark	A				+			+	+		+		+	+							+
Vanellus miles	Masked Lapwing	C				+				+		+										
Glossopsitta concinna	Musk Lorikeet	U													+							
Philemon corniculatus	Noisy Friarbird	C						+	+						+		+					
Manorina melanocephala	Noisy Miner	A		+			+	+	+	+	+	+	+	+	+	+	+		+	+	+	
Oriolus sagittatus	Olive-backed Oriole	C	+				+	+	+						+		+					
Aviceda subcristata	Pacific Baza	O											+									
Anas superciliosa	Pacific Black Duck	C								+										+		
Centropus phasianinus	Pheasant Coucal	U					+	+	+													+
Cracticus nigrogularis	Pied Butcherbird	C		+	+	+					+	+	+	+						+	+	+
Strepera graculina	Pied Currawong	C													+				+	+	+	+
Merops ornatus	^Rainbow Bee-eater	U																			+	
Anthochaera carnunculata	Red Wattlebird	U														+						
Neochmia temporalis	Red-browed Finch	A				+					+		+	+			+	+	+	+	+	+
Petroica rosea	Rose Robin	U															+					
Pachycephala rufiventris	Rufous Whistler	C	+		+		+				+		+		+							
Todiramphus sanctus	^Sacred Kingfisher	U													+							+
Ptilonorhynchus violaceus	Satin Bowerbird	U																				+
Myzomela sanguinolenta	Scarlet Honeyeater	U													+							
Chrysococcyx lucidus	^Shining Bronze-Cuckoo	U													+							
Zosterops lateralis	^Silvereye	C	+																+		+	+
Stipiturus malachurus	Southern Emu-wren	U			+																	+
Chthonicola sagittata	# Speckled Warbler	U	+		+																	
Pardalotus punctatus	Spotted Pardalote	A	+	+	+		+	+	+		+		+			+	+	+	+	+	+	+
Threskiornis spinicollis	^Straw-necked Ibis	U																			+	

			Bird survey plots and transects																			
Scientific Name	Common Name	RA	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	T1	T2	T3	T4	T5	T6	T7	T8
Pardalotus striatus	Striated Pardalote	C	+	+	+			+	+	+	+		+						+			
Acanthiza lineata	Striated Thornbill	A		+			+	+			+		+		+	+		+		+		
Malurus cyaneus	Superb Fairy-wren	A			+	+	+	+	+	+	+		+	+	+		+	+	+	+	+	+
Hirundo nigricans	Tree Martin	U								+					+							
Daphoenositta chrysoptera	Varied Sittella	U													+							
Malurus lamberti	Variegated Fairy-wren	C			+										+				+	+	+	+
Aquila audax	Wedge-tailed Eagle	C											+								+	
Hirundo neoxena	^Welcome Swallow	C			+					+											+	
Coracina papuensis	^White-bellied Cuckoo-shrike	U									+		+									
Sericornis frontalis	White-browed Scrubwren	C													+		+		+	+		
Columba leucomela	White-headed Pigeon	U																				+
Melithreptus lunatus	White-naped Honeyeater	C					+	+	+				+		+	+	+	+				
Lichenostomus penicillatus	White-plumed Honeyeater	A	+	+					+				+		+		+					
Gerygone olivacea	White-throated Gerygone	C								+	+		+		+							
Cormobates leucophaeus	White-throated Treecreeper	A	+	+	+	+		+										+	+		+	+
Corcorax melanorhamphos	White-winged Chough	C	+		+						+	+										
Rhipidura leucophrys	Willie Wagtail	A			+					+	+		+	+	+		+		+			+
Leucosarcia melanoleuca	Wonga Pigeon	U				+																
Acanthiza nana	Yellow Thornbill	C	+		+			+	+	+							+		+			
Lichenostomus chrysops	Yellow-faced Honeyeater	A	+	+			+	+	+	+					+	+	+	+	+			
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	C	+							+												
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	C	+			+													+	+	+	
Sericornis citreogularis	Yellow-throated Scrubwren	U																	+			+
	Total no. of species per site		**23**	**15**	**21**	**15**	**15**	**21**	**22**	**24**	**21**	**12**	**26**	**13**	**39**	**8**	**21**	**16**	**34**	**24**	**25**	**37**

* - Introduced species

- Listed as threatened under the TSC Act

+ - Listed as threatened under the EPBC Act

^ - Listed as a marine species under the EPBC Act

RA = Relative abundance

Scientific Name	Common Name	RA
Opportunistic bird records across study area		
Elanus axillaris	Black-shouldered Kite	C
Climacteris picumnus	# Brown Treecreeper	O
Anas castanea	Chestnut Teal	C
Anhinga melanogaster	Darter	U
Pomatostomus temporalis temporalis	# Grey-crowned Babbler	U
Phalacrocorax melanoleucos	Little Pied Cormorant	C
Lathamus discolor	#+Swift Parrot	O
Smicrornis brevirostris	Weebill	U
Egretta novaehollandiae	White-faced Heron	C
Lalage sueurii	White-winged Triller	U
Ninox novaeseelandiae	^Southern Boobook	C
Podargus strigoides	Tawny Frogmouth	C
Tyto javanica	Barn Owl	U

* - Introduced species

- Listed as threatened under the TSC Act

+ - Listed as threatened under the EPBC Act

^ - Listed as a marine species under the EPBC Act

RA = Relative abundance

Appendix 4: Flora species recorded within the study area

Family Name	Species Name	Vegetation Community Gap							
		1	2	3	4	5	6	7	8
CLASS FILICOPSIDA (Ferns)									
Adiantaceae	*Adiantum aethiopicum*	+	+	+	+		+		
Adiantaceae	*Adiantum hispidulum*	+					+	+	
Adiantaceae	*Cheilanthes distans*							+	+
Adiantaceae	*Cheilanthes sieberi subsp. sieberi*			+	+	+		+	
Blechnaceae	*Blechnum cartilagineum*				+				
Blechnaceae	*Doodia aspera*	+					+		
Dennstaedtiaceae	*Hypolepis glandulifera*				+				
Dennstaedtiaceae	*Pteridium esculentum*		+	+	+		+		+
Dicksoniaceae	*Calochlaena dubia*				+				
Lindsaeaceae	*Lindsaea linearis*			+		+			
Lindsaeaceae	*Lindsaea microphylla*		*	*					
Polypodiaceae	*Platycerium bifurcatum*	*	*						
Polypodiaceae	*Pyrrosia confluens*	+							
Selaginellaceae	*Selaginella uliginosa*		*						
Sinopteridaceae	*Pellaea falcata*	+							
CLASS MAGNOLIAOPSIDA (Flowering Plants)									
Subclass MAGNOLIIDAE (DICOTYLEDONS)									
Acanthaceae	*Brunoniella australis*			+		+	+	+	
Acanthaceae	*Pseuderanthemum variabile*	+	+		+	+		+	
Apiaceae	*Daucus glochidiatus*	+	+						+
Apiaceae	*Hydrocotyl peduncularis*	+	+	+		+		+	
Apiaceae	*Hydrocotyle tripartita*		+	+	+	+		+	+
Apocynaceae	*Parsonsia straminea*	+	+	+		+	+		
Araliaceae	*Polyscias sambucifolia*				+				
Asclepiadaceae	*Marsdenia suaveolens*	+							
Asteraceae	*Facelis retusa**			+					
Asteraceae	*Ageratina adenophora**	+							
Asteraceae	*Ageratina riparia*	+							
Asteraceae	*Aster subulatus**								+
Asteraceae	*Bidens pilosa**							+	
Asteraceae	*Brachycome multifida var multifida*					+		+	
Asteraceae	*Brachyscome angustifolia var. heterophylla*							+	
Asteraceae	*Calotis cuneifolia*					*			
Asteraceae	*Cassinia quinquefaria*				+				
Asteraceae	*Chrysanthemoides monulifera **			*					
Asteraceae	*Cirsium vulgare**	+	+					+	+
Asteraceae	*Conyza bonariensis**	+						+	+
Asteraceae	*Conzya sp.**		+					+	+
Asteraceae	*Euchiton pensylvanicum**				*				*
Asteraceae	*Euchiton collinus**								+
Asteraceae	*Euchiton gymnocephalus*		+	+					
Asteraceae	*Euchiton involucratus*				*	*			
Asteraceae	*Euchiton sp.**								+

Family Name	Species Name	Vegetation Community Gap							
		1	2	3	4	5	6	7	8
Asteraceae	*Euchiton sphaericus**							+	+
Asteraceae	*Galinsoga parviflora**	*							*
Asteraceae	*Hypochaeris radicata**	+	+	+	+	+			+
Asteraceae	*Lagenifera stipitata*		+	+	+	+		+	+
Asteraceae	*Ozothamnus diosmifolius*	+	+	+	+				
Asteraceae	*Senecio madagascariensis**	+	+	+				+	+
Asteraceae	*Tagetes minuta**								+
Asteraceae	*Taraxacum officinale**							+	+
Asteraceae	*Vernonia cineria*				+	+	+	+	
Asteraceae	*Vittadinia cuneata*				*				
Asteraceae	*Xanthium occidentale**	*							
Asteraceae	*Chrysocephalum semipapposum*					*			
Bignoniaceae	*Pandorea pandorana subsp. pandorana*		+		+		+	+	
Campanulaceae	*Wahlenbergia communis*					*		*	
Campanulaceae	*Wahlenbergia gracilis*					*			+
Campanulaceae	*Wahlenbergia planiflora*			*	*				+
Campanulaceae	*Wahlenbergia stricta*			*					
Caryophyllaceae	*Cerastium glomeratum**		+						
Casuarinaceae	*Allocasuarina torulosa*				+	+		+	
Casuarinaceae	*Casuarina cunninghamii*	+			+		+		
Celastraceae	*Maytenus silvestris*	+					+	+	
Chenopodiaceae	*Einadia trigonos subsp. leiocarpa*	+	+			+			
Clusiaceae	*Hypericum gramineum*		*	*	*				
Convolvulaceae	*Dichondra repens*		+	+	+	+	+	+	+
Convolvulaceae	*Polymeria calycina*				+	+			
Dilleniaceae	*Hibbertia aspera*		+	+			+	+	
Dilleniaceae	*Hibbertia dentata*			+					
Dilleniaceae	*Hibbertia diffusa*			+		+	+	+	
Dilleniaceae	*Hibbertia linearis*						+		
Dilleniaceae	*Hibbertia obtusifolia*							+	
Dilleniaceae	*Hibbertia pedunculata*		*	*		*			
Dilleniaceae	*Hibbertia riparia*					+			
Dilleniaceae	*Hibbertia scandens*			+				+	
Dilleniaceae	*Hibbertia serpyllifolia*				+	+			
Droseraceae	*Drosera auriculata*		*						
Elaeocarpaceae	*Elaeocarpus obovatus*	*							
Epacridaceae	*Leucopogon juniperinus*			+	+	+	+	+	
Euphorbiaceae	*Baloghia inophylla*	+		+					
Euphorbiaceae	*Breynia oblongifolia*	+	+	+	+	+	+	+	
Euphorbiaceae	*Glochidion ferdinandi var. ferdinandi*	+			+	+	+		
Euphorbiaceae	*Poranthera microphylla*		+	+	+				
Fabaceae (Faboideae)	*Bossiaea prostrata*					+			
Fabaceae (Faboideae)	*Daviesia genistifolia*					+			
Fabaceae (Faboideae)	*Daviesia ulicifolia*					+		+	
Fabaceae (Faboideae)	*Desmodium brachypodum*					+			+
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*							+	+
Fabaceae (Faboideae)	*Desmodium varians*		+	+	+	+	+	+	+
Fabaceae (Faboideae)	*Dillwynia retorta*			*					

Family Name	Species Name	Vegetation Community Gap							
		1	2	3	4	5	6	7	8
Fabaceae (Faboideae)	*Glycine clandestina*		+	+	+	+		+	+
Fabaceae (Faboideae)	*Glycine microphylla*		+	+	+	+			+
Fabaceae (Faboideae)	*Glycine tabacina*					+			
Fabaceae (Faboideae)	*Gompholobium inconspicuum*					+			
Fabaceae (Faboideae)	*Gompholobium pinnatum*							*	
Fabaceae (Faboideae)	*Gompholobium virgatum var. virgatum*							*	
Fabaceae (Faboideae)	*Hardenbergia violacea*							+	
Fabaceae (Faboideae)	*Indigofera australis*						*		
Fabaceae (Faboideae)	*Kennedia rubicunda*		+	+		+		+	
Fabaceae (Faboideae)	*Lotus australis*								+
Fabaceae (Faboideae)	*Platylobium formosum subsp parviflorum*								+
Fabaceae (Faboideae)	*Podolobium ilicifolium*							+	
Fabaceae (Faboideae)	*Podolobium scandens*					+			
Fabaceae (Faboideae)	*Podolobium scandens*					*			
Fabaceae (Faboideae)	*Pultenaea euchila*					*			
Fabaceae (Faboideae)	*Pultenaea retusa*			*					
Fabaceae (Faboideae)	*Pultenaea villosa*			+		+			
Fabaceae (Faboideae)	*Trifolium dubium**								+
Fabaceae (Faboideae)	*Trifolium fragiferum**								+
Fabaceae (Faboideae)	*Trifolium repens**								*
Fabaceae (Faboideae)	*Viminaria juncea*							+	
Fabaceae (Mimosoideae)	*Acacia decurrens*							*	
Fabaceae (Mimosoideae)	*Acacia falcata*			*	*				
Fabaceae (Mimosoideae)	*Acacia floribunda*		+					+	
Fabaceae (Mimosoideae)	*Acacia implexa*	+			+				+
Fabaceae (Mimosoideae)	*Acacia irrorata*	+	+	+	+	+	+	+	
Fabaceae (Mimosoideae)	*Acacia linifolia*						*		
Fabaceae (Mimosoideae)	*Acacia longifolia*		*	*					
Fabaceae (Mimosoideae)	*Acacia longissima*					+		+	
Fabaceae (Mimosoideae)	*Acacia maidenii*					*	*	*	
Fabaceae (Mimosoideae)	*Acacia melanoxylon*					+	+		
Fabaceae (Mimosoideae)	*Acacia myrtifolia*					+			
Fabaceae (Mimosoideae)	*Acacia ulicifolia*			+		+	+	+	+
Geraniaceae	*Erodium cicutarium**								*
Geraniaceae	*Geranium homeanum*		+						+
Geraniaceae	*Geranium solanderi var solanderi*				+				+
Goodeniaceae	*Goodenia heterophylla subsp. heterophylla*							+	
Goodeniaceae	*Goodenia paniculata*							+	
Haloragaceae	*Gonocarpus micranthus subsp. micranthus*		*						
Haloragaceae	*Gonocarpus teucrioides*		+	+	+	+	+		+
Lamiaceae	**Stachys arvensis*		+						
Lamiaceae	*Plectranthus parviflorus*					+			
Lauraceae	*Cassytha glabella forma glabella*			*	*				
Lobeliaceae	*Pratia purpurascens*	+	+	+	+	+	+	+	+
Loranthaceae	*Amyema miquelii*			+					
Luzuriagaceae	*Eustrephus latifolius*	+			+				
Luzuriagaceae	*Geitonoplesium cymosum*		+	+	+	+	+	+	

Family Name	Species Name	Vegetation Community Gap							
		1	2	3	4	5	6	7	8
Malvaceae	*Sida rhombifolia**								+
Meliaceae	*Melia azedarach*						+		
Menispermaceae	*Stephania japonica var. discolor*	*							
Monimiaceae	*Wilkiea huegeliana*	+							
Moraceae	*Ficus coronata*	+							
Moraceae	*Streblus brunonianus*	+							
Myoporaceae	*Eremophila debilis*							+	
Myrsinaceae	**Anangallis arvensis*								+
Myrsinaceae	*Myrsine howittiana*	+							
Myrtaceae	*Angophora costata*			*					
Myrtaceae	*Angophora floribunda*			+	+	+	+		
Myrtaceae	*Backhousia myrtifolia*			+					
Myrtaceae	*Callistemon linearis*	*	*						
Myrtaceae	*Callistemon rigidus*			*					
Myrtaceae	*Callistemon salignus*	+	+	+	+		+		
Myrtaceae	*Corymbia maculata*					+		+	
Myrtaceae	*Eucalyptus acmenoides*			+	+	+	+		
Myrtaceae	*Eucalyptus amplifolia subsp. amplifolia*	+	+		+				
Myrtaceae	*Eucalyptus canaliculata*					+	+	+	
Myrtaceae	*Eucalyptus carnea*			+		+	+	+	
Myrtaceae	*Eucalyptus crebra*							+	+
Myrtaceae	*Eucalyptus eugenioides*			+					
Myrtaceae	*Eucalyptus fibrosa*			+	+	+			
Myrtaceae	*Eucalyptus globoidea*		+	+	+	+			
Myrtaceae	*Eucalyptus microcorys*			+				+	
Myrtaceae	*Eucalyptus molucanna*				+	+			
Myrtaceae	*Eucalyptus propinqua*				*				
Myrtaceae	*Eucalyptus punctata*				*		*		
Myrtaceae	*Eucalyptus resinifera*		+	+					
Myrtaceae	*Eucalyptus saligna*	+	+						
Myrtaceae	*Eucalyptus siderophloia*		+	+	+	+		+	
Myrtaceae	*Eucalyptus tereticornis*				+	+			
Myrtaceae	*Leptospermum polygalifolium subsp. cismontanum*	+	+	+			+		
Myrtaceae	*Leptospermum trinervium*			*					
Myrtaceae	*Melaleuca decora*		+						
Myrtaceae	*Melaleuca linariifolia*	+	+	+	+	+	+		
Myrtaceae	*Melaleuca nodosa*		+	+					
Myrtaceae	*Melaleuca styphelioides*	+	+		+		+		
Myrtaceae	*Syncarpia glomulifera*					*		*	
Myrtaceae	*Tristaniopsis laurina*	+							
Myrtaceae	*Waterhousea floribunda*	+							
Oleaceae	*Ligustrum sinense**	+		+					
Oleaceae	*Notelaea longifolia*		+	+	+	+	+	+	
Oxalidaceae	*Oxalis exilis*		+	+	+	+		+	+
Oxalidaceae	*Oxalis perennans*		+	+					
Phyllanthaceae	*Phyllanthus gunnii*				+				
Phyllanthaceae	*Phyllanthus hirtellus*					+		+	

Family Name	Species Name	Vegetation Community Gap							
		1	2	3	4	5	6	7	8
Phytolaccaceae	*Phytolacca octandra**								*
Pittosporaceae	*Billardiera scandens var. scandens*			+	+	+			
Pittosporaceae	*Bursaria spinosa*					+	+	+	
Pittosporaceae	*Pittosporum multiflorum*						*		
Pittosporaceae	*Pittosporum revolutum*			+	+		+		
Pittosporaceae	*Pittosporum undulatum*		+		+				+
Plantaginaceae	*Plantago lanceolata**								+
Polygalaceae	*Comesperma ericinum*					*			
Polygonaceae	*Persicaria decipiens*	*							
Polygonaceae	*Persicaria hydropiper*	*							
Polygonaceae	*Rumex crispus**	*							*
Proteaceae	*Banksia spinulosa var. collina*			+					
Proteaceae	*Lomatia silaifolia*							*	
Proteaceae	*Persoonia levis*							+	
Proteaceae	*Persoonia linearis*					*	*	*	
Ranunculaceae	*Clematis aristata*	+		+	+	+	+	+	
Ranunculaceae	*Clematis glycinoides*					+		+	
Ranunculaceae	*Ranunculus inundatus*								*
Ranunculaceae	*Ranunculus lappaceus*				+				
Rhamnaceae	*Alphitonia excelsa*	+					+		
Rhamnaceae	*Pomaderris elliptica*							*	
Rosaceae	*Rubus fruticosus**	+							
Rosaceae	*Rubus hillii*	*	*	*			*		
Rosaceae	*Rubus parvifolius*						*		+
Rosaceae	*Rubus rosifolius var rosifolius*					+	+		
Rubiaceae	*Asperula conferta*				*		*		
Rubiaceae	*Galium propinquum*		+	+					
Rubiaceae	*Opercularia diphylla*		+		+	+	+	+	
Rubiaceae	*Pomax umbellata*			+	+	+		+	
Rubiaceae	*Richardia humistrata**								+
Rubiaceae	*Richardia stellaris.**								+
Rutaceae	*Boronia polygalifolia*				+				
Rutaceae	*Zieria smithii*			+			+		
Santalaceae	*Exocarpos cupressiformis*		+		+	+			
Sapindaceae	*Dodonaea triquetra*			*		*		*	
Sapindaceae	*Dodonaea viscosa subsp. angustifolia*							*	
Sapindaceae	*Guioa semiglauca*	+							
Scrophulariaceae	*Veronica plebeia*					+			
Solanaceae	*Duboisia myoporoides*	+					+		
Solanaceae	*Solanum mauritianum**	+	+						+
Solanaceae	*Solanum prinophyllum*				+	+	+	+	
Stackhousiaceae	*Stackhousia viminea*				+				
Sterculiaceae	*Brachychiton populneus*							+	
Thymelaeaceae	*Pimelea linifolia subsp. linifolia*			+	+	+			+
Ulmaceae	*Trema tomentosa var. viridis*		+				+		
Urticaceae	**Urtica urens*	+							
Verbenaceae	*Lantana camara**	+						+	

Family Name	Species Name	Vegetation Community Gap							
		1	2	3	4	5	6	7	8
Verbenaceae	*Verbena bonariensis**		+			+		+	+
Verbenaceae	*Verbena rigida**								*
Violaceae	*Viola betonicifolia*							+	
Violaceae	*Viola hederacea*			+	+	+	+		+
Vitaceae	*Cissus antarctica*		+	+					
Vitaceae	*Cissus hypoglauca*						*		
CLASS MAGNOLIAOPSIDA (Flowering Plants)									
Subclass LILIIDAE (MONOCOTYLEDONS)									
Anthericaceae	*Caesia parviflora var. parviflora*					+		+	
Anthericaceae	*Laxmannia gracilis*				+				
Anthericaceae	*Tricoryne simplex*				+	+			+
Commelinaceae	*Commelina cyanea*	+	+			+			
Commelinaceae	*Tradescantia fluminensis*	+							
Cyperaceae	*Carex appressa*	+	+	+	+		+		
Cyperaceae	*Carex brownii*								+
Cyperaceae	*Carex longebrachiata*	+				+			
Cyperaceae	*Carex maculata*								+
Cyperaceae	*Cyperus brevifolius**								+
Cyperaceae	*Cyperus congestus**		+						+
Cyperaceae	*Cyperus eragrostis**					+			
Cyperaceae	*Cyperus polystachyos*								*
Cyperaceae	*Eleocharis sphacelata*								*
Cyperaceae	*Fimbristylis dichotoma*				+				+
Cyperaceae	*Gahnia clarkei*	+		+	+		+		
Cyperaceae	*Gahnia radula*			+					
Cyperaceae	*Gahnia sieberiana*				+				
Cyperaceae	*Lepidosperma laterale*			+	+	+		+	
Cyperaceae	*Schoenoplectus mucronatus*								*
Cyperaceae	*Schoenus ericetorum*		*						*
Juncaceae	*Juncus bufonius*		+						
Juncaceae	*Juncus continuus*		*					*	
Juncaceae	*Juncus usitatus*		+			+			+
Liliaceae	*Lilium formosanum**							+	
Lomandraceae	*Lomandra confertifolia subsp. rubiginosa*					+		+	
Lomandraceae	*Lomandra filiformis subsp. filiformis*		+			+			
Lomandraceae	*Lomandra glauca*				+	+		+	
Lomandraceae	*Lomandra longifolia*	+	+	+	+	+	+		
Lomandraceae	*Lomandra multiflora*					+			
Lomandraceae	*Lomandra obliqua*					*		*	
Orchidaceae	*Acianthus fornicatus*			+			+		
Orchidaceae	*Caladenia carnea var carnea*		*		*	*			
Orchidaceae	*Chiloglottis diphylla*			+			+		
Orchidaceae	*Cymbidium suave*						*		
Orchidaceae	*Glossodia major*					*			
Orchidaceae	*Pterostylis spp.*						*		
Orchidaceae	*Spiranthes sinensis*							+	
Philydraceae	*Philydrum lanuginosum*								*

Family Name	Species Name	Vegetation Community Gap							
		1	2	3	4	5	6	7	8
Phormiaceae	*Dianella caerulea*			+					
Phormiaceae	*Dianella longifolia*		+	+		+		+	
Phormiaceae	*Dianella tasmanica*					+		+	
Poaceae	*Andropogon virginicus**		+	+		+		+	+
Poaceae	*Aristida ramosa var. ramosa*			+					
Poaceae	*Aristida vagans*				+	+		+	+
Poaceae	*Capillipedium parviflorum*								+
Poaceae	*Chloris gayana**								+
Poaceae	*Chloris virgata**								+
Poaceae	*Cymbopogon refractus*		+		+	+		+	+
Poaceae	*Cynodon dactylon*								+
Poaceae	*Cynosurus echinatus*								+
Poaceae	*Dichelachne crinita*							+	
Poaceae	*Dichelachne micrantha*				+	+			
Poaceae	*Digitaria aequiglumis*							*	
Poaceae	*Digitaria parviflora*			+	+	+	+		
Poaceae	*Digitaria ramularis*							+	
Poaceae	*Digitaria sanguinalis**								*
Poaceae	*Echinopogan caespitosus*			+	+	+			+
Poaceae	*Echinopogan ovatus*		+		+			+	
Poaceae	*Entolasia marginata*		+	+	+		+		
Poaceae	*Entolasia stricta*		+	+	+	+	+	+	+
Poaceae	*Eragrostis brownii*		+		+			+	+
Poaceae	*Eragrostis cilianensis**								+
Poaceae	*Eragrostis curvula**								+
Poaceae	*Eragrostis leptostachya*				+	+			
Poaceae	*Imperata cylindrica var. major*		+	+	+	+	+	+	+
Poaceae	*Joycea pallida*				*			*	
Poaceae	*Melinis repens**								*
Poaceae	*Microlaena stipoides var stipoides*		+	+	+	+		+	+
Poaceae	*Oplismenus aemulus*		+					+	
Poaceae	*Oplismenus imbecillis*	+	+	+	+	+	+	+	
Poaceae	*Panicum capillare**								+
Poaceae	*Panicum simile*			+	+	+		+	+
Poaceae	*Paspalum dilatatum**		+		+	+		+	+
Poaceae	*Paspalum urvellei**								*
Poaceae	*Pennisetum alopecuroides*				+	+	+		
Poaceae	*Pennisetum clandestinum**	+	+		+				
Poaceae	*Pennisetum villosum*		+						+
Poaceae	*Poa affinis*			+					
Poaceae	*Poa annua*		+						
Poaceae	*Setaria glauca**								+
Poaceae	*Setaria pumilla**								+
Poaceae	*Setaria sphacelata**								+
Poaceae	*Setaria viridis**								+
Poaceae	*Sporobolus africanus**								+
Poaceae	*Sporobolus creber*								*

Family Name	Species Name	Vegetation Community Gap							
		1	2	3	4	5	6	7	8
Poaceae	*Sporobolus elongatus*								+
Poaceae	*Stenotaphrum secundatum**								*
Poaceae	*Themeda australis*			+	+	+	+	+	+
Poaceae	*Austrodanthonia fulva*							+	
Poaceae	*Austrodanthonia tenuior*				+	+			
Poaceae	*Axonopus fissifolius**		+		+	+			+
Poaceae	*Bothriochloa macra*								+
Typhaceae	*Typha orientalis*								*
Xanthorrhoeaceae	*Xanthorrhoea latifolia subsp latifolia*					+		+	

* - denotes an introduced species
+ - Recorded in quadrats (communities 1-8)
* - Species recorded in random meanders (communities 1-8)

Appendix 5: Fauna habitat assessment

Zone 1	Date: 8/4/09
Habitat characteristic	Description
Remnant patch	Large remnant section with little cleared land
Regrowth/old growth	Regrowth
Bare ground	Some along and adjacent to roads/tracks
Number of habitat layers	Grass, shrub, mid-storey and canopy
Ground log abundance	High
Hollow abundance	None observed
Herb grass cover	Grass covers majority of forest floor
Dominant tree/shrub height (m)	15-20m
Regeneration occurring	Yes, Eucalypt saplings common
Internal connectivity	Remnant patch connected
External connectivity	Thin vegetation corridors to North, South and West
Nests	None observed
Trunk scratches	None observed
Level of grazing	None

Zone 2	Date: 8/4/09
Habitat characteristic	Description
Remnant patch	Ironbark along gully
Regrowth/old growth	All regrowth
Bare ground	None
Number of habitat layers	Grass, some mid-storey, canopy
Ground log abundance	Low
Hollow abundance	Low
Herb grass cover	Mostly grass, some leaf litter under dense tree patches
Dominant tree/shrub height (m)	10-15m
Regeneration occurring	Smaller trees on outskirts of remnant patch/ Acacia scrubs in open paddock
Internal connectivity	Remnant patch is continuous
External connectivity	Connects to forest patch to north and northeast
Nests	None observed
Trunk scratches	None observed
Level of grazing	Long grass, medium level of grazing

Zone 3	Date: 7/4/09
Habitat characteristic	Description
Remnant patch	Sparse trees along road and isolated patch in paddock
Regrowth/old growth	Regrowth
Bare ground	Along road and edge of dams
Number of habitat layers	Grass and canopy
Ground log abundance	Minimal, some logs under trees
Hollow abundance	Low
Herb grass cover	All grass cover, improved introduced pasture
Dominant tree/shrub height (m)	20m
Regeneration occurring	Approximately 50 Eucalypt saplings growing in paddock
Internal connectivity	None
External connectivity	Separates northwest patch from river to east and patch to the south
Nests	None observed
Trunk scratches	None observed
Level of grazing	Grass kept low

Zone 4	Date: 7/4/09
Habitat characteristic	Description
Remnant patch	Narrow remnant section, surrounded by cleared land
Regrowth/old growth	Regrowth, occasional old growth tree
Bare ground	Minimal
Number of habitat layers	Grass, tall canopy with little undergrowth
Ground log abundance	Some medium to large ground logs in forest patch. Mostly absent in grassy areas with the exception of the occasional fallen tree.
Hollow abundance	Low
Herb grass cover	Forest patches contain leaf litter and little grass. Adjoining cleared areas have almost 100% grass coverage.
Dominant tree/shrub height (m)	20m
Regeneration occurring	Some young trees (Eucalypts 4-10m) in grassland. Very few seedlings coming through in grassed areas.
Internal connectivity	High within remnant section
External connectivity	Mostly separates northern and southern forests with cleared land. A strip of vegetation connects these two patches.
Nests	None observed
Trunk scratches	None observed
Level of grazing	Grass tall but obviously grazed

Zone 5	Date: 8/4/09
Habitat characteristic	Description
Remnant patch	Ironbark along edge of mine
Regrowth/old growth	Regrowth
Bare ground	Around mine and roads
Number of habitat layers	Grass, mid-storey and canopy
Ground log abundance	Low
Hollow abundance	None observed
Herb grass cover	Grass covers forest floor
Dominant tree/shrub height (m)	10m
Regeneration occurring	No
Internal connectivity	Patches split by roads and cleared sections
External connectivity	Connects to western forest patch. To the north and east is cleared with the mine to south.
Nests	None observed
Trunk scratches	None observed
Level of grazing	None

Zone 6	Date: 7/4/09

Habitat characteristic	Description
Remnant patch	Spotted Gum/Ironbark on ridge top with scattered Red Gum and Red Gum also occurring along drainage line
Regrowth/old growth	Regrowth in paddock (mostly Spotted Gum and Red Gum)
Bare ground	Minimal – mostly covered in leaf litter in remnant
Number of habitat layers	Canopy, sparse shrub and mid-storey, grass layer
Ground log abundance	Moderate in remnant / low in paddock
Hollow abundance	Low (several small hollows)
Herb grass cover	Remnant – 50% coverage, paddocks 90% coverage
Dominant tree/shrub height (m)	15-20m Eucalypts / 1-3m Acacia and regrowth Eucalypts
Regeneration occurring	Yes
Internal connectivity	No
External connectivity	Joins larger patch of remnant vegetation to the north
Nests	None observed
Trunk scratches	None observed
Level of grazing	Moderate, some patches of long grass

Zone 7	Date: 8/4/09
Habitat characteristic	Description
Remnant patch	Ironbark forest adjacent to mine
Regrowth/old growth	Regrowth
Bare ground	Leaf litter with emergent sedges
Number of habitat layers	Understorey, midstorey, canopy of Ironbark
Ground log abundance	Medium
Hollow abundance	None observed
Herb grass cover	Low, some herbs/sedges and low understorey in gully
Dominant tree/shrub height (m)	20m
Regeneration occurring	None
Internal connectivity	High – remnant all connected
External connectivity	None – surrounded by mine, road and cleared land
Nests	None observed
Trunk scratches	None observed
Level of grazing	None

Zone 8 (a)	Date: 8/4/09
Habitat characteristic	Description
Remnant patch	Along riparian zone, contains a high level of Privet
Regrowth/old growth	Mostly regrowth with some very large trees
Bare ground	Along flood zone
Number of habitat layers	Grass and canopy
Ground log abundance	Low
Hollow abundance	None observed
Herb grass cover	Some herbs covering upper river banks but predominantly bare ground on lower banks, tall grass and weed species adjoining riparian zone
Dominant tree/shrub height (m)	Trees 15 – 20m along river
Regeneration occurring	No
Internal connectivity	Vegetated along entire riparian zone
External connectivity	River connects to vegetation in the south
Nests	None observed
Trunk scratches	None observed
Level of grazing	Low, very tall grass and weeds

Zone 8 (b)	Date: 10/4/09
Habitat characteristic	Description
Remnant patch	Along river and to south
Regrowth/old growth	Regrowth
Bare ground	None
Number of habitat layers	Grassland with the occasional canopy tree
Ground log abundance	Low
Hollow abundance	None observed
Herb grass cover	Grass and bracken fern
Dominant tree/shrub height (m)	10m
Regeneration occurring	No
Internal connectivity	None
External connectivity	River connects to good vegetation in the south
Nests	None observed
Trunk scratches	None observed
Level of grazing	Low

Zone 8 (c)	Date: 7/4/09
Habitat characteristic	Description
Remnant patch	Vegetated along riparian zone, cleared elsewhere
Regrowth/old growth	Mostly regrowth, very few old trees
Bare ground	Some areas present in flood zone and on areas of erosion
Number of habitat layers	Canopy and grass/herb, small amount of mid-storey species
Ground log abundance	None
Hollow abundance	None
Herb grass cover	Herb cover under canopy, long grass in adjacent cleared areas
Dominant tree/shrub height (m)	20m
Regeneration occurring	No
Internal connectivity	Vegetated along entire riparian zone
External connectivity	River connects surrounding remnants
Nests	None observed
Trunk scratches	Some observed on one old growth tree
Level of grazing	Low

Zone 9	Date: 7/4/09
Habitat characteristic	Description
Remnant patch	No – cleared paddock with scattered trees
Regrowth/old growth	Minimal – some Red Gums and Melaleucas in drainage line
Bare ground	Very little – some areas of bare ground at base of trees
Number of habitat layers	Canopy and ground layer
Ground log abundance	Low
Hollow abundance	Low – some dead stags in paddock and old Melaleucas
Herb grass cover	95%
Dominant tree/shrub height (m)	Trees to 15m
Regeneration occurring	Minimal
Internal connectivity	No
External connectivity	Poor – large patch to east along ridgeline
Nests	None observed
Trunk scratches	None observed
Level of grazing	Moderate, grass height to 30-40cm in some areas

Appendix 6: Co-ordinates of all sites, quadrats and transects.

Site/Quadrat/Transect	Sampling location co-ordinates			
	From or Single Point		To	
Flora Quadrats	Longitude	Latitude	Longitude	Latitude
Quadrat no. Duralie (Quadrat no. Bell/ Year)				
1 (20/07)	151.9423	-32.3046		
2 (21/07)	151.9430	-32.3043		
3 (22/07)	151.9432	-32.3039		
4 (23/07)	151.9366	-32.2867		
5 (24/07)	151.9375	-32.2901		
6 (25/07)	151.9375	-32.2863		
7 (26/07)	151.9423	-32.2880		
8 (27/07)	151.9420	-32.2861		
9 (27/07)	151.9409	-32.2826		
10 (28/07)	151.9373	-32.2810		
11 (29/07)	151.9340	-32.2836		
12 (30/07)	151.9362	-32.2841		
13 (31/07)	151.9361	-32.2782		
14 (32/07)	151.9301	-32.2854		
15 (33/07)	151.9316	-32.2815		
16 (34/07)	151.9315	-32.2666		
17 (35/07)	151.9310	-32.2684		
18 (36/07)	151.9281	-32.2706		
19 (37/07)	151.9327	-32.2690		
20 (38/07)	151.9320	-32.2696		
21 (40/08)	151.9540	-32.2977		
22 (40/07)	151.9309	-32.2842		
23 (41/08)	151.9533	-32.3003		
24 (42/09)	151.9436	-32.3062		
25 (43/09)	151.9360	-32.2931		
26 (44/09)	151.9258	-32.2961		
27 (45/09)	151.9469	-32.3190		
28 (46/09)	151.9579	-32.3078		
29 (47/09)	151.9247	-32.2753		
30 (48/09)	151.9279	-32.2752		
31 (49/09)	151.9321	-32.2738		
32 (50/09)	151.9337	-32.2751		
SAT Locations				
1	151.9308	-32.2695		
2	151.9263	-32.2707		
3	151.9373	-32.2700		
4	151.9242	-32.2740		
5	151.9356	-32.2828		
6	151.9295	-32.2897		
7	151.9426	-32.3038		
8a	151.9511	-32.2852		

Site/Quadrat/Transect	Sampling location co-ordinates			
	From or Single Point		To	
SAT Locations cont.				
8b	151.9523	-32.3039		
8c	151.9452	-32.3129		
9	151.9519	-32.3082		
Trapping Transects				
TT1	151.9292	-32.2683	151.9312	-32.2715
TT2	151.9308	-32.2807	151.9301	-32.2858
TT3	151.9380	-32.2849	151.9421	-32.2868
TT4	151.9432	-32.3028	151.9420	-32.3054
TT5	151.9454	-32.3121	151.9448	-32.3140
TT6	151.9237	-32.2731	151.9252	-32.2764
HT1	151.9339	-32.2670	151.9324	-32.2682
HT2	151.9501	-32.2848	151.9510	-32.2868
HT3	151.9381	-32.2836	151.9391	-32.2857
HT4	151.9423	-32.3032	151.9422	-32.3056
Harp Traps				
H1	151.9285	-32.2707		
H2	151.9313	-32.2841		
H3	151.9405	-32.2868		
H4	151.9420	-32.3046		
Anabats				
A1	151.9302	-32.2710		
A2	151.9252	-32.2760		
A3	151.9376	-32.2811		
A4	151.9316	-32.2834		
A5	151.9263	-32.2860		
A6	151.9369	-32.2853		
A7	151.9398	-32.2849		
A8	151.9523	-32.2820		
A9	151.9407	-32.2883		
A10	151.9424	-32.3040		
A11	151.9403	-32.3047		
A12	151.9420	-32.3066		
A13	151.9515	-32.3043		
A14	151.9504	-32.3093		
A15	151.9449	-32.3132		
Bird Surveys				
B1	151.9286	-32.2710		
B2	151.9313	-32.2838		
B3	151.9406	-32.2854		
B4	151.9428	-32.3037		
B5	151.9272	-32.2812		
B6	151.9279	-32.2849		
B7	151.9259	-32.2872		
B8	151.9340	-32.3015		
B9	151.9242	-32.2736		
B10	151.9342	-32.2719		

Site/Quadrat/Transect	Sampling location co-ordinates			
	From or Single Point		To	
Bird Surveys cont.				
B11	151.9312	-32.2884		
B12	151.9518	-32.3071		
T1	151.9301	-32.2674		
T2	151.9281	-32.2688		
T3	151.9317	-32.2825		
T4	151.9368	-32.2854		
T5	151.9521	-32.3038	151.9458	-32.3062
T6	151.9522	-32.3052	151.9584	-32.3043
T7	151.9563	-32.2902	151.9560	-32.2948
T8	151.9507	-32.2819	151.9511	-32.2845
Owl Surveys				
OC1	151.9337	-32.2677		
OC2	151.9296	-32.2713		
OC3	151.9447	-32.2736		
OC4	151.9253	-32.2760		
OC5	151.9299	-32.2832		
OC6	151.9286	-32.2854		
OC7	151.9351	-32.2857		
OC8	151.9407	-32.2861		
OC9	151.9551	-32.2856		
OC10	151.9308	-32.2883		
OC11	151.9309	-32.2906		
OC12	151.9424	-32.3032		
OC13	151.9418	-32.3036		
OC14	151.9407	-32.3058		
OC15	151.9530	-32.3049		
OC16	151.9485	-32.3082		
OC17	151.9481	-32.3081		
OC18	151.9451	-32.3135		
OC19	151.9454	-32.3142		
DOS1	151.9315	-32.2667	151.9306	-32.2724
DOS2	151.9315	-32.2667	151.9335	-32.2710
DOS3	151.9313	-32.2790	151.9316	-32.2851
DOS4	151.9354	-32.2805	151.9415	-32.2882
DOS5	151.9407	-32.2863	151.9403	-32.2810
Amphibian Surveys				
Ap1	151.9258	-32.2681		
Ap2	151.9309	-32.2665		
Ap3	151.9313	-32.2669		
Ap4	151.9322	-32.2691		
Ap5	151.9317	-32.2801		
Ap6	151.9338	-32.2834		
Ap7	151.9404	-32.2811		
Ap8	151.9346	-32.2844		
Ap9	151.9353	-32.2860		
Ap10	151.9258	-32.2681		
Ap11	151.9394	-32.2856		
Ap12	151.9406	-32.2858		
Ap13	151.9386	-32.2866		
Ap14	151.9398	-32.2878		
Site/Quadrat/Transect	Sampling location co-ordinates			

	From or Single Point		To	
Amphibian Surveys cont.				
Ap15	151.9416	-32.2872		
Ap16	151.9539	-32.2944		
Ap17	151.9612	-32.2975		
AS1	151.9278	-32.2651	151.9261	-32.2686
AS2a	151.9321	-32.2657	151.9306	-32.2724
AS2b	151.9315	-32.2667	151.9335	-32.2710
AS3	151.9317	-32.2796	151.9311	-32.2848
AS4a	151.9353	-32.2803	151.9415	-32.2882
AS4b	151.9407	-32.2863	151.9402	-32.2809
AS4c	151.9415	-32.2882	151.9356	-32.2872
AS4d	151.9410	-32.2879	151.9383	-32.2886
AS5	151.9461	-32.2808	151.9506	-32.2856
AS6a	151.9464	-32.3020	151.9430	-32.3249
AS6b	151.9462	-32.3044	151.9529	-32.3038
AS6c	151.9432	-32.3084	151.9399	-32.3075
Reptile Surveys				
R1	151.9258	-32.2681		
R2	151.9309	-32.2665		
R3	151.9313	-32.2669		
R4	151.9322	-32.2691		
R5	151.9293	-32.2706		
R6	151.9378	-32.2695		
R7	151.9384	-32.2747		
R8	151.9317	-32.2801		
R9	151.9404	-32.2811		
R10	151.9314	-32.2834		
R11	151.9325	-32.2875		
R12	151.9300	-32.2890		
R13	151.9394	-32.2856		
R14	151.9406	-32.2858		
R15	151.9386	-32.2866		
R16	151.9416	-32.2872		
R17	151.9398	-32.2878		
R18	151.9609	-32.2928		
R19	151.9620	-32.2978		
R20	151.9427	-32.3039		
R21	151.9552	-32.3060		

Appendix 7: Flora Quadrat Data (species per quadrat)

Cover Abundance Scale calculated as:
1 = few individuals / less than 1% cover
2 = cover between 1-5%
3 = cover between 6-25%
4 = cover between 26-50%
5 = cover between 51-75%
6 = cover between 76-100%

Job Gloucester Coal			Date 2-5-07		
Quadrat: 1 (20/07)					
Species		CA	Species		CA
1	*Eucalyptus acmenoides*	5			
2	*Eucalyptus crebra*	3			
3	*Eucalyptus carnea*	3			
4	*Melaleuca nodosa*	6			
5	*Themeda australis*	3			
6	*Imperata cylindrica var. major*	3			
7	*Panicum simile*	3			
8	*Pomax umbellata*	2			
9	*Dianella longifolia*	2			
10	*Pratia purpurascens*	2			
11	*Lagenifera stipitata*	2			
12	*Glycine microphylla*	2			
13	*Lomandra longifolia*	2			
14	*Lindsaea linearis*	2			
15	*Entolasia marginata*	2			
16	*Hibbertia diffusa*	2			
17	*Acacia irrorata subsp irrorata*	2			
18	*Acacia ulicifolia*	1			
19	*Lepidosperma laterale*	1			
20	*Echinopogan caespitosus*	1			
21	*Notelaea longifolia*	1			
22	*Parsonsia straminea*	2			
23	*Breynia oblongifolia*	1			
24	*Dichondra repens*	2			
25	*Chiloglottis diphylla*	2			
26	*Leucopogon juniperinus*	2			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 2 (21/07)					
Species		CA	Species		**CA**
1	*Angophora floribunda*	4			
2	*Melaleuca nodosa*	6			
3	*Parsonsia straminea*	3			
4	*Pratia purpurascens*	3			
5	*Dichondra repens*	2			
6	*Glycine microphylla*	2			
7	*Entolasia marginata*	3			
8	*Lomandra longifolia*	2			
9	*Acacia ulicifolia*	2			
10	*Imperata cylindrica var. major*	2			
11	*Panicum simile*	2			
12	*Breynia oblongifolia*	2			
13	*Hibbertia diffusa*	2			
14	*Notelaea longifolia*	1			
15	*Lepidosperma laterale*	2			
16	*Aristida ramosa var. ramosa*	2			
17	*Pomax umbellata*	1			
18	*Amyema miquelii*	1			
19	*Zieria smithii*	2			
20	*Gonocarpus tetragynus*	2			
21	*Leucopogon juniperinus*	2			
22	*Chiloglottis diphylla*	2			
23	*Eucalyptus eugenioides*	4			
24	*Digitaria parviflora*	1			
25	*Poa affinis*	2			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 3 (22/07)					
Species		CA	Species		**CA**
1	*Angophora floribunda*	5			
2	*Eucalyptus eugenioides*	3			
3	*Melaleuca linariifolia*	4			
4	*Eucalyptus fibrosa*	2			
5	*Eucalyptus microcorys*	2			
6	*Leptospermum polygalifolium subsp.*	5			
7	*Callistemon salignus*	3			
8	*Parsonsia straminea*	4			
9	*Pteridium esculentum*	2			
10	*Imperata cylindrica var. major*	5			
11	*Pratia purpurascens*	3			
12	*Lindsaea linearis*	3			
13	*Entolasia marginata*	4			
14	*Gonocarpus tetragynus*	2			
15	*Hibbertia diffusa*	2			
16	*Oplismenus imbecillis*	2			
17	*Viola hederacea*	2			
18	*Lomandra longifolia*	2			
19	*Breynia oblongifolia*	2			
20	*Melaleuca nodosa*	3			
21	*Oxalis exilis*	2			
22	*Dichondra repens*	2			
23	*Carex appressa*	3			
24	*Hibbertia dentata*	1			
25	*Backhousia myrtifolia*	1			
26	*Baloghia inophylla*	1			
27	*Zieria smithii*	2			
28	*Notelaea longifolia*	2			
29	*Desmodium varians*	2			
30	*Glycine microphylla*	2			
31	*Eucalyptus acmenoides*	3			
32	*Ozothamnus diosmifolius*	2			
33	*Geitonoplesium cymosum*	1			
34	*Hydrocotyl peduncularis*	3			
35	*Galium propinquum*	3			
36	*Poa affinis*	2			
37	*Leucopogon juniperinus*	2			
38	*Pittosporum revolutum*	1			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 4 (23/07)					
Species		CA	Species		**CA**
1	*Eucalyptus tereticornis*	4			
	Eucalyptus amplifolia subsp amplifolia	2			
2	*Eucalyptus molucanna*	5			
3	*Acacia irrorata subsp irrorata*	4			
4	*Imperata cylindrica var. major*	5			
5	*Themeda australis*	4			
6	*Axonopus fissifolius**	4			
7	*Pratia purpurascens*	3			
8	*Dichondra repens*	2			
9	*Plantago lanceolata**	2			
10	*Paspalum dilatatum**	3			
11	*Geranium solanderi var solanderi*	2			
12	*Opercularia diphylla*	2			
13	*Desmodium varians*	2			
14	*Gonocarpus teucrioides*	2			
15	*Oxalis exilis*	2			
16	*Lomandra longifolia*	1			
17	*Pseuderanthemum variabile*	2			
18	*Phyllanthus gunnii*	2			
19	*Microlaena stipoides*	3			
20	*Carex appressa*	2			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 5 (24/07)					
Species		CA	Species		**CA**
1	*Eucalyptus molucanna*	4			
2	*Eucalyptus siderophloia*	4			
3	*Eucalyptus globoidea*	4			
4	*Eucalyptus tereticornis*	3			
5	*Microlaena stipoides var stipoides*	5			
6	*Imperata cylindrica var. major*	3			
7	*Pratia purpurascens*	3			
8	*Dichondra repens*	2			
9	*Oplismenus imbecillis*	3			
10	*Opercularia diphylla*	2			
11	*Einadia trigonos subsp. leiocarpa*	2			
12	*Veronica plebeia*	2			
13	*Plectranthus parviflorus*	2			
14	*Oxalis exilis*	2			
15	*Acacia decurrens*	1			
16	*Themeda australis*	2			
17	*Echinopogan caespitosus*	2			
18	*Cymbopogon refractus*	2			
19	*Acacia ulicifolia*	2			
20	*Lindsaea linearis*	2			
21	*Vittadinia cuneata*	2			
22	*Juncus usitatus*	1			
23	** Cyperus eragrostis*	3			
24	*Commelina cyanea*	3			
25	** Sida rhombifolia*	2			
26	*Solanum prinophyllum*	2			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 6 (25/07)					
Species		CA	Species		CA
1	*Eucalyptus tereticornis*	4	20	*Polyscias sambucifolia*	2
2	*Casuarina cunninghamia*	4	21	*Eustrephus latifolius*	1
3	*Angophora floribunda*	3	22	*Pteridium esculentum*	2
4	*Acacia decurrens*	3	23	*Setaria pumilla**	2
5	*Glycine clandestina*	2	24	*Geitonoplesium cymosum*	2
6	*Paspalum dilatatum**	6	25	*Carex appressa*	3
7	*Lomandra longifolia*	3	26	*Pennisetum alopecuroides*	2
8	*Verbena rigida**	3	27	*Digitaria parviflora*	2
9	*Xanthium occidentale**	2	28	*Ranunculus lappaceus*	2
10	*Pratia purpurascens*	4	29	*Adiantum aethiopicum*	3
11	*Echinopogan ovatus*	2	30	*Notelaea longifolia*	2
12	*Trifolium repens**	2	31	*Calochlaena dubia*	2
13	*Viola hederacea*	2	32	*Pandorea pandorana*	2
14	*Plantago lanceolata**	2	33	*Hypolepis grandulifera*	2
15	*Clematis aristata*	2	34	*Blechnum cartilagineum*	2
16	*Oplismenus imbecillis*	3	35	*Pseuderanthemum variabile*	2
17	*Opercularia diphylla*	2	36	*Pittosporum revolutum*	2
18	*Geranium solanderi var solanderi*	2	37	*Solanum prinophyllum*	2
19	*Glochidion ferdinandi var. ferdinandi*	1			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 7(26/07)					
Species		CA	Species		CA
1	*Eucalyptus siderophloia*	5			
	Eucalyptus fibrosa	2			
2	*Eucalyptus tereticornis*	4			
	Eucalyptus amplifolia subsp	2			
3	*Eucalyptus acmenoides*	4			
4	*Leucopogon juniperinus*	3			
5	*Themeda australis*	5			
6	*Aristida vagans*	3			
7	*Microlaena stipoides var stipoides*	3			
8	*Glycine clandestina*	2			
9	*Imperata cylindrica var. major*	3			
10	*Pimelea linifolia subsp. linifolia*	2			
11	*Gonocarpus tetragynus*	2			
12	*Lagenifera stipitata*	2			
13	*Acacia ulicifolia*	1			
14	*Acacia irrorata subsp irrorata*	1			
15	*Allocasuarina torulosa*	1			
16	*Lindsaea linearis*	2			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 8 (27/07)					
Species		CA	Species		CA
1	*Eucalyptus tereticornis*	5			
2	*Eucalyptus acmenoides*	3			
3	*Eucalyptus molucanna*	3			
4	*Imperata cylindrica var. major*	6			
5	*Themeda australis*	3			
6	*Acacia irrorata subsp irrorata*	2			
7	*Pratia purpurascens*	3			
8	*Entolasia marginata*	2			
9	*Dichondra repens*	2			
10	*Paspalum dilatatum**	3			
11	*Verbena rigida**	2			
12	*Pimelea linifolia subsp. linifolia*	1			
13	*Gonocarpus tetragynus*	2			
14	*Axonopus fissifolius**	3			
15	*Digitaria parviflora*	2			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 9 (28/07)					
Species		CA	Species		CA
1	*Eucalyptus tereticornis*	4			
2	*Angophora floribunda*	4			
3	*Melaleuca linariifolia*	5			
4	*Imperata cylindrica var. major*	6			
5	*Lomandra longifolia*	3			
6	*Gonocarpus tetragynus*	3			
7	*Pennisetum alopecuroides*	3			
8	*Acacia decurrens*	2			
9	*Themeda australis*	3			
10	*Hibbertia diffusa*	2			
11	*Pimelea linifolia subsp. linifolia*	2			
12	*Glycine tabacina*	2			

Job Gloucester Coal			Date 2-5-07		
Quadrat: 10 (29/07)					
Species		CA	Species		CA
1	*Eucalyptus carnea*	6	17	*Andropogon virginicus**	3
2	*Eucalyptus siderophloia*	3	18	*Oxalis exilis*	2
3	*Acacia melanoxylon*	1	19	*Pimelea linifolia subsp. linifolia*	1
4	*Breynia oblongifolia*	1	20	*Acacia myrtifolia*	2
5	*Acacia ulicifolia*	2	21	*Desmodium varians*	2
6	*Leucopogon juniperinus*	3	22	*Bossiaea prostrata*	2
7	*Acacia longissima*	1	23	*Hibbertia diffusa*	2
8	*Imperata cylindrica var. major*	3	24	*Echinopogan caespitosus*	2
9	*Themeda australis*	5	25	*Pomax umbellata*	2
10	*Panicum simile*	3	26	*Pratia purpurascens*	2
11	*Dichondra repens*	2	27	*Aristida vagans*	2
12	*Lagenifera stipitata*	2	28	*Austrodanthonia tenuior*	1
13	*Hypochaeris radicata**	2	29	*Lomandra filiformis subsp. filiformis*	1
14	*Billardiera scandens var. scandens*	2	30	*Lindsaea linearis*	2
15	*Glycine microphylla*	2	31	*Dichelachne micrantha*	1
16	*Tricoryne simplex*	1	32	*Brachycome multifida var multifida*	2

Job Gloucester Coal			Date 2-5-07		
Quadrat: 11 (30/07)					
Species		CA	Species		CA
1	*Eucalyptus acmenoides*	5	16	*Aristida vagans*	3
2	*Eucalyptus carnea*	4	17	*Digitaria parviflora*	2
3	*Corymbia maculata*	5	18	*Oxalis exilis*	1
4	*Acacia longissima*	2	19	*Pratia purpurascens*	2
5	*Opercularia diphylla*	2	20	*Notelaea longifolia*	2
6	*Imperata cylindrica var. major*	5	21	*Eucalyptus crebra*	2
7	*Acacia ulicifolia*	2	22	*Lindsaea linearis*	2
8	*Pultenaea villosa*	2	23	*Glycine clandestina*	2
9	*Daviesia genistifolia*	2	24	*Leucopogon juniperinus*	2
10	*Desmodium varians*	2	25	*Rubus rosifolius*	3
11	*Hibbertia diffusa*	2	26	*Solanum nigrum**	1
12	*Microlaena stipoides var stipoides*	2			
13	*Panicum simile*	2			
14	*Axonopus fissifolius**	2			
15	*Themeda australis*	3			

Job Gloucester Coal			Date 3-5-07		
Quadrat: 12 (31/07)					
Species		CA	Species		CA
1	*Eucalyptus tereticornis*	5			
2	*Eucalyptus fibrosa*	4			
3	*Themeda australis*	5			
4	*Microlaena stipoides var stipoides*	3			
5	*Imperata cylindrica var. major*	3			
6	*Paspalum dilatatum**	3			
7	*Entolasia stricta*	4			
8	*Dichondra repens*	2			
9	*Billardiera scandens var. scandens*	2			
10	*Clematis aristata*	3			
11	*Glycine clandestina*	2			
12	*Caesia parviflora var. parviflora*	1			
13	*Panicum simile*	2			
14	*Echinopogan caespitosus*	2			

Job Gloucester Coal			Date 3-5-07		
Quadrat: 13 (32/07)					
Species		CA	Species		CA
1	*Corymbia maculata*	6			
2	*Eucalyptus acmenoides*	3			
3	*Eucalyptus fibrosa*	2			
4	*Microlaena stipoides var stipoides*	3			
5	*Imperata cylindrica var. major*	3			
6	*Paspalum dilatatum**	3			
7	*Entolasia stricta*	4			
8	*Dichondra repens*	2			
9	*Billardiera scandens var. scandens*	2			
10	*Clematis aristata*	3			
11	*Themeda australis*	2			
12	*Glycine clandestina*	2			
13	*Parsonsia straminea*	2			
14	*Eucalyptus globoidea*	2			
15	*Eucalyptus crebra*	2			
16	*Caesia parviflora var. parviflora*	1			
17	*Panicum simile*	2			
18	*Echinopogan caespitosus*	2			
19	*Solanum prinophyllum*	2			
20	*Digitaria parviflora*	2			

Job Gloucester Coal			Date 3-5-07		
Quadrat: 14 (33/07)					
Species		CA	Species		CA
1	*Corymbia maculata*	3		Disturbed site	
2	*Eucalyptus fibrosa*	3			
3	*Eucalyptus punctata*	5			
4	*Eucalyptus carnea*	4			
5	*Leucopogon juniperinus*	4			
6	*Acacia irrorata subsp irrorata*	2			
7	*Imperata cylindrica var. major*	3			
8	*Themeda australis*	5			
9	*Glycine clandestina*	2			
10	*Pomax umbellata*	2			
11	*Sporobolus virginicus**	2			

Job Gloucester Coal			Date 3-5-07		
Quadrat: 15 (34/07)					
Species		CA	Species		CA
1	*Eucalyptus punctata*	5	15	*Geitonoplesium cymosum*	2
2	*Eucalyptus carnea*	4	16	*Viola hederacea*	2
3	*Acacia irrorata subsp irrorata*	4	17	*Lomandra longifolia*	2
4	*Imperata cylindrica var. major*	5	18	*Hibbertia linearis*	1
5	*Clematis aristata*	2	19	*Opercularia diphylla*	2
6	*Dichondra repens*	3	20	*Adiantum hispidulum*	2
7	*Pratia purpurascens*	4	21	*Oplismenus imbecillis*	3
8	*Leucopogon juniperinus*	3	22	*Solanum prinophyllum*	1
9	*Acacia ulicifolia*	2			
10	*Pennisetum alopecuroides*	3			
11	*Doodia aspera*	2			
12	*Acacia melanoxylon*	2			
13	*Desmodium varians*	2			
14	*Pandorea pandorana subsp. pandorana*	2			

Job Gloucester Coal			Date 3-5-07		
Quadrat: 16 (35/07)					
Species		CA	Species		CA
1	*Eucalyptus acmenoides*	4	20	*Leucopogon juniperinus*	2
2	*Melaleuca styphelioides*	5	21	*Maytenus silvestris*	2
3	*Angophora floribunda*	4	22	*Dichondra repens*	2
4	*Callistemon salignus*	4	23	*Notelaea longifolia*	2
5	*Alphitonia excelsa*	2	24	*Duboisia myoporoides*	2
6	*Gahnia clarkei*	3	25	*Pandorea pandorana subsp. pandorana*	2
7	*Melia azedarach*	1	26	*Trema tomentosa var. viridis*	2
8	*Breynia oblongifolia*	3	27	*Pennisetum alopecuroides*	2
9	*Imperata cylindrica var. major*	3	28	*Opercularia diphylla*	2
10	*Themeda australis*	4	29	*Vittadinia cuneata*	1
11	*Geitonoplesium cymosum*	2	30	*Hibbertia diffusa*	1
12	*Adiantum aethiopicum*	5	31	*Digitaria parviflora*	3
13	*Pteridium esculentum*	2	32	*Chiloglottis diphylla*	2
14	*Entolasia stricta*	2	33	*Pittosporum revolutum*	2
15	*Lagenifera stipitata*	2	34	*Rubus rosifolius var rosifolius*	2
16	*Doodia aspera*	2			
17	*Zieria smithii*	2			
18	*Clematis aristata*	2			
19	*Parsonsia straminea*	2			

Job Gloucester Coal			Date 3-5-07		
Quadrat: 17 (36/07)					
Species		CA	Species		CA
1	*Eucalyptus tereticornis*	5			
2	*Eucalyptus fibrosa*	4			
3	*Imperata cylindrica var. major*	5			
4	*Aristida vagans*	5			
5	*Cymbopogon refractus*	4			
6	*Leucopogon juniperinus*	3			
7	*Tricoryne simplex*	2			
8	*Boronia polygalifolia*	2			
9	*Entolasia stricta*	3			
10	*Dichelachne crinata*	2			
11	*Eragrostis brownii*	2			
12	*Austrodanthonia tenuior*	2			

Job Gloucester Coal			Date 4-5-07		
Quadrat: 18 (37/07)					
Species		CA	Species		**CA**
1	*Pseuderanthemum variabile*	1			
2	*Lagenifera stipitata*	1			
3	*Lepidosperma laterale*	1			
4	*Glochidion ferdinandi var. ferdinandi*	1			
5	*Desmodium brachypodum*	1			
6	*Glycine clandestina*	1			
7	*Glycine microphylla*	1			
8	*Gompholobium inconspicuum*	1			
9	*Pultenaea villosa*	1			
10	*Acacia falcata*	1			
11	*Pratia purpurascens*	1			
12	*Lomandra longifolia*	1			
13	*Lomandra multiflora subsp. multiflora*	1			
14	*Dianella longifolia var. longifolia*	1			
15	*Dianella tasmanica*	1			
16	*Eragrostis leptostachya*	1			
17	*Pomax umbellata*	1			
18	*Cheilanthes sieberi subsp. sieberi*	2			
19	*Hibbertia serpyllifolia*	2			
20	*Leucopogon juniperinus*	2			
21	*Phyllanthus hirtellus*	2			
22	*Daviesia ulicifolia*	2			
23	*Podolobium scandens*	2			
24	*Acacia ulicifolia*	2			
25	*Lomandra confertifolia subsp. rubiginosa*	2			
26	*Aristida vagans*	2			
27	*Imperata cylindrica var. major*	2			
28	*Pimelea linifolia subsp. linifolia*	2			
29	*Lomandra glauca*	3			
30	*Corymbia maculata*	3			
31	*Entolasia stricta*	3			
32	*Eucalyptus carnea*	4			
33	*Eucalyptus fibrosa*	4			

Job Gloucester Coal			Date 4.05.2007		
Quadrat: 19 (38/07)					
Species		CA	Species		**CA**
1	*Imperata cylindrica*	4			
2	*Eucalyptus tereticornis*	4			
3	*Themeda australis*	3			
4	*Leucopogon juniperinus*	3			
5	*Eucalyptus globoidea*	3			
6	*Eragrostis leptostachya*	3			
7	*Aristida vagans*	3			
8	*Acacia implexa*	3			
9	*Vittadenia cunneata*	2			
10	*Viola hederacea*	2			
11	*Tricoryne simplex*	2			
12	*Pratia purpurascens*	2			
13	*Poranthera microphylla*	2			
14	*Polymeria calycina*	2			
15	*Panicum simile*	2			
16	*Ozothamnus diosmifolius*	2			
17	*Oxalis exilis*	2			
18	*Opercularia diphylla*	2			
19	*Lagenifera stipitata*	2			
20	*Hypochaeris radicata**	2			
21	*Hypericum gramineum*	2			
22	*Glycine clandestina*	2			
23	*Fimbristylis dichotoma*	2			
24	*Exocarpos cupressiformis*	2			
25	*Entolasia stricta*	2			
26	*Echinopogan caespitosus*	2			
27	*Dichelachne micrantha*	2			
28	*Desmodium varians*	2			
29	*Cheilanthes sieberi subsp. sieberi*	2			
30	*Brunoniella australis*	2			
31	*Breynia oblongifolia*	2			
32	*Billardiera scandens var. scandens*	2			
33	*Austrodanthonia tenuior*	2			
34	*Cassinia quinquefaria*	1			

Job Gloucester Coal			Date 4-5-07		
Quadrat: 20 (39/07)					
Species		CA	Species		**CA**
1	*Eucalyptus tereticornis*	5	39	*Entolasia marginata*	2
2	*Acacia implexa*	4	40	*Cassinia quinquefaria*	1
3	*Imperata cylindrica*	3	41	*Hibbertia serpyllifolia*	1
4	*Themeda australis*	3			
5	*Leucopogon juniperinus*	3			
6	*Aristida vagans*	3			
7	*Acacia irrorata subsp irrorata*	2			
8	*Viola hederacea*	2			
9	*Echinopogan caespitosus*	2			
10	*Tricoryne simplex*	2			
11	*Pratia purpurascens*	2			
12	*Polymeria calycina*	2			
13	*Panicum simile*	2			
14	*Hypericum gramineum*	2			
15	*Glycine clandestina*	2			
16	*Desmodium varians*	2			
17	*Cheilanthes sieberi subsp. sieberi*	2			
18	*Austrodanthonia tenuior*	2			
19	*Pomax umbellata*	2			
20	*Oplismenus imbecillis*	2			
21	*Microlaena stipoides var stipoides*	2			
22	*Lomandra glauca*	2			
23		2			
24	*Eucalyptus globoidea*	2			
25	*Oxalis exilis*	2			
26	*Lagenifera stipitata*	2			
27	*Hypochaeris radicata**	2			
28	*Entolasia stricta*	2			
29	*Brunoniella australis*	2			
30	*Breynia oblongifolia*	2			
31	*Billardiera scandens var. scandens*	2			
32	*Stackhousia viminea*	2			
33	*Pimelea linifolia subsp. linifolia*	2			
34	*Lepidosperma laterale*	2			
35	*Laxmannia gracilis*	2			
36	*Glycine microphylla*	2			
37	*Gahnia sieberiana*	2			
38	*Eucalyptus fibrosa*	2			

Job Gloucester Coal			Date 19.09.2008		
Quadrat: 21 (40/08)					
Species		CA	Species		CA
1	*Melaleuca nodosa*	5	39	*Facelis retusa**	1
2	*Leptospermum polygalifolium subsp.*	5	40	*Euchiton gymnocephalus*	1
3	*Eucalyptus carnea*	4	41	*Dianella caerulea*	1
4	*Eucalyptus acmenoides*	4	42	*Clematis aristata*	1
5	*Microlaena stipoides var stipoides*	3	43	*Cissus antarctica*	1
6	*Zieria smithii*	3	44	*Callistemon salignus*	1
7	*Imperata cylindrica*	2	45	*Banksia spinulosa var. collina*	1
8	*Leucopogon juniperinus*	2	46	*Andropogon virginicus**	1
9	*Pratia purpurascens*	2			
10	*Cheilanthes sieberi subsp. sieberi*	2			
11	*Oplismenus imbecillis*	2			
12	*Entolasia stricta*	2			
13	*Gonocarpus teucrioides*	2			
14	*Lomandra longifolia*	2			
15	*Ozothamnus diosmifolius*	2			
16	*Pultenaea villosa*	2			
17	*Ligustrum sinense**	2			
18	*Hibbertia aspera*	2			
19	*Eucalyptus resinifera*	2			
20	*Adiantum aethiopicum*	2			
21	*Acacia ulicifolia*	2			
22	*Themeda australis*	1			
23	*Viola hederacea*	1			
24	*Hypericum gramineum*	1			
25	*Lagenifera stipitata*	1			
26	*Hypochaeris radicata**	1			
27	*Breynia oblongifolia*	1			
28	*Billardiera scandens var. scandens*	1			
29	*Pimelea linifolia subsp. linifolia*	1			
30	*Glycine microphylla*	1			
31	*Entolasia marginata*	1			
32	*Kennedia rubicunda*	1			
33	*Poranthera microphylla*	1			
34	*Senecio madagascariensis**	1			
35	*Pteridium esculentum*	1			
36	*Oxalis perennans*	1			
37	*Hibbertia scandens*	1			
38	*Gahnia sp.*	1			

Job Gloucester Coal			Date 4-5-07		
Quadrat: 22 (40/07)					
Species		CA	Species		**CA**
1	*Imperata cylindrica*	4			
2	*Eucalyptus tereticornis*	4			
3	*Carex longebrachiata*	4			
4	*Acacia irrorata subsp irrorata*	4			
5	*Themeda australis*	3			
6	*Viola hederacea*	3			
7	*Echinopogan caespitosus*	3			
8	*Eucalyptus carnea*	3			
9	*Leucopogon juniperinus*	2			
10	*Tricoryne simplex*	2			
11	*Pratia purpurascens*	2			
12	*Polymeria calycina*	2			
13	*Panicum simile*	2			
14	*Opercularia diphylla*	2			
15	*Hypericum gramineum*	2			
16	*Glycine clandestina*	2			
17	*Desmodium varians*	2			
18	*Cheilanthes sieberi subsp. sieberi*	2			
19	*Austrodanthonia tenuior*	2			
20	*Verbena bonariensis**	2			
21	*Pseuderanthemum variabile*	2			
22	*Pomax umbellata*	2			
23	*Oplismenus imbecillis*	2			
24	*Microlaena stipoides var stipoides*	2			
25	*Hydrocotyl peduncularis*	2			
26	*Hibbertia riparia*	2			
27	*Gonocarpus teucrioides*	2			
28	*Eucalyptus canaliculata*	2			
29	*Clematis glycinoides*	2			
30	*Exocarpos cupressiformis*	1			
31	*Lomandra longifolia*	1			
32	*Lomandra glauca*	1			
33	*Kennedia rubicunda*	1			

Job Gloucester Coal			Date 19.09.2008		
Quadrat: 23 (41/08)					
Species		CA	Species		CA
1	*Melaleuca nodosa*	5	39	*Notelaea longifolia*	1
2	*Microlaena stipoides var stipoides*	5	40	*Juncus usitatus*	1
3	*Eucalyptus amplifolia subsp. amplifolia*	5	41	*Geitonoplesium cymosum*	1
4	*Melaleuca decora*	3	42	*Galium propinquum*	1
5	*Dichondra repens*	3	43	*Acacia floribunda*	1
6	*Pratia purpurascens*	2			
7	*Oplismenus imbecillis*	2			
8	*Entolasia stricta*	2			
9	*Gonocarpus teucrioides*	2			
10	*Lomandra longifolia*	2			
11	*Ozothamnus diosmifolius*	2			
12	*Eucalyptus resinifera*	2			
13	*Lagenifera stipitata*	2			
14	*Hypochaeris radicata**	2			
15	*Entolasia marginata*	2			
16	*Kennedia rubicunda*	2			
17	*Senecio madagascariensis**	2			
18	*Pteridium esculentum*	2			
19	*Oxalis perennans*	2			
20	*Euchiton gymnocephalus*	2			
21	*Cissus antarctica*	2			
22	*Callistemon salignus*	2			
23	*Pseuderanthemum variabile*	2			
24	*Hydrocotyl peduncularis*	2			
25	*Parsonsia straminea*	2			
26	*Hydrocotyle tripartita*	2			
27	*Daucus glochidiatus*	2			
28	*Cerastium glomeratum*	2			
29	*Carex appressa*	2			
30	*Leptospermum polygalifolium subsp.*	1			
31	*Hibbertia aspera*	1			
32	*Breynia oblongifolia*	1			
33	*Glycine microphylla*	1			
34	*Acacia irrorata subsp irrorata*	1			
35	*Exocarpos cupressiformis*	1			
36	*Stachys arvensis**	1			
37	*Pittosporum undulatum*	1			
38	*Pandorea pandorana*	1			

Job Gloucester Coal			Date 24.04.2009		
Quadrat: 24 (42/09)					
Species		CA	Species		CA
1	*Eucalyptus amplifolia subsp. amplifolia*	4	39	*Cymbopogon refractus*	1
2	*Entolasia marginata*	4	40	*Conzya sp.**	1
3	*Imperata cylindrica*	4	41	*Cirsium vulgare**	1
4	*Pratia purpurascens*	3			
5	*Pseuderanthemum variabile*	3			
6	*Microlaena stipoides var stipoides*	2			
7	*Entolasia stricta*	2			
8	*Hypochaeris radicata**	2			
9	*Senecio madagascariensis**	2			
10	*Juncus usitatus*	2			
11	*Adiantum aethiopicum*	2			
12	*Poranthera microphylla*	2			
13	*Andropogon virginicus**	2			
14	*Glycine clandestina*	2			
15	*Eucalyptus globoidea*	2			
16	*Oxalis exilis*	2			
17	*Opercularia diphylla*	2			
18	*Verbena bonariensis**	2			
19	*Lomandra filiformis subsp. filiformis*	2			
20	*Eragrostis brownii*	2			
21	*Echinopogan ovatus*	2			
22	*Commelina cyanea*	2			
23	*Axonopus fissifolius**	2			
24	*Ozothamnus diosmifolius*	1			
25	*Euchiton gymnocephalus*	1			
26	*Breynia oblongifolia*	1			
27	*Desmodium varians*	1			
28	*Trema tomentosa var. viridis*	1			
29	*Solanum mauritianum**	1			
30	*Poa annua*	1			
31	*Pennisetum villosum*	1			
32	*Oplismenus aemulus*	1			
33	*Juncus bufonius*	1			
34	*Geranium homeanum*	1			
35	*Einadia trigonos subsp. leiocarpa*	1			
36	*Dianella longifolia*	1			
37	*Cyperus congestus**	1			
38	*Cyperus brevifolius**	1			

Job Gloucester Coal			Date 29.04.2009		
Quadrat: 25 (43/09)					
Species		CA	Species		**CA**
1	*Axonopus fissifolius**	4			
2	*Sporobolus elongatus*	4			
3	*Capillipedium parviflorum*	3			
4	*Paspalum dilatatum**	3			
5	*Imperata cylindrica*	2			
6	*Hypochaeris radicata**	2			
7	*Verbena bonariensis**	2			
8	*Cyperus brevifolius**	2			
9	*Themeda australis*	2			
10	*Bothriochloa macra*	2			
11	*Desmodium brachypodum*	2			
12	*Eragrostis curvula**	2			
13	*Goodenia paniculata*	2			
14	*Lotus australis*	2			
15	*Panicum capillare**	2			
16	*Plantago lanceolata**	2			
17	*Trifolium fragiferum**	2			
18	*Senecio madagascariensis**	1			
19	*Cirsium vulgare**	1			
20	*Conzya sp.**	1			
21	*Cyperus congestus**	1			
22	*Pennisetum villosum*	1			
23	*Aster subulatus**	1			
24	*Cynosurus echinatus*	1			
25	*Euchiton collinus**	1			
26	*Fimbristylis dichotoma*	1			
27	*Spiranthes sinensis*	1			

Job Gloucester Coal			Date 29.04.2009		
Quadrat: 26 (44/09)					
Species		CA	Species		CA
1	*Corymbia maculata*	4	39	*Cheilanthes sieberi subsp. sieberi*	1
2	*Eucalyptus carnea*	3	40	*Hibbertia scandens*	1
3	*Imperata cylindrica*	2	41	*Pomax umbellata*	1
4	*Verbena bonariensis**	2	42	*Lepidosperma laterale*	1
5	*Pratia purpurascens*	2	43	*Austrodanthonia fulva*	1
6	*Entolasia stricta*	2	44	*Brachyscome*	1
7	*Glycine clandestina*	2	45	*Clematis aristata*	1
8	*Opercularia diphylla*	2	46	*Conyza bonariensis**	1
9	*Eragrostis brownii*	2	47	*Daviesia ulicifolia*	1
10	*Desmodium varians*	2	48	*Dianella tasmanica*	1
11	*Cymbopogon refractus*	2	49	*Dichelachne crinita*	1
12	*Dichondra repens*	2	50	*Lilium formosanum**	1
13	*Acacia ulicifolia*	2	51	*Maytenus silvestris*	1
14	*Hypericum gramineum*	2	52	*Viminaria juncea*	1
15	*Panicum simile*	2	53	*Vittadenia cunneata*	1
16	*Clematis glycinoides*	2			
17	*Eucalyptus canaliculata*	2			
18	*Lomandra glauca*	2			
19	*Eucalyptus siderophloia*	2			
20	*Aristida vagans*	2			
21	*Desmodium rhytidophyllum*	2			
22	*Euchiton sphaericus**	2			
23	*Goodenia heterophylla subsp. heterophylla*	2			
24	*Hardenbergia violacea*	2			
25	*Hibbertia obtusifolia*	2			
26	*Lomandra confertifolia subsp. rubiginosa*	2			
27	*Phyllanthus hirtellus*	2			
28	*Podolobium ilicifolium*	2			
29	*Paspalum dilatatum**	1			
30	*Cirsium vulgare**	1			
31	*Conzya sp.**	1			
32	*Andropogon virginicus**	1			
33	*Oxalis exilis*	1			
34	*Dianella longifolia*	1			
35	*Oplismenus imbecillis*	1			
36	*Kennedia rubicunda*	1			
37	*Hibbertia aspera*	1			
38	*Geitonoplesium cymosum*	1			

Job Gloucester Coal			Date 29.04.2009		
Quadrat: 27 (45/09)					
Species		CA	Species		CA
1	*Axonopus fissifolius**	5	39	*Setaria sphacelata**	1
2	*Sporobolus elongatus*	3	40	*Targetes minuta**	1
3	*Cyperus brevifolius**	3	41	*Taraxacum officinale**	1
4	*Themeda australis*	3	42	*Wahlenbergia gracilis*	1
5	*Microlaena stipoides var stipoides*	3	43	*Wahlenbergia planiflora*	1
6	*Cynodon dactylon*	3			
7	*Glycine clandestina*	2			
8	*Cymbopogon refractus*	2			
9	*Dichondra repens*	2			
10	*Acacia ulicifolia*	2			
11	*Euchiton sphaericus**	2			
12	*Hypochaeris radicata**	2			
13	*Eragrostis curvula**	2			
14	*Plantago lanceolata**	2			
15	*Pennisetum villosum*	2			
16	*Fimbristylis dichotoma*	2			
17	*Gonocarpus teucrioides*	2			
18	*Pteridium esculentum*	2			
19	*Tricoryne simplex*	2			
20	*Cheilanthes distans*	2			
21	*Eragrostis cilianensis**	2			
22	*Rubus parvifolius*	2			
23	*Imperata cylindrica*	1			
24	*Verbena bonariensis**	1			
25	*Pratia purpurascens*	1			
26	*Entolasia stricta*	1			
27	*Desmodium varians*	1			
28	*Panicum simile*	1			
29	*Paspalum dilatatum**	1			
30	*Cirsium vulgare**	1			
31	*Conzya sp.**	1			
32	*Cyperus congestus**	1			
33	*Juncus usitatus*	1			
34	*Geranium homeanum*	1			
35	*Daucus glochidiatus*	1			
36	*Anangallis arvensis**	1			
37	*Eucalyptus crebra*	1			
38	*Euchiton sp.**	1			

Job Gloucester Coal			Date 29.04.2009		
Quadrat: 28 (46/09)					
Species		CA	Species		**CA**
1	*Axonopus fissifolius**	4			
2	*Sporobolus elongatus*	4			
3	*Themeda australis*	3			
4	*Cyperus brevifolius**	2			
5	*Microlaena stipoides var stipoides*	2			
6	*Glycine clandestina*	2			
7	*Cymbopogon refractus*	2			
8	*Hypochaeris radicata**	2			
9	*Fimbristylis dichotoma*	2			
10	*Cheilanthes distans*	2			
11	*Verbena bonariensis**	2			
12	*Desmodium varians*	2			
13	*Panicum simile*	2			
14	*Conzya sp.**	2			
15	*Eragrostis brownii*	2			
16	*Aristida vagans*	2			
17	*Desmodium rhytidophyllum*	2			
18	*Bothriochloa macra*	2			
19	*Senecio madagascariensis**	2			
20	*Conyza bonariensis**	1			
21	*Richardia stellaris.**	1			

Job Gloucester Coal			Date 30.04.2009		
Quadrat: 29 (47/09)					
Species		CA	Species		CA
1	*Corymbia maculata*	4	39	*Daviesia ulicifolia*	1
2	*Eucalyptus carnea*	4	40	*Dianella tasmanica*	1
3	*Eucalyptus siderophloia*	3	41	*Dichelachne crinita*	1
4	*Eucalyptus microcorys*	3	42	*Lilium formosanum**	1
5	*Themeda australis*	2	43	*Maytenus silvestris*	1
6	*Microlaena stipoides var stipoides*	2	44	*Goodenia paniculata*	1
7	*Glycine clandestina*	2	45	*Echinopogan ovatus*	1
8	*Cymbopogon refractus*	2	46	*Breynia oblongifolia*	1
9	*Aristida vagans*	2	47	*Lagenifera stipitata*	1
10	*Dichondra repens*	2	48	*Notelaea longifolia*	1
11	*Imperata cylindrica*	2	49	*Acacia floribunda*	1
12	*Pratia purpurascens*	2	50	*Leucopogon juniperinus*	1
13	*Entolasia stricta*	2	51	*Acacia longissima*	1
14	*Paspalum dilatatum**	2	52	*Bidens pilosa**	1
15	*Opercularia diphylla*	2	53	*Caesia parviflora var. parviflora*	1
16	*Eucalyptus canaliculata*	2	54	*Digitaria ramularis*	1
17	*Hardenbergia violacea*	2	55	*Eremophila debilis*	1
18	*Podolobium ilicifolium*	2	56	*Lantana camara**	1
19	*Vittadenia cunneata*	2	57	*Solanum prinophyllum*	1
20	*Pseuderanthemum variabile*	2	58	*Brachychiton populneus*	1
21	*Oplismenus aemulus*	2			
22	*Hydrocotyl peduncularis*	2			
23	*Pandorea pandorana*	2			
24	*Acacia linifolia*	2			
25	*Brachyscome angustifolia var.*	2			
26	*Viola betonicifolia*	2			
27	*Hypochaeris radicata**	1			
28	*Panicum simile*	1			
29	*Senecio madagascariensis**	1			
30	*Acacia ulicifolia*	1			
31	*Plantago lanceolata**	1			
32	*Taraxacum officinale**	1			
33	*Lomandra glauca*	1			
34	*Hibbertia obtusifolia*	1			
35	*Lomandra confertifolia subsp. rubiginosa*	1			
36	*Phyllanthus hirtellus*	1			
37	*Geitonoplesium cymosum*	1			
38	*Cheilanthes sieberi subsp. sieberi*	1			

Job Gloucester Coal			Date 30.04.2009		
Quadrat: 30 (48/09)					
Species		CA	Species		**CA**
1	*Paspalum dilatatum**	4			
2	*Axonopus fissifolius**	4			
3	*Andropogon virginicus**	4			
4	*Imperata cylindrica*	3			
5	*Sporobolus elongatus*	3			
6	*Cyperus brevifolius**	3			
7	*Themeda australis*	2			
8	*Hypochaeris radicata**	2			
9	*Plantago lanceolata**	2			
10	*Fimbristylis dichotoma*	2			
11	*Verbena bonariensis**	2			
12	*Eragrostis brownii*	2			
13	*Tricoryne simplex*	2			
14	*Eragrostis cilianensis**	2			
15	*Juncus usitatus*	2			
16	*Daucus glochidiatus*	2			
17	*Anangallis arvensis**	2			
18	*Hypericum gramineum*	2			
19	*Capillipedium parviflorum*	2			
20	*Entolasia stricta*	1			
21	*Senecio madagascariensis**	1			
22	*Conzya sp.**	1			
23	*Aster subulatus**	1			
24	*Carex brownii*	1			
25	*Setaria viridis**	1			

Job Gloucester Coal			Date 30.04.2009		
Quadrat: 31 (49/09)					
Species		CA	Species		**CA**
1	*Axonopus fissifolius**	4			
2	*Andropogon virginicus**	4			
3	*Imperata cylindrica*	4			
4	*Paspalum dilatatum**	3			
5	*Sporobolus elongatus*	3			
6	*Cyperus brevifolius**	2			
7	*Hypochaeris radicata**	2			
8	*Plantago lanceolata**	2			
9	*Verbena bonariensis**	2			
10	*Eragrostis cilianensis**	2			
11	*Senecio madagascariensis**	2			
12	*Glycine clandestina*	2			
13	*Desmodium rhytidophyllum*	2			
14	*Trifolium fragiferum**	2			
15	*Trifolium dubium**	2			
16	*Themeda australis*	1			
17	*Eragrostis brownii*	1			
18	*Tricoryne simplex*	1			
19	*Juncus usitatus*	1			
20	*Hypericum gramineum*	1			
21	*Capillipedium parviflorum*	1			
22	*Entolasia stricta*	1			
23	*Conzya sp.**	1			
24	*Cymbopogon refractus*	1			
25	*Aristida vagans*	1			
26	*Dichondra repens*	1			
27	*Pratia purpurascens*	1			
28	*Acacia ulicifolia*	1			
29	*Rubus parvifolius*	1			
30	*Cyperus congestus**	1			
31	*Solanum mauritianum**	1			
32	*Viola hederacea*	1			
33	*Platylobium formosum subsp parviflorum*	1			
34	*Richardia humistrata**	1			
35	*Setaria pumila**	1			
36	*Sida rhombifolia**	1			

Job Gloucester Coal			Date 30.04.2009		
Quadrat: 32 (50/09)					
Species		CA	Species		**CA**
1	*Axonopus fissifolius**	3			
2	*Andropogon virginicus**	3			
3	*Imperata cylindrica*	3			
4	*Themeda australis*	3			
5	*Pteridium esculentum*	3			
6	*Cyperus brevifolius**	2			
7	*Hypochaeris radicata**	2			
8	*Plantago lanceolata**	2			
9	*Verbena bonariensis**	2			
10	*Senecio madagascariensis**	2			
11	*Glycine clandestina*	2			
12	*Trifolium fragiferum**	2			
13	*Dichondra repens*	2			
14	*Acacia ulicifolia*	2			
15	*Cyperus congestus**	2			
16	*Aster subulatus**	2			
17	*Cynodon dactylon*	2			
18	*Eragrostis curvula**	2			
19	*Echinopogan caespitosus*	2			
20	*Geranium solanderi var solanderi*	2			
21	*Eragrostis brownii*	1			
22	*Tricoryne simplex*	1			
23	*Hypericum gramineum*	1			
24	*Entolasia stricta*	1			
25	*Conzya sp.**	1			
26	*Setaria pumila**	1			
27	*Sida rhombifolia**	1			
28	*Panicum simile*	1			
29	*Conyza bonariensis**	1			
30	*Setaria sphacelata**	1			
31	*Oxalis exilis*	1			
32	*Pimelea linifolia subsp. linifolia*	1			
33	*Acacia implexa*	1			

Appendix 8: Contributions and qualifications of EcoBiological staff

Name	Qualification	Title/Experience	Contribution
Simon Clulow	B. Sc./B. Teach PhD candidate	Ecologist (Herpetologist) 6 years - Research in evolutionary biology, ecology, reproductive physiology and conservation biology (with a focus in the field of herpetology). PhD Thesis focus "Manipulations of reproduction and development to investigate amphibian plasticity and fitness".	Project management, amphibian and reptile surveys, trapping design, mammal and reptile trap checking, owl call playback spotlighting, report writing.
Kristy Peters	B. Park Mgt.	Ecologist (Ornithologist) 3 years – Bird identification and Anabat analysis. Enrolled in Honours at University of Armidale researching "The occurrence and detectability of uncommon woodland birds in the Hunter Valley" under Professor Hugh Ford.	Bird surveys, spotlighting, owl call playback, Anabat analysis, report review.
Adam Blundell	B. Env Sc. (Hons)	Managing Director 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.
Dan Pedersen	B. Sc.	Botanist 6 years - Botany, vegetation classification and mapping, bushfire consultant.	Flora survey and species ID, vegetation community mapping.
Ryan Parsons	B. Env.Sc.	Botanist	Habitat hollow survey.
Dianna Brettschneider	B. App. Sc (Env)	GIS Manager 2 years - georeferencing, processing, analysis and display of spatial data in GIS.	Preparation of map layouts for report.

Appendix 9: 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 2009) 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.

ATTACHMENT EB

FAUNA HABITAT ASSESSMENT
(CENWEST ENVIRONMENTAL SERVICES AND RESOURCE STRATEGIES, 2009)

Table EB-1
Habitat Assessment Results

Parameter	Site 1		Site 2	
Landform	North aspect ~15 degree (^{o}) slope		North aspect ~ 15^{o} slope	
Internal Connectivity	Intermediate fragmentation and clearing with adequate stepping stones		Low level of fragmentation (e.g. roads)	
External Connectivity	Significant fragmentation and clearing with inadequate habitat stepping stones		Cleared land	
Vegetation Community (as mapped by Ecbiological, 2009)	Red Gum Grassy Woodland		Spotted Gum – Grey Iron-bark	
Dominant Groundcover Species	Grasses and herbs		Grasses and herbs	
Dominant Mid-storey Species	Scattered few regenerated trees		Absent	
Dominant Upper-storey Species	Eucalypt trees – including Spotted Gum		Regrowth trees – including Spotted Gum and Narrow- leaved Ironbark	
Classification	Secondary Grassland with Regrowth Open Woodland/Forest		Secondary Grassland with Regrowth Open Woodland/Forest	
Successional Stage	Predominantly regrowth		Predominantly regrowth	
Tree Density	Medium		Medium	
Diameter at Breast Height (DBH) range/average (centimetres [cm])	10 / 40		5 / 100	
Tree Health	Generally healthy		Generally healthy	
Hollows Present	Few		Few- Many	
Trees Regenerating	Many		Some	
Water Sources	None		None	
Habitat Layers Present				
	% Cover	**Average Height (metres [m])**	**% Cover**	**Average Height (m)**
Bare Soil	0 - 5	N/A	0 - 5	N/A
Litter	0 - 5	N/A	0 - 5	N/A
Rock	0 - 5	N/A	0	N/A
Sticks/Logs	0 - 5	N/A	0 - 5	N/A
Herb	6 - 25	0.3	0 - 5	0.15
Grass	76 - 100	0.1	51 - 75	0.3
Shrub	0 - 5	1	0	-
Mid-storey Tree	0 - 5	5	0 - 5	4
Upper-storey Tree	51 - 75	15	51 - 75	20
Mistletoe	0	N/A	0	N/A
Disturbances				
Evidence of Fire	No		No	
Evidence of Logging	Past heavy		None	
Dieback	None		None	
Under-storey Disturbance	None		Considerable	
Herbaceous Weeds	Light		Light	
Woody Weeds	Perimeter only		None	
Other Disturbance Events	Logging, grazing		Grazing, logging	
Conservation				
Conservation Rating	Some conservation value but with significant levels of disturbance		Degraded with significant loss of resilience, little regeneration occuring	
Conservation Trends	Balanced between being able to return to original community condition or further degrade and eventually require restoration		Balanced between being able to return to original community condition or further degrade and eventually require restoration	

Table EB-1 (Continued)
Habitat Assessment Results

Parameter	Site 3		Site 4	
Landform	East aspect ~ 15^{o} slope		Low decline valley formation	
Internal Connectivity	Significant fragmentation and clearing with inadequate habitat stepping stones		Homogenous and/or continous habitat with low level of fragmentation (e.g. tracks)	
External Connectivity	Significant fragmentation and clearing with inadequate habitat stepping stones		Intermediate fragmentation and clearing with adequate stepping stones	
Vegetation Community (as mapped by Ecbiological, 2009)	Spotted Gum – Grey Ironbark		Grey Gum – Red Gum – Apple Riparian Forest	
Dominant Groundcover Species	Grasses and herbs		Lomandra, grasses and herbs	
Dominant Mid-storey Species	Few shrubs		Regenerated Eucalypts and Acacias	
Dominant Upper-storey Species	Spotted Gum with Red Stringybark		Mixed Eucalypt trees	
Classification	Regrowth Open Forest		Regrowth Open Forest	
Successional Stage	Predominantly regrowth		Predominantly regrowth	
Tree Density	Medium		High	
DBH range/average (cm)	5 / 45		4 / 100	
Tree Health	Generally healthy		Generally healthy	
Hollows Present	None		Few	
Trees Regenerating	Many		Many	
Water Sources	None		Creek	
Habitat Layers Present				
	% Cover	**Average Height (m)**	**% Cover**	**Average Height (m)**
Bare Soil	0 - 5	N/A	0 - 5	N/A
Litter	0 - 5	N/A	6 - 25	N/A
Rock	0 - 5	N/A	0	N/A
Sticks/Logs	0 - 5	N/A	0 - 5	N/A
Herb	6 - 25	0.1	0 - 5	0.1
Grass	51 - 75	0.3	6 - 25	0.3
Shrub	0 - 5	1	26 - 50	1
Mid-storey Tree	0 - 5	1	6 - 25	10
Upper-storey Tree	51 - 75	15	51 - 75	25
Mistletoe	0	N/A	0	N/A
Disturbances				
Evidence of Fire	No		No	
Evidence of Logging	Past light		Past heavy	
Dieback	None		None	
Under-storey Disturbance	Considerable		Moderate	
Herbaceous Weeds	Light		Light	
Woody Weeds	None		Light (Lantana)	
Other Disturbance Events	Grazing, pastoral land clearing		Some grazing	
Conservation				
Conservation Rating	Degraded with significant loss of resilience, no regeneration occuring		Some conservation value but with significant levels of disturbance	
Conservation Trends	Under approapriate management would return original community condition through regeneration strategies		Under appropriate managament would return to original community condition through regeneration strategies	

Table EB-1 (Continued)
Habitat Assessment Results

Parameter	Site 5		Site 6	
Landform	Valleyside with north aspect ~ 10 to 15^{o}		Valleyside with north-east aspect ~ 15^{o}	
Internal Connectivity	Homogenous and/or continous habitat with low level of fragmentation (e.g. roads)		Intermediate fragmentation and clearing with adequate stepping stones	
External Connectivity	Intermediate fragmentation and clearing with adequate stepping stones		Significant fragmentation and clearing with inadequate habitat stepping stones	
Vegetation Community (as mapped by Ecbiological, 2009)	Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest		Red Gum Grassy Woodland	
Dominant Groundcover Species	Grasses, herbs and some scattered Lomandra		Grasses, herbs and Lomandra	
Dominant Mid-storey Species	Scattered shrubs and regenerating trees		Regenerated trees and shrubs	
Dominant Upper-storey Species	Grey Ironbark - Stringbark		Forest Red Gum and scattered Grey Ironbark	
Classification	Regrowth Open Forest		Regrowth Open Forest	
Successional Stage	Predominantly regrowth		Predominantly regrowth	
Tree Density	Medium to high		Medium	
DBH range/average (cm)	5 / 75		5 / 75	
Tree Health	Generally healthy		Generally healthy	
Hollows Present	None		None	
Trees Regenerating	Many		Many	
Water Sources	Valley heading to creekline		Creek	
Habitat Layers Present				
	% Cover	**Average Height (m)**	**% Cover**	**Average Height (m)**
Bare Soil	0 - 5	N/A	0 - 5	N/A
Litter	6 - 25	N/A	6 - 25	N/A
Rock	0	N/A	0 - 5	N/A
Sticks/Logs	6 - 25	N/A	0 - 5	N/A
Herb	6 - 25	0.1	0 - 5	0.1
Grass	26 - 50	0.3	6 - 25	0.3
Shrub	0 - 5	0.5	0 - 5	0.5
Mid-storey Tree	0 - 5	2	0 - 5	3
Upper-storey Tree	51 - 75	30	51 - 75	25
Mistletoe	0	N/A	0	N/A
Disturbances				
Evidence of Fire	No		No	
Evidence of Logging	Past heavy		Past heavy	
Dieback	None		None	
Under-storey Disturbance	Moderate		Moderate	
Herbaceous Weeds	Light		Light	
Woody Weeds	Permeter only		Light	
Other Disturbance Events	Grazing and logging		Grazing and pastoral clearing	
Conservation				
Conservation Rating	Some conservation value but with significant levels of disturbance		Some conservation value but with significant levels of disturbance	
Conservation Trends	Balanced between being able to return to original community condition or further degrade and eventually require restoration		Balanced between being able to return to original community condition or further degrade and eventually require restoration	

Table EB-1 (Continued)
Habitat Assessment Results

Parameter	Site 7		Site 8	
Landform	Undulating cleared land with scattered trees		North-east aspect ~ 15^{o} slope	
Internal Connectivity	Low level of fragmentation (e.g. roads)		Intermediate fragmentation and clearing with adequate stepping stones	
External Connectivity	Intermediate fragmentation and clearing with adequate stepping stones		Intermediate fragmentation and clearing with adequate stepping stones	
Vegetation Community (as mapped by Ecbiological, 2009)	Derived Grassland		Spotted Gum – Grey Ironbark	
Dominant Groundcover Species	Whiskey Grass and Bladey Grass with herbs		Grass, herbs and litter	
Dominant Mid-storey Species	Scattered shrubs		Scattered shrubs and Lomandra	
Dominant Upper-storey Species	Scattered trees (Forest Red Gum)		Regrowth Forest Red Gum, Stringybark and Ironbark	
Classification	Secondary Grassland		Regrowth Open Forest	
Successional Stage	Climax Bladey Grass community		Predominantly regrowth	
Tree Density	Low		Medium	
DBH range/average (cm)	10 / 105		5 / 65	
Tree Health	Generally healthy		Generally healthy	
Hollows Present	None		None	
Trees Regenerating	None		Few	
Water Sources	Creek		No	
Habitat Layers Present				
	% Cover	**Average Height (m)**	**% Cover**	**Average Height (m)**
Bare Soil	0 - 5	N/A	0 - 5	N/A
Litter	0 - 5	N/A	26 - 50	N/A
Rock	0	N/A	0	N/A
Sticks/Logs	0	N/A	0 - 5	N/A
Herb	0 - 5	0.15	0 - 5	0.15
Grass	51 - 75	0.45	0 - 5	0.3
Shrub	0 - 5	1	0 - 5	1
Mid-storey Tree	0	0	0 - 5	10
Upper-storey Tree	0 - 5	20	51 - 75	30
Mistletoe	0	N/A	0	N/A
Disturbances				
Evidence of Fire	No		No	
Evidence of Logging	Past heavy		Past heavy	
Dieback	N/A		None	
Under-storey Disturbance	Low level of fragmentation (e.g. roads)		Moderate	
Herbaceous Weeds	Light –heavy (drainage areas)		Perimeter only	
Woody Weeds	Light		None	
Other Disturbance Events	Pastoral clearing and grazing		Grazing and pastoral logging	
Conservation				
Conservation Rating	Degraded with significant loss of resilience, no regeneration occurring		Some conservation value but with significant levels of disturbance	
Conservation Trends	Balanced between being able to return to original community condition or further degrade and eventually require restoration		Balanced between being able to return to original community condition or further degrade and eventually require restoration	

Table EB-1 (Continued)
Habitat Assessment Results

Parameter	Site 9		Site 10	
Landform	Valley slope ~ 15 to 20 ^{o} slope		Hill top	
Internal Connectivity	Intermediate fragmentation and clearing with adequate stepping stones		Intermediate fragmentation and clearing with adequate stepping stones	
External Connectivity	Significant fragmentation and clearing with inadequate habitat stepping stones		Significant fragmentation and clearing with inadequate habitat stepping stones	
Vegetation Community (as mapped by Ecbiological, 2009)	Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest		Stringybark /Paperbark Forest	
Dominant Groundcover Species	Grasses and herbs		Grass, herbs, Bracion? And Lomandra	
Dominant Mid-storey Species	Regenerating Acacias and various shrubs		Regenerating trees and shrubs	
Dominant Upper-storey Species	Forest Red Gum and Ironbark		Grey Ironbark, Red Stringybark	
Classification	Regrowth Open Forest		Regrowth Open Forest	
Successional Stage	Predominantly regrowth		Predominantly regrowth	
Tree Density	Medium		Medium	
DBH range/average (cm)	5 / 65		5 / 100	
Tree Health	Generally healthy		Generally healthy	
Hollows Present	None		Few	
Trees Regenerating	Few		Some	
Water Sources	Creek		No	
Habitat Layers Present				
	% Cover	**Average Height (m)**	**% Cover**	**Average Height (m)**
Bare Soil	0 - 5	N/A	0 - 5	N/A
Litter	6 - 25	N/A	26 - 50	0.02
Rock	0 - 5	N/A	0	N/A
Sticks/Logs	0 - 5	N/A	6 - 25	N/A
Herb	0 - 5	0.1	0 - 5	0.15
Grass	26 - 50	0.3	6 - 25	0.3
Shrub	0 - 5	1	0 - 5	3
Mid-storey Tree	6 - 25	15	0 - 5	10
Upper-storey Tree	26 - 50	30	51 - 75	30
Mistletoe	0	N/A	0	N/A
Disturbances				
Evidence of Fire	No		No	
Evidence of Logging	Past heavy		Past heavy	
Dieback	None		None	
Under-storey Disturbance	Considerable		Moderate	
Herbaceous Weeds	None		Light	
Woody Weeds	Perimeter only		Light	
Other Disturbance Events	Pastoral clearing and grazing		Railway line, pastoral logging and grazing	
Conservation				
Conservation Rating	Degraded with significant loss of resilience, no regeneration occurring		Some conservation value but with significant levels of disturbance	
Conservation Trends	Balanced between being able to return to original community condition or further degrade and eventually require restoration		Balanced between being able to return to original community condition or further degrade and eventually require restoration	

Table EB-1 (Continued)
Habitat Assessment Results

Parameter	Site 11		Site 12	
Landform	Mammy Johnsons River		Hill slope	
Internal Connectivity	Homogenous and/or continuous habitat(s)		Intermediate fragmentation and clearing with adequate stepping stones	
External Connectivity	Significant fragmentation and clearing with inadequate habitat stepping stones		Significant fragmentation and clearing with inadequate habitat stepping stones	
Vegetation Community (as mapped by Ecbiological, 2009)	Riparian Closed Forest		Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest	
Dominant Groundcover Species	Riparian		Bladey grass, Kangaroo Grass and Lomandra	
Dominant Mid-storey Species	Riparian		Acacia and shrubs	
Dominant Upper-storey Species	Weeping Lillypilly, Water Gum and River Oak		Eucalypts dominant to 20m	
Classification	Riparian Forest		Regrowth Open Forest	
Successional Stage	Predominantly regrowth		Predominantly regrowth	
Tree Density	High		Medium to high	
DBH range/average (cm)	5 / 80		5 / 80	
Tree Health	Generally healthy		Generally healthy	
Hollows Present	Some		Few	
Trees Regenerating	Some		Some	
Water Sources	Creek (Mammy Johnsons River)		No	
Habitat Layers Present				
	% Cover	**Average Height (m)**	**% Cover**	**Average Height (m)**
Bare Soil	0 - 5	N/A	0 - 5	N/A
Litter	26 - 50	N/A	6 - 25	N/A
Rock	river bed	N/A	0	N/A
Sticks/Logs	6 - 25	N/A	6 - 25	N/A
Herb	0 - 5	0.3	0 - 5	0.15
Grass	6 - 25	0.5	26 - 50	0.3
Shrub	6 - 25	4	0 - 5	2
Mid-storey Tree	6 - 25	4	6 - 25	4
Upper-storey Tree	51 - 75	15-35	51 - 75	20
Mistletoe	0	N/A	0	N/A
Disturbances				
Evidence of Fire	No		No	
Evidence of Logging	Past heavy		Past heavy	
Dieback	None		None	
Under-storey Disturbance	Considerable		Moderate	
Herbaceous Weeds	Heavy		Light	
Woody Weeds	Heavy		Light	
Other Disturbance Events	Major woody weed infestation		Pastoral logging and grazing	
Conservation				
Conservation Rating	Moderate conservation value but with significant levels of disturbance		Some conservation value but with significant levels of disturbance	
Conservation Trends	High abundance of weeds indicating trend towards highly modified system with siginifcant effort required to change trend.		Balanced between being able to return to original community condition or further degrade and eventually require restoration	

Source: Ecbiological (2009) *Flora and Fauna Survey Report: Duralie Coal Mine*, *Gloucester, New South Wales.*

ATTACHMENT EC

THREATENED SPECIES DATABASE SEARCH RESULTS

Table EC-1
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Flora												
APIACEAE												
Parsonsia dorrigoensis	Milky Silkpod	V	E	-	-	X	-	-	X	-	Very Unlikely	No potential habitat
APOCYNACEAE												
Cynanchum elegans	White-flowered Wax Plant	E	E	-	-	X	X	X	X	-	Possible	Some potential habitat
Tylophora woollsii	Cryptic Forest Twiner	E	E	-	-	-	-	X	-	-	Very Unlikely	Outside known distribution.
ASCLEPIADACEAE												
Marsdenia longiloba	Slender Marsdenia	E	V	-	-	X	X	-	-	-	Very Unlikely	No potential habitat
ASTERACEAE												
Rutidosis heterogama	Heath Wrinklewort	V	V	-	-	X	X	-	X	-	Very Unlikely	No potential habitat
Senecio spathulatus	Coast Groundsel	E	-	-	-	X	X	-	X	-	Very Unlikely	No potential habitat
CASUARINACEAE												
Allocasuarina defungens	Dwarf Heath Casuarina	E	E	-	-	X	X	X	X	-	Very Unlikely	Outside known distribution.
Allocasuarina simulans	Nabiac Casuarina	V	V	-	-	X	-	X	X	-	Very Unlikely	Outside known distribution.
ELAEOCARPACEAE												
Tetratheca juncea	Black-eyed Susan	V	V	-	-	X	X	X	-	-	Very Unlikely	No potential habitat
EUPHORBIACEAE												
Chamaesyce psammogeton	Sand Spurge	E	-	-	-	X	X	-	X	-	Very Unlikely	No potential habitat
FABACEAE (CAESALPINIOIDEAE)												
Senna acclinis	Rainforest Cassia	E	-	-	-	X	X	-	X	-	Very Unlikely	No potential habitat
FABACEAE (FABOIDEAE)												
Dillwynia tenuifolia	-	V	V	-	-		-	X	-	-	Very Unlikely	No potential habitat

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
JUNCAGINACEAE												
Maundia triglochinoides	-	V	-	-	-	X	-	-	X	-	Very Unlikely	No potential habitat
LAMIACEAE												
Prostanthera densa	Villous Mint-bush	V	V	-	-	X	X	X	X	-	Very Unlikely	No potential habitat
Prostanthera marifolia	Seaforth Mintbush	CE	Ex	-	-	X	X	-	X	-	Very Unlikely	Outside known distribution.
MELIACEAE												
Owenia cepiodora	Onion Cedar	V	V	-	-	-	X	-	X	-	Very Unlikely	Outside known distribution.
MYRTACEAE												
Angophora inopina	Charmhaven Apple	V	V	-	-	X	X	X	X	-	Unlikely	Outside known distribution.
Callistemon linearifolius	Netted Bottle Brush	V	-	-	-	X	X	-	X	-	Very Unlikely	Outside known distribution.
Eucalyptus camfieldii	Camfield's Stringybark	V	V	-	-	-	X	X	-	-	Very Unlikely	No potential habitat
Eucalyptus glaucina	Slaty Red Gum	V	V	-	-	X	X	X	X	-	Possible	Some potential habitat
Eucalyptus parramattensis subsp. *decadens*	Earp's Gum	V	V	-	-	X	X	X	X	-	Very Unlikely	Outside known distribution.
Melaleuca biconvexa	Biconvex Paperbark	V	V	-	-	X	X	X	X	-	Unlikely	Outside known distribution.
Melaleuca groveana	Grove's Paperbark	V	-	-	-	X	X	-	X	-	Very Unlikely	No potential habitat
Syzygium paniculatum	Magenta Lilly Pilly	V	V	-	-	X	X	X	X	-	Possible	Some potential habitat
ORCHIDACEAE												
Caladenia tessellata	Tessellated Spider Orchid	E	V	-	-	-	-	-	X	-	Very Unlikely	Outside known distribution.
Chiloglottis platyptera	Barrington Tops Ant Orchid	V	-	-	-	X	X	-	X	-	Very Unlikely	Outside known distribution.
Corybas dowlingii	Red Helmet Orchid	E	-	-	-	X	-	-	X	-	Unlikely	No nearby records.

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	-	-	X	X	X	X	-	Unlikely	Known to occur closer to the coast.
Diuris arenaria	Sand Doubletail	E	-	-	-	X	X	-	X	-	Very Unlikely	Outside known distribution.
Diuris pedunculata	Small Snake Orchid	E	E	-	-	X	X	-	X	-	Unlikely	Outside known distribution.
Diuris praecox	Rough Double Tail	V	V	-	-	X	X	X	X	-	Very Unlikely	Outside known distribution.
Diuris venosa	Veined Doubletail	V	V	-	-	X	X	X	X	-	Very Unlikely	No habitat.
Prasophyllum fuscum	Slaty Leek Orchid	V	V	-	-	X	X	-	-	-	Very Unlikely	Outside known distribution.
Pterostylis elegans	Elegant Greenhood	V	-	-	-	X	X	-	-	-	Very Unlikely	No habitat.
Rhizanthella slateri	Eastern Underground Orchid	V	E	-	-	-	-	X	-	-	Very Unlikely	Outside known distribution.
POLYGONACEAE												
Persicaria elatior	Tall Knotweed	V	V	-	-	X	X	-	X	-	Very Unlikely	Outside known distribution.
PROTEACEAE												
Grevillea guthrieana	Guthrie's Grevillea	E	E	-	-	X	X	-	X	-	Possible	Some potential habitat
Grevillea obtusiflora subsp. *obtusiflora*	Grey Grevillea	E	E			X	-	-	-	-	Very Unlikely	Outside known distribution.
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	-	-	X	X	X	X	-	Very Unlikely	Outside known distribution.
RHAMNACEAE												
Pomaderris queenslandica	Scant Pomaderris	E	-	-	-	X	X	-	X	-	Very Unlikely	No habitat.
RUBIACEAE												
Asperula asthenes	Trailing Woodruff	V	V	-	-	X	X	X	X	-	Possible	Some potential habitat

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
RUTACEAE												
Zieria lasiocaulis	Willi Willi Zieria	E	E	-	-	X	X	-	X	-	Very Unlikely	No habitat.
SANTALACEAE												
Thesium australe	Austral Toadflax, Toadflax	V	V	-	-	-	-	X	-	-	Unlikely	Outside known distribution.
SCROPHULARIACEAE												
Euphrasia ciliolata	Polblue Eyebright	V	-	-	-	X	X	-	X	-	Very Unlikely	No habitat.
Lindernia alsinoides	Noah's False Chickweed	E	-	-	-	X	-	-	X	-	Very Unlikely	Outside known distribution.
STERCULIACEAE												
Rulingia prostrata	Dwarf Kerrawang	E	E	-	-	-	X	X	-	-	Very Unlikely	No habitat.
WINTERACEAE												
Tasmannia glaucifolia	Fragrant Pepperbush	V	V	-	-	X	X	X	X	-	Very Unlikely	No habitat.
Tasmannia purpurascens	Broad-leaved Pepperbush	V	V	-	-	X	X	X	X	-	Very Unlikely	No habitat.
Fauna[#]												
Invertebrates												
PETALURIDAE												
Petalura gigantea	Giant Dragonfly	E	-	-	-	X	X	-	-	-	Unlikely	Outside known distribution.
Amphibians												
MYOBATRACHIDAE												
Crinia tinnula	Wallum Froglet	V	-	-	X	X	X	-	-	-	Very unlikely	Lack of suitable habitat (e.g. acid paperbark swamps)

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Amphibians (Continued)												
Mixophyes balbus	Stuttering Frog	E	V	-	X	X	X	X	-	-	Possible	Wet Eucalypt Forest, creeklines and Mammy Johnsons River may provide suitable habitat
Mixophyes iteratus	Giant Barred Frog	E	E	-	X	X	X	X	-	A	Known to Occur	Creeklines and Mammy Johnsons River may provide suitable habitat
Philoria sphagnicolus	Sphagnum Frog	V	-	-	-	X	X	-	-	-	Unlikely	Outside distribution
HYLIDAE												
Litoria aurea	Green and Golden Bell Frog	E	V	-	X	X	X	X	-	-	Possible but unlikely	No nearby records
Litoria booroolongensis	Booroolong Frog	E	E	-	X	X	X	X	-	-	Possible but unlikely	Riparian vegetation may provide suitable habitat, but no nearby records
Litoria brevipalmata	Green-thighed Frog	V	-	-	-	X	X	-	-	-	Possible but unlikely	Riparian vegetation may provide suitable habitat, but no nearby records
Litoria daviesae	Davies' Tree Frog	V	-	-	-	X	X	-	-	-	Unlikely	Distributed to the north
Litoria littlejohni	Littlejohn's Tree Frog	V	V	-	-	X	X	-	-	-	Unlikely	Distributed to the south
Litoria subglandulosa	Glandular Frog	V	-	-	-	X	X	-	-	-	Unlikely	Outside distribution
Reptiles												
ELAPIDAE												
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	-	X	X	X	-	-	-	Possible	Suitable habitat present within the Project area and surrounds

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Reptiles (Continued)												
Hoplocephalus bungaroides	Broad-headed Snake	E	V	-	-	-	-	X	-	-	Very unlikely	Lack of suitable habitat
Hoplocephalus stephensii	Stephens' Banded Snake	V	-	-	X	X	X	-	-	-	Possible	Suitable habitat present within the Project area and surrounds
Birds												
ANSERANATIDAE												
Anseranas semipalmata	Magpie Goose	V	-	X	-	X	X	-	-	-	Unlikely	Limited potential habitat
ANATIDAE												
Stictonetta naevosa	Freckled Duck	V	-	X	-	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area
Oxyura australis	Blue-billed Duck	V	-	X	-	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area
DIOMEDEIDAE												
Diomedea exulans	Wandering Albatross	E	V	X	X	-	-	X	-	-	Very Unlikely	No potential habitat
Diomedea exulans exulans	Tristan Albatross	-	E	-	-	-	-	X	-	-	Very Unlikely	No potential habitat
Diomedea exulans antipodensis	Antipodean Albatross	-	V	-	-	-	-	X	-	-	Very Unlikely	No potential habitat
Diomedea exulans gibsoni	Gibson's Albatross	-	V	-	-	-	-	X	-	-	Very Unlikely	No potential habitat
Thalassarche melanophrys	Black-browed Albatross	V	V	X	-	X	-	X	-	-	Very Unlikely	No potential habitat
Thalassarche melanophrys impavida	Campbell Albatross	-	V	-	-	-	-	X	-	-	Very Unlikely	No potential habitat
Thalassarche bulleri	Buller's Albatross	-	V	-	-	-	-	X	-	-	Very Unlikely	No potential habitat
Thalassarche cauta	Shy Albatross	V	-	X	-	-	-	-	-	-	Very Unlikely	No potential habitat

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Birds (Continued)												
Thalassarche cauta steadi	White-capped Albatross	-	V	-	-	-	-	X	-	-	Very Unlikely	No potential habitat
Thalassarche cauta salvini	Salvin's Albatross	-	V	-	-	-	-	X	-	-	Very Unlikely	No potential habitat
PROCELLARIIDAE												
Macronectes giganteus	Southern Giant-Petrel	E	E	X	X	X	X	X	-	-	Very Unlikely	No potential habitat
Macronectes halli	Northern Giant-Petrel	V	V	-	-	-	-	X	-	-	Very Unlikely	No potential habitat
Pterodroma neglecta	Kermadec Petrel	V	-	X	-	-	-	-	-	-	Very Unlikely	No potential habitat
Pterodroma leucoptera leucoptera	Gould's Petrel	E	E	X	X	X	X	X	-	-	Very Unlikely	No potential habitat
Puffinus carneipes	Flesh-footed Shearwater	V	-	X	-	X	X	-	-	-	Very Unlikely	No potential habitat
CICONIIDAE												
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	X	X	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area
ARDEIDAE												
Botaurus poiciloptilus	Australasian Bittern	V	-	X	-	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area
Ixobrychus flavicollis	Black Bittern	V	-	X	X	X	X	-	-	-	Very Unlikely	No potential habitat
FALCONIDAE												
Falco hypoleucos	Grey Falcon	V	-	-	-	X	X	-	-	-	Possible	Possible vagrant in the area
ACCIPITRIDAE												
Pandion haliaetus	Osprey	V	-	X	-	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Birds (Continued)												
Lophoictinia isura	Square-tailed Kite	V	-	X	-	X	X	-	-	-	Possible	Wide ranging species
BURHINIDAE												
Burhinus grallarius	Bush Stone-curlew	E	-	X	X	X	X	-	-	-	Possible	Limited habitat, no nearby records
HAEMATOPODIDAE												
Haematopus longirostris	Pied Oystercatcher	V	-	X	X	X	X	-	-	-	Very Unlikely	No potential habitat
Haematopus fuliginosus	Sooty Oystercatcher	V	-	X	-	X	X	-	-	-	Very Unlikely	No potential habitat
CHARADRIIDAE												
Charadrius mongolus	Lesser Sand-plover	V	-	X	X	X	X	-	-	-	Unlikely	No potential habitat
Charadrius leschenaultii	Greater Sand Plover	V	-	X	-	-	-	-	-	-	Unlikely	No potential habitat
ROSTRATULIDAE												
Rostratula australis[10]	Australian Painted Snipe	E	V	X	-	-	-	X	-	-	Unlikely	Limited potential habitat, possible vagrant in the area
JACANIDAE												
Irediparra gallinacea	Comb-crested Jacana	V	-	X	-	X	X	-	-	-	Very Unlikely	No potential habitat
SCOLOPACIDAE												
Xenus cinereus	Terek Sandpiper	V	-	X	-	-	-	-	-	-	Very Unlikely	No potential habitat
Calidris tenuirostris	Great Knot	V	-	X	-	-	-	-	-	-	Unlikely	No potential habitat
Calidris alba	Sanderling	V	-	X	-	-	-	-	-	-	Unlikely	No potential habitat
Limicola falcinellus	Broad-billed Sandpiper	V	-	X	-	-	-	-	-	-	Very Unlikely	No potential habitat
LARIDAE												
Sterna albifrons	Little Tern	E	-	X	X	X	X	-	-	-	Very Unlikely	No potential habitat
Sterna fuscata	Sooty Tern	V	-	-	X	-	-	-	-	-	Very Unlikely	No potential habitat

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Birds (Continued)												
COLUMBIDAE												
Ptilinopus magnificus	Wompoo Fruit-Dove	V	-	X	X	X	X	-	-	-	Possible	Riparian Vegetation along the Mammy Johnsons River may provide suitable habitat
Ptilinopus superbus	Superb Fruit-Dove	V	-	X	-	X	X	-	-	-	Possible	Riparian Vegetation along the Mammy Johnsons River may provide suitable habitat
Ptilinopus regina	Rose-crowned Fruit-Dove	V	-	X	-	X	X	-	-	B[9]	Previously recorded	Riparian Vegetation along the Mammy Johnsons River may provide suitable habitat
PSITTACIDAE												
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	X	X	X	X	-	-	-	Possible.	Limited habitat
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	X	-	X	X	-	-	-	Possible.	Limited habitat
Neophema pulchella	Turquoise Parrot	V	-	X	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds
Lathamus discolor	Swift Parrot	E	E	X	-	X	X	X		A	Previously recorded	Possible vagrant in the area
TYTONIDAE												
Tyto tenebricosa	Sooty Owl	V	-	X	-	X	X	-	-	D[11]	Previously recorded	Potential habitat present within the Project area and surrounds

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Birds (Continued)												
Tyto novaehollandiae	Masked Owl	V	-	X	X	X	X	-	-	-	Possible	Some potential habitat
Tyto capensis	Grass Owl	V	-	X	-	X	X	-	-	-	Possible	Some potential habitat
STRIGIDAE												
Ninox strenua	Powerful Owl	V	-	X	X	X	X	-	-	B	Previously recorded	Potential habitat present within the Project area and surrounds
Ninox connivens	Barking Owl	V	-	X	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds
ATRICHORNITHIDAE												
Atrichornis rufescens	Rufous Scrub-bird	V	-	X	-	X	X	-	-	-	Unlikely	Distributed to the north
CLIMACTERIDAE												
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	-	X	-	X	X	-	-	A	Known to Occur	Continuous areas of woodland
ACANTHIZIDAE												
Pyrrholaemus saggitatus	Speckled Warbler	V	-	X	-	X	X	-	-	A	Previously recorded	Potential habitat present within the Project area and surrounds
MELIPHAGIDAE												
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	X	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Birds (Continued)												
Anthochaera phrygia[8]	Regent Honeyeater	E	E	X	X	X	X	X	-	-	Possible	Suitable habitat present within the Project area and surrounds
Grantiella picta	Painted Honeyeater	V	-	X	X	-	-	-	-	-	Unlikely	No nearby records.
PETROICIDAE												
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	X	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds
POMATOSTOMIDAE												
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	X	X	X	X	-	-	A	Previously recorded	Potential habitat present within the Project area and surrounds
PACHYCEPHALIDAE												
Pachycephala olivacea	Olive Whistler	V	-	X	X	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area
CAMPEPHAGIDAE												
Coracina lineata	Barred Cuckoo-shrike	V	-	-	-	X	X	-	-	-	Unlikely	Distributed to the north
ESTRILDIDAE												
Stagonopleura guttata	Diamond Firetail	V	-	X	X	X	X	-	-	-	Possible	Limited potential habitat, possible vagrant in the area

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Mammals												
DASYURIDAE												
Dasyurus maculatus	Spotted-tailed Quoll	V	E	-	X	X	X	X	-	-	Possible	Potential habitat present within the Project area and surrounds
Dasyurus viverrinus	Eastern Quoll	E	-	-	-	X	X		-	-	Unlikely	No recent sightings of this species in NSW
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	-	X	X	X	-	-	A, B, C	Previously recorded	Potential habitat present within the Project area and surrounds
Planigale maculata	Common Planigale	V	-	-	-	X	X	-	-	C	Previously recorded	Potential habitat present within the Project area and surrounds
PHASCOLARCTIDAE												
Phascolarctos cinereus	Koala	V	-	-	X	X	X	-	-	B, E	Previously recorded	Potential habitat present within the Project area and surrounds
BURRAMYIDAE												
Cercartetus nanus	Eastern Pygmy-possum	V	-	-	-	X	X	-	-	-	Unlikely	Limited potential habitat.
PETAURIDAE												
Petaurus australis	Yellow-bellied Glider	V	-	-	-	X	X	-	-	-	Possible	Potential habitat in the surrounds.
Petaurus norfolcensis	Squirrel Glider	V	-	-	X	X	X	-	-	A, C, F	Previously recorded	Potential habitat present within the Project area and surrounds

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Mammals (Continued)												
POTOROIDAE												
Aepyprymnus rufescens	Rufous Bettong	V	-	-	X	X	X		-	-	Unlikely	Limited potential habitat as outside main distribution
Potorous tridactylus	Long-nosed Potoroo	V	V	-	-	X	X	X	-	-	Unlikely	Limited habitat.
MACROPODIDAE												
Macropus parma	Parma Wallaby	V	-	-	X	X	X	-	-	-	Possible	Potential habitat in the surrounds.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	-	-	X	X	X	-	-	Unlikely	Lack of potential habitat
Thylogale stigmatica	Red-legged Pademelon	V	-	-	X	X	X	-	-	-	Unlikely	Limited habitat.
PTEROPODIDAE												
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	-	X	X	X	X	-	-	Possible	Potential habitat present within the Project area and surrounds
EMBALLONURIDAE												
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	-	-	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds
MOLOSSIDAE												
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	-	X	X	X	-	-	A, B	Previously recorded	Potential habitat present within the Project area and surrounds

Table EC-1 (Continued)
Threatened Species Database Search Results

Scientific Name	Common Name	Conservation Status[1]		Source of Record						Previously Located in the Project Area and Immediate Surrounds	Considered to Potentially Occur in the Project Area or Immediate Surrounds	Comments
		TSC Act	EPBC Act	Birds Australia[2]	Australian Museum[3]	DECC Atlas of NSW Wildlife[4]	BioNet[5]	EPBC Act Protected Matters Search[6]	Sydney Royal Botanic Gardens[7]			
Mammals (Continued)												
VESPERTILIONIDAE												
Kerivoula papuensis	Golden-tipped Bat	V	-	-	X	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds
Miniopterus australis	Little Bentwing-bat	V	-	-	X	X	X	-	-	-	Possible	Predominately foraging habitat only.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	-	-	X	X	-	-	A, B, G	Previously recorded	Potential habitat present within the Project area and surrounds
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	-	-	X	X	X	-	-	Possible	Foraging habitat only.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	-	X	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds
Myotis adversus	Large-footed Myotis	V	-	-	X	X	X	-	-	A, B, G	Previously recorded	Potential habitat present within the Project area and surrounds
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	-	X	X	X	-	-	-	Possible	Potential habitat present within the Project area and surrounds
Vespadelus troughtoni	Eastern Cave Bat	V	-	-	-	X	X	-	-	-	Possible	Foraging habitat only.
MURIDAE												
Mastacomys fuscus	Broad-toothed Rat	V	-	-	X	X	X	-	-	-	Unlikely	No potential habitat
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V	-	-	X	X	X	-	-	-	Unlikely	Limited habitat.
Pseudomys oralis	Hastings River Mouse	E	E	-	-	-	-	X	-	-	Unlikely	Limited habitat.

[1] Threatened species conservation status under the NSW *Threatened Species Conservation Act, 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999.*

V = Vulnerable E = Endangered CE = Critically Endangered Ex = Extinct

[2] Birds Australia (2009) *Database Records for the Search Area: -31 50 to 32 45 and 151 23 to 152 28.*

[3] Australian Museum (2009) *Australian Museum Database Records within a Search Area between 151°50', 32°24', 151°50', 32°12', 152°03', 32°24', 152°03', 32°12'.*

[4] Department of Environment, Climate Change and Water (2009b) *Atlas of NSW Wildlife Records for the Search Area: 350000E, 6376000N, 450000E, 6476000N.*

[5] NSW Government (2009) *Database Records within a Search Area between 151.4, -32.75, 152.4, -31.85.*

[6] Department of the Environment, Water, Heritage and the Arts (2009) *Database Records within a Search Area between -31.8612, 151.3811, -32.7747, 151.3811, -32.7747, 152.4864, -31.8612, 152.4864.*

[7] Sydney Royal Botanic Gardens (2009) *Database Records within a Search Area: -31.85, 151.4, -31.85, 152.4, -32.75, 152.4, -32.75, 151.4.*

[8] Listed as *Xanthomyza phrygia* under the TSC Act.

[9] Recorded to the east of Project in 1996.

[10] Listed as *Rostratula benghalensis* under the TSC Act.

[11] Recorded along Mammy Johnsons River area.

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

References:

A EcoBiological (2009) *Flora and Fauna Survey Report: Duralie Coal Mine.*

B Woodward Clyde (1996) *Summer Fauna Report.* Appendix Gb in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement*.

C Place Planning and Design (2003) *Duralie Coal Mine – Pre-clearance Survey and Habitat Assessment.*

D Paul Webber Consulting Services (1996) *Herptological Survey of the Proposed Duralie Coal Mine via Gloucester, NSW*. Appendix GC in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement*.

E ERM Mitchell McCotter (1996) *Winter Fauna Survey for Proposed Duralie Coal Mine near Gloucester.* Appendix Ga in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

F Duralie Coal Pty Ltd (2007) Duralie *Annual Environmental Management Report - September 2007.*

G Fly By Night Bat Surveys (1996) *Winter Survey of the Bat Fauna of the Proposed Duralie Mine near Gloucester, New South Wales*. Attachment GaB in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

ATTACHMENT ED

FLORA RECORDS WITHIN THE DURALIE COAL MINE AREA AND SURROUNDS

Table ED-1
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
ADIANTACEAE				
Adiantum aethiopicum	Common Maidenhair Fern	●	●	●
Adiantum formosum	Giant Maidenhair	-	●	-
Adiantum hispidulum	Rough Maidenhair	●	●	-
Cheilanthes distans	Bristly Cloak Fern	●	●	-
Cheilanthes sieberi	Poison Rock Fern	-	●	●
Cheilanthes sieberi subsp. *sieberi*	Poison Rock Fern	●	-	-
Pellaea falcata	Sickle Fern	●	●	-
BLECHNACEAE				
Blechnum cartilagineum	Gristle Fern	●	-	-
Doodia aspera	Rasp Fern	●	●	-
DENNSTAEDTIACEAE				
Hypolepis glandulifera	Downy Ground Fern	●	-	-
Hypolepis rugosula	Ruddy Ground Fern	-	-	●
Pteridium esculentum	Common Bracken	●	●	●
DICKSONIACEAE				
Calochlaena dubia	Rainbow Fern	●	-	-
LINDSAEACEAE				
Lindsaea linearis	Screw Fern	●	-	-
Lindsaea microphylla	Lacy Wedge Fern	●	-	-
POLYPODIACEAE				
Platycerium bifurcatum	Elkhorn	●	-	-
Pyrrosia confluens	Robber Fern	●	-	-
SELAGINELLACEAE				
Selaginella uliginosa	Swamp Selaginella	●	-	-
ACANTHACEAE				
Brunoniella australis	Blue Trumpet	●	-	-
Pseuderanthemum variabile	Pastel Flower	●	-	-
APIACEAE				
Centella asiatica	Indian Pennywort	-	-	●
Daucus glochidiatus	Native Carrot	●	-	-
Hydrocotyle peduncularis	-	●	-	-
Hydrocotyle tripartita	Pennywort	●	-	-
APOCYNACEAE				
Parsonsia straminea	Common Silkpod	●	●	●
ARALIACEAE				
Polyscias sambucifolia	Elderberry Panax	●	-	-
Polyscias sambucifolia subsp. A	Elderberry Panax	-	●	-
ASCLEPIADACEAE				
Marsdenia suaveolens	Scented Marsdenia	●	-	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
ASTERACEAE				
**Facelis retusa*	-	●	-	-
**Ageratina adenophora*	Crofton Weed	●	-	-
**Aster subulatus*	Wild Aster	●	-	-
**Bidens pilosa*	Cobblers Pegs	●	-	-
Brachyscome multifida var multifida	Cut-leaf Daisy	●	-	-
Brachyscome angustifolia var. *heterophylla*	-	●	-	-
Calotis cuneifolia	Purple Burr-daisy	●	-	-
Cassinia quinquefaria	-	●	-	-
**Chrysanthemoides monilifera*	Bitou Bush	●	-	-
Chrysocephalum apiculatum	Common Everlasting	-	-	●
**Cirsium vulgare*	Spear Thistle	●	-	-
**Conyza bonariensis*	Flaxleaf Fleabane	●	●	-
**Conyza* sp.	-	●	-	-
**Gamochaeta pensylvanica*	Cudweed	●	-	-
Euchiton gymnocephalus	-	●	-	-
Euchiton involucratus	Star Cudweed	●	-	-
**Euchiton* sp.	-	●	-	-
Euchiton sphaericus	-	●	-	-
**Galinsoga parviflora*	Potato Weed	●	-	-
**Hypochaeris radicata*	Flatweed	●	●	●
Lagenophora stipitata	Blue Bottle-daisy	●	-	-
Ozothamnus diosmifolius	White Dogwood	●	●	●
**Senecio madagascariensis*	Fireweed	●	●	●
**Silybum marianum*	Variegated Thistle	-	●	-
**Tagetes minuta*	Stinking Roger	●	-	-
**Taraxacum officinale*	Dandelion	●	-	-
Vittadinia cuneata	Fuzzweed	●	-	-
**Xanthium occidentale*	Noogoora Burr	●	-	-
Chrysocephalum semipapposum	Clustered Everlasting	●	-	-
BIGNONIACEAE				
Pandorea pandorana subsp. *pandorana*	Wonga Wonga Vine	●	●	-
CAMPANULACEAE				
Wahlenbergia communis	Tufted Bluebell	●	-	-
Wahlenbergia gracilis	Sprawling Bluebell	●	-	-
Wahlenbergia planiflora	-	●	-	-
Wahlenbergia stricta	Australian Bluebell	●	-	-
CARYOPHYLLACEAE				
**Cerastium glomeratum*	Mouse-eared Chickweed	●	●	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
CASUARINACEAE				
Allocasuarina littoralis	Black She-oak	●	-	-
Allocasuarina torulosa	Foeest Oak	●	●	-
Casuarina cunninghamia	River Oak	●	●	-
Casuarina glauca	Swamp Oak	-	-	●
CELASTRACEAE				
Maytenus silvestris	Narrow-leaved Orangebark	●	-	-
CHENOPODIACEAE				
Einadia trigonos subsp. *leiocarpa*	Fishweed	●	-	-
CLUSIACEAE				
Hypericum gramineum	Small Saint John's Wort	●	-	●
CONVOLVULACEAE				
Dichondra repens	Kidney Weed	●	-	●
Polymeria calycina	-	●	-	-
CUNONIACEAE				
Aphanopetalum resinosum	Gum Vine	-	●	-
DILLENIACEAE				
Hibbertia aspera	Rough Guinea Flower	●	●	-
Hibbertia dentata	Trailing Guinea Flower	●	-	-
Hibbertia diffusa	Wedge Guinea Flower	●	●	-
Hibbertia linearis	-	●	-	-
Hibbertia obtusifolia	Hoary Guinea Flower	●	-	-
Hibbertia pedunculata	-	●	-	-
Hibbertia riparia	Erect Guinea-flower	●	-	-
Hibbertia scandens	Climbing Guinea Flower	●	-	-
Hibbertia serpyllifolia	Hairy Guinea Flower	●	-	-
Hibbertia sp.	-	-	●	●
DROSERACEAE				
Drosera auriculata	-	●	-	-
ELAEOCARPACEAE				
Elaeocarpus obovatus	Hard Quandong	●	-	-
ERICACEAE				
Leucopogon juniperinus	Prickly Beard Heath	●	●	●
Leucopogon sp.	-	-	-	●
EUPHORBIACEAE				
Baloghia inophylla	Brush Bloodwood	●	-	-
Breynia oblongifolia	Coffee Bush	●	-	-
Glochidion ferdinandi var. *ferdinandi*	Cheese Tree	●	-	-
Poranthera microphylla	-	●	-	-
Phyllanthus hirtellus forma A	-	-	●	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
FABACEAE (FABOIDEAE)				
Bossiaea prostrata	-	●	-	-
Daviesia genistifolia	Broom Bitter Pea	●	●	-
Daviesia ulicifolia	Gorse Bitter Pea	●	-	●
Desmodium brachypodum	Large Tick-trefoil	●	-	-
Desmodium rhytidophyllum	-	●	-	-
Desmodium varians	Slender Tick-trefoil	●	-	-
Dillwynia retorta	-	●	-	-
Glycine clandestina	-	●	-	●
Glycine clandestina species complex		-	●	-
Glycine microphylla	Small-leaf glycine	●	-	-
Glycine tabacina	-	●	-	●
Gompholobium inconspicuum	-	●	-	-
Gompholobium pinnatum	Pinnate Wedge Pea	●	-	-
Gompholobium virgatum var. *virgatum*	Leafy Wedge Pea	●	-	-
Hardenbergia violacea	False Sarsaparilla	●	●	●
Indigofera australis	Australian Indigo	●	-	-
Jacksonia scoparia	Winged Broom-pea	-	-	●
Kennedia rubicunda	Red Kidney Pea	●	●	-
Lotus australis	Australian Trefoil	●	-	-
Platylobium formosum subsp *parviflorum*	-	●	-	-
Podolobium ilicifolium	Prickly Shaggy Pea	●	-	-
Podolobium scandens	Netted Shaggy Pea	●	-	-
Pultenaea euchila	-	●	-	-
Pultenaea retusa	-	●	-	●
Pultenaea villosa	Hairy Bush-pea	●	●	-
**Trifolium dubium*	Yellow Suckling Flower	●	-	●
**Trifolium fragiferum*	Strawberry Clover	●	-	-
**Trifolium repens*	White Clover	●	●	-
Viminaria juncea	Golden Spray	●	-	-
FABACEAE (MIMOSOIDEAE)				
Acacia decurrens	Black Wattle	●	-	-
Acacia falcata	Sickle Wattle	●	●	-
Acacia floribunda	White Sally Wattle	●	-	-
Acacia implexa	Hickory Wattle	●	-	-
Acacia irrorata	Green Wattle	●	●	●
Acacia linifolia	White Wattle	●	-	-
Acacia longifolia	Sydney Golden Wattle	●	●	●
Acacia longissima	Long-leaf Wattle	●	●	●

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
Acacia maidenii	Maiden's Wattle	●	-	-
Acacia melanoxylon	Blackwood	●	-	-
Acacia myrtifolia	Red-stemmed Wattle	●	-	-
Acacia ulicifolia	Prickly Moses	●	●	●
GERANIACEAE				
**Erodium cicutarium*	Common Storksbill	●	-	-
Geranium homeanum	-	●	-	-
Geranium solanderi var solanderi	Austral Cranesbill	●	-	-
GOODENIACEAE				
Goodenia heterophylla subsp. *heterophylla*	-	●	●	-
Goodenia paniculata	Branched Goodenia	●	-	-
HALORAGACEAE				
Gonocarpus micranthus subsp. *micranthus*	Creeping Raspwort	●	-	-
Gonocarpus teucrioides	Raspwort	●	-	●
LAMIACEAE				
**Stachys arvensis*	Stagger Weed	●	-	-
Plectranthus parviflorus	-	●	-	-
**Prunella vulgaris*	Self-Heal	-	-	●
LAURACEAE				
Cassytha glabella forma glabella	-	●	-	-
Cryptocarya microneura	Murrogum	-	●	-
LOBELIACEAE				
Pratia purpurascens	Whiteroot	●	●	●
LOGANIACEAE				
Mitrasacme sp.	-	-	-	●
LORANTHACEAE				
Amyema miquelii	-	●	-	-
LUZURIAGACEAE				
Eustrephus latifolius	Wombat Berry	●	●	-
Geitonoplesium cymosum	Scrambling Lily	●	-	-
MALVACEAE				
**Sida rhombifolia*	Paddy's Lucerne	●	-	●
MELIACEAE				
Melia azedarach	White Cedar	●	-	-
MENISPERMACEAE				
Stephania japonica var. *discolor*	Snake Vine	●	-	-
MONIMIACEAE				
Wilkiea huegeliana	Veiny Wilkiea	●	-	-
MORACEAE				
Ficus coronata	Sandpaper Fig	●	-	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
Streblus brunonianus	Whalebone Tree	●	-	-
MYOPORACEAE				
Eremophila debilis	Amulla	●	●	-
MYRSINACEAE				
**Anagallis arvensis*	Scarlet Pimpernel	●	-	-
Myrsine howittiana	Brush Muttonwood	●	-	-
MYRTACEAE				
Angophora costata	Sydney Red Gum	●	-	-
Angophora floribunda	Rough-barked Apple	●	●	●
Backhousia myrtifolia	Grey Myrtle	●	-	-
Callistemon linearis	Narrow-leaved Bottlebrush	●	-	●
Callistemon rigidus	Stiff Bottlebrush	●	-	-
Callistemon salignus	Willow Bottlebrush	●	●	●
Choricarpia leptopetala	Brown Myrtle	-	●	-
Corymbia maculata	Spotted Gum	●	●	●
Eucalyptus acmenoides	White Mahogany	●	●	-
Eucalyptus amplifolia subsp. *amplifolia*	Cabbage Gum	●	●	●
Eucalyptus canaliculata	Large-fruited Grey Gum	●	●	-
Eucalyptus carnea	Thin-leaved White Mahogany	●	●	-
Eucalyptus crebra	Narrow-leaved Ironbark	●	-	-
Eucalyptus eugenioides	Thin-leaved Stringybark	●	●	●
Eucalyptus fibrosa	Red Ironbark	●	●	●
Eucalyptus globoidea	White Stringybark	●	●	●
Eucalyptus microcorys	Tallowwood	●	-	-
Eucalyptus molucanna	Grey Box	●	●	●
Eucalyptus propinqua	Small-fruited Grey Gum	●	-	-
Eucalyptus punctata	Grey Gum	●	●	●
Eucalyptus resinifera	Red Mahogany	●	-	-
Eucalyptus saligna	Sydney Blue Gum	●	●	-
Eucalyptus siderophloia	Grey Ironbark	●	●	●
Eucalyptus tereticornis	Forest Red Gum	●	●	●
Leptospermum juniperinum	Prickly Tea-tree	-	●	-
Leptospermum polygalifolium	Tantoon	-	-	●
Leptospermum polygalifolium subsp. *cismontanum*	Tantoon	●	●	-
Leptospermum trinervium	Slender Tea-tree	●	-	-
Melaleuca decora	-	●	●	-
Melaleuca linariifolia	Flax-leaved Paperbark	●	●	●
Melaleuca nodosa	-	●	●	●
Melaleuca sieberi	-	-	●	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
Melaleuca styphelioides	Prickly-leaved Tea Tree	●	●	-
Syncarpia glomulifera	Turpentine	●	●	-
Syzgium australe	Brush Cherry	-	●	-
Tristaniopsis laurina	Water Gum	●	●	●
Waterhousea floribunda	Weeping Lilly Pilly	●	-	-
OLEACEAE				
**Ligustrum sinense*	Small-leaved Privet	●	●	-
Notelaea longifolia	Large Mock-olive	●	●	-
ONAGRACEAE				
Ludwigia peploides	Water Primrose	●	-	-
OXALIDACEAE				
Oxalis exilis	-	●	-	-
Oxalis perennans	-	●	-	-
PHYLLANTHACEAE				
Phyllanthus gunnii	Scrubby Spurge	●	-	-
Phyllanthus hirtellus	-	●	-	-
PHYTOLACCACEAE				
**Phytolacca octandra*	Inkweed	●	-	-
PITTOSPORACEAE				
Billardiera scandens var. *scandens*	Appleberry	●	●	-
Bursaria spinosa	Blackthorn	●	-	-
Pittosporum multiflorum	Orange Thorn	●	●	-
Pittosporum revolutum	Wild Yellow Jasmine	●	-	-
Pittosporum undulatum	Native Daphne	●	-	-
PLANTAGINACEAE				
**Plantago lanceolata*	Lamb's Tongues	●	-	●
POLYGALACEAE				
Comesperma ericinum	Pyramid Flower	●	-	-
POLYGONACEAE				
Persicaria decipiens	Slender Knotweed	●	-	-
Persicaria hydropiper	Water Pepper	●	-	-
Persicaria strigosa	-	-	●	-
**Rumex crispus*	Curled Dock	●	-	-
PROTEACEAE				
Banksia spinulosa var. *collina*	Hairpin Banksia	●	●	-
Lomatia silaifolia	Crinkle Bush	●	-	-
Persoonia levis	Broad-leaved Geebung	●	-	-
Persoonia linearis	Narrow-leaved Geebung	●	●	-
RANUNCULACEAE				
Clematis aristata	Old Man's Beard	●	-	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
Clematis glycinoides	Headache Vine	●	●	-
Ranunculus inundatus	River Buttercup	●	-	-
Ranunculus lappaceus	Common Buttercup	●	-	-
Ranunculus sp.	-	-	-	●
RHAMNACEAE				
Alphitonia excelsa	Red Ash	●	-	-
Pomaderris elliptica	-	●	-	-
ROSACEAE				
**Rubus fruticosus*	Blackberry	●	●	-
Rubus moluccanus var. *trilobus*	Molucca Bramble	●	-	-
Rubus parvifolius	Native Raspberry	●	-	-
Rubus rosifolius var rosifolius	Rose-leaf Bramble	●	-	-
RUBIACEAE				
Asperula conferta	Common Woodruff	●	-	-
Galium propinquum	Maori Bedstraw	●	-	-
Opercularia diphylla	-	●	-	-
Pomax umbellata	-	●	●	●
**Richardia humistrata*	-	●	-	-
**Richardia stellaris*	-	●	-	-
RUTACEAE				
Boronia polygalifolia	Dwarf Boronia	●	-	-
Melicope micrococca	Hairy-leaved Doughwood	-	●	-
Zieria smithii	Sandfly Zieria	●	-	-
Zieria sp.	-	-	●	-
SANTALACEAE				
Exocarpos cupressiformis	Native Cherry	●	●	●
SAPINDACEAE				
Dodonaea triquetra	Large-leaf Hop-bush	●	-	-
Dodonaea viscosa subsp. *angustifolia*	Sticky Hop-bush	●	-	-
Guioa semiglauca	Guioa	●	-	-
SCROPHULARIACEAE				
**Veronica peregrina*	Wandering Speedwell	-	-	●
Veronica plebeia	Trailing Speedwell	●	-	●
SOLANACEAE				
Duboisia myoporoides	Corkwood	●	-	-
**Solanum mauritianum*	Wild Tobacco Bush	●	-	●
Solanum prinophyllum	Forest Nightshade	●	-	-
Solanum sp.	-	-	●	-
STACKHOUSIACEAE				
Stackhousia viminea	Slender Stackhousia	●	-	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
STERCULIACEAE				
Brachychiton populneus	Kurrajong	●	-	-
THYMELAEACEAE				
Pimelea linifolia[#]	Slender Rice Flower	-	-	●
Pimelea linifolia subsp. *linifolia*	Rice Flower	●	-	-
Pimelea sp.	-	-	-	●
ULMACEAE				
Trema tomentosa var. *viridis*	Peach-leaf Poison-bush	●	-	-
URTICACEAE				
**Urtica urens*	Small Nettle	●	-	-
VERBENACEAE				
**Lantana camara*	Lantana	●	-	-
**Verbena bonariensis*	Purpletop	●	●	-
**Verbena rigida*	Veined Verbena	●	-	-
**Verbena* sp.	-	-	-	●
VIOLACEAE				
Viola betonicifolia	Native Violet	●	-	-
Viola hederacea	Ivy-leaved Violet	●	●	-
VITACEAE				
Cissus antarctica	Kangaroo Vine	●	●	-
Cissus hypoglauca	Water Vine	●	-	-
ANTHERICACEAE				
Caesia parviflora	Pale Grass-lily	-	-	●
Caesia parviflora var. *parviflora*	Pale Grass-lily	●	-	-
Laxmannia gracilis	Slender Wire Lily	●	-	●
Tricoryne elatior	Yellow Rush-Lily	-	-	●
Tricoryne simplex	-	●	-	-
COMMELINACEAE				
Commelina cyanea	Native Wandering Jew	●	-	-
**Tradescantia fluminensis*	Wandering Jew	●	-	-
CYPERACEAE				
Carex appressa	Tall Sedge	●	-	-
Carex brownii	-	●	-	-
Carex longebrachiata	-	●	-	-
Carex maculata	-	●	-	-
Carex sp.	-	-	●	●
**Cyperus brevifolius*	-	●	-	-
**Cyperus congestus*	-	●	-	-
**Cyperus eragrostis*	-	●	-	-
Cyperus difformis	-	-	●	-
Cyperus polystachyos	-	●	-	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
Cyperus sp.		-	●	-
Eleocharis sphacelata	-	●	-	-
Fimbristylis dichotoma	Common Fringe-sedge	●	-	-
Gahnia aspera	Rough Saw-sedge	-	●	●
Gahnia clarkei	Tall Saw-sedge	●	●	-
Gahnia radula	-	●	-	-
Gahnia sieberiana	Red-fruit Saw-sedge	●	-	-
Lepidosperma laterale	-	●	-	-
Schoenoplectus mucronatus	-	●	●	-
Schoenus ericetorum	-	●	-	-
HYDROCHARITACEAE				
Ottelia ovalifolia	Swamp Lily	-	●	-
IRIDACEAE				
**Romulea rosea* var. *australis*	Onion Grass	-	●	-
JUNCACEAE				
Juncus bufonius	Toad Rush	●	-	-
Juncus continuus	-	●	-	-
Juncus usitatus	-	●	-	-
Juncus sp.	-	-	●	●
Juncus subsecundus	-	-	-	●
JUNCAGINACEAE				
Triglochin procera	Water Ribbons	-	●	-
LILIACEAE				
**Lilium formosanum*	Formosan Lily	●	-	-
LOMANDRACEAE				
Lomandra confertifolia subsp. *rubiginosa*	-	●	-	-
Lomandra filiformis	Wattle Mat-rush	-	-	●
Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush	●	-	-
Lomandra glauca	Pale Mat-rush	●	-	-
Lomandra longifolia	Spiny-headed Mat-rush	●	●	●
Lomandra multiflora	Many-flowered Mat-rush	●	●	-
Lomandra obliqua	-	●	-	-
ORCHIDACEAE				
Acianthus fornicatus	Pixie Caps	●	-	-
Acianthus sp.	-	-	●	-
Caladenia carnea var. *carnea*	Pink Fairy	●	-	-
Chiloglottis diphylla	-	●	-	-
Cymbidium canaliculatum	Tiger Orchid	-	-	-
Cymbidium suave	Snake Orchid	●	-	-
Dendrobium aemulum	Ironbark Orchid	-	-	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
Glossodia major	Waxlip Orchid	●	-	-
Pterostylis sp.	-	●	-	-
Spiranthes australis	Ladies' Tresses	●	-	-
PHILYDRACEAE				
Philydrum lanuginosum	Woolly Waterlily	●	-	-
PHORMIACEAE				
Dianella caerulea	Blue Flax-lily	●	-	-
Dianella longifolia	Blueberry Lily	●	-	-
Dianella tasmanica	Tasman Flax-lily	●	-	-
Dianella sp.	-	-	●	●
POACEAE				
**Andropogon virginicus*	Whisky Grass	●	●	●
Aristida ramosa	Purple Wiregrass	●	-	-
Aristida sp.	-	-	●	-
Aristida vagans	Threeawn Speargrass	●	-	-
Austrodanthonia tenuior	-	-	-	●
**Briza minor*	Shivery Grass	-	●	●
Capillipedium parviflorum	Scented-top Grass	●	-	-
**Chloris gayana*	Rhodes Grass	●	-	-
Chloris truncata	Windmill Grass	-	●	-
**Chloris virgata*	Feathertop Rhodes Grass	●	-	-
Cymbopogon refractus	Barbed Wire Grass	●	●	-
Cynodon dactylon	Common Couch	●	●	-
**Cynosurus echinatus*	Rough Dog's Tail	●	-	-
Danthonia sp.	-	-	●	-
Dichelachne crinita	Longhair Plumegrass	●	-	-
Dichelachne micrantha	Shorthair Plumegrass	●	-	-
**Digitaria aequiglumis*	-	●	-	-
Digitaria parviflora	Small-flowered Finger Grass	●	-	-
Digitaria ramularis	-	●	-	-
**Digitaria sanguinalis*	Summer Grass	●	-	-
Digitaria sp.	-	-	●	-
Echinopogon caespitosus	Bushy Hedgehog-grass	●	●	-
Echinopogon caespitosus var. *caespitosus*	Tufted Hedgehog Grass	-	-	●
Echinopogon ovatus	Forest Hedgehog Grass	●	-	-
Entolasia marginata	Bordered Panic	●	-	-
Entolasia stricta	Wiry Panic	●	●	-
Eragrostis brownii	Brown's Lovegrass	●	-	-
**Eragrostis cilianensis*	Stinkgrass	●	-	-
**Eragrostis curvula*	African Lovegrass	●	-	-
Eragrostis leptostachya	Paddock Lovegrass	●	-	-

Table ED-1 (Continued)
Flora Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Reference		
		EcoBiological (2009)[1]	ERM Mitchell McCotter (1996)[2]	FloraSearch (2005)[3]
Imperata cylindrica	Blady Grass	-	-	●
Imperata cylindrica var. *major*	Blady Grass	●	●	-
Joycea pallida	Silvertop Wallaby Grass	●	-	-
**Melinis repens*	Red Natal Grass	●	-	-
Microlaena stipoides var *stipoides*	Weeping Grass	●	-	-
**Paspalum dilatatum*	Paspalum	-	-	●
Paspalidium sp.	-	-	-	●
Poa sieberiana	Snowgrass	-	-	●
Themeda australis	Kangaroo Grass	-	-	●

[1] EcoBiological (2009) *Flora and Fauna Survey Report: Duralie Coal Mine.*

[2] ERM Mitchell McCotter (1996) *Flora Survey for Proposed Duralie Coal Mine Near Gloucester*. Appendix Fa in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

[3] FloraSearch (2005) *Vegetation Mapping and Targeted Threatened Flora Species Search for Duralie Extended*.

* Introduced species.

Equivalent to *Pimelea linifolia* subsp. *linifolia.*

Table ED-2
Explanations for Exclusion of Some Species Names in Table ED-1

Scientific Name	Survey(s)[1, 2]	Reasons for Change
Euchiton collinus	EcoBiological (2009)	Species name change from *Euchiton collinus* to *E. gymnocephalus.*
Lagenifera stipitata	EcoBiological (2009)	This species is now in the genus *Lagenophora*.
Vittadenia cunneata	EcoBiological (2009)	EcoBiological recorded *Vittadenia cunneata* and *Vittadinia cuneata*. *Vittadenia cunneata* is most likely an error and not listed in Table EB-1 above.
**Euchiton pensylvanica*	EcoBiological (2009)	This species is now in the genus *Gamochaeta.*
Citriobatus pauciflorus	ERM Mitchell McCotter (1996)	Taxonomic name change to *Pittosporum multiflorum.*
Rubus hillii	ERM Mitchell McCotter (1996)	Taxonomic name change to *Rubus moluccanus* var. *trilobus.*
Eucalyptus maculata	ERM Mitchell McCotter (1996)	Taxonomic name change to *Corymbia maculata.*
Triglochin procerum	ERM Mitchell McCotter (1996)	Taxonomic name change to *Triglochin procera.*
Spiranthes sinensis	EcoBiological (2009)	Taxonomic name change to *Spiranthes australis.*
Aristida ramosa var. *ramosa*	EcoBiological (2009)	Taxonomic name *Aristida ramosa*.
**Setaria glauca*	EcoBiological (2009)	Synonym of **Setaria pumila*.

[1] EcoBiological (2009) *Flora and Fauna Survey Report: Duralie Coal Mine.*

[2] ERM Mitchell McCotter (1996) *Flora Survey for Proposed Duralie Coal Mine Near Gloucester*. Appendix Fa in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

ATTACHMENT EE

VERTEBRATE FAUNA RECORDS WITHIN THE DURALIE COAL MINE AREA AND SURROUNDS

Table EE-1
Vertebrate Fauna Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Conservation Status[1]		Reference								
		TSC Act	EPBC Act	EcoBiological (2009a)[2]	ERM Mitchell McCotter (1996)[3]	Fly By Night Bat Surveys (1996)[4]	Woodward-Clyde (1996)[5]	Paul Webber Consulting Services (1996)[6]	Debus (1995)[7]	Place Planning and Design (2003)[8]	Duralie Coal Pty Ltd (2007)[9]	EcoBiological (2009b)[10]
Amphibians												
MYOBATRACHIDAE												
Adelotus brevis	Tusked Frog			●	-	-	-	-	-	-	-	●
Crinia signifera	Common Eastern Froglet			●	●	-	-	●	-	-	-	●
Crinia parinsignifera	Eastern Sign-bearing Froglet			-	-	-	-	●	-	-	-	-
Limnodynastes peronii	Brown-striped Frog			●	●	-	-	●	-	-	-	●
Limnodynastes tasmaniensis	Spotted Grass Frog			●	-	-	-	●	-	-	-	-
Mixophyes iteratus	Giant Barred Frog	E	E	●	-	-	-	-	-	-	-	●
Pseudophryne bibronii	Brown Toadlet			●	-	-	-	-	-	-	-	-
Pseudophryne coriacea	Red-backed Toadlet			●	-	-	-	-	-	-	-	●
Uperoleia fusca	Dusky Toadlet			●	-	-	-	-	-	-	-	-
Uperoleia laevigata	Smooth Toadlet			●	-	-	-	●	-	-	-	-
HYLIDAE												
Litoria dentata	Bleating Tree Frog			●	-	-	-	●	-	-	-	-
Litoria fallax	Eastern Dwarf Tree Frog			●	●	-	-	●	-	-	-	●
Litoria latopalmata	Broad-palmed Frog			●	-	-	-	●	-	-	-	●
Litoria peronii	Peron's Tree Frog			●	-	-	-	●	-	-	-	-
Litoria phyllochroa	Leaf-green Tree Frog			●	-	-	-	-	-	-	-	●
Litoria tyleri	Tyler's Tree Frog			●	-	-	-	●	-	-	-	-
Litoria verreauxii	Verreaux's Tree Frog			●	●	-	-	●	-	-	-	●
Litoria wilcoxii	Rocky River Frog			●	-	-	-	-	-	-	-	●

Table EE-1 (Continued)
Vertebrate Fauna Records within the Duralie Coal Mine Area and Surrounds

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Reptiles												
CHELIDAE												
Chelodina longicollis	Snake-necked Turtle			●	-	-	-	●	-	-	-	●
SCINCIDAE												
Ctenotus robustus	Robust Ctenotus			●	-	-	-	-	-	-	-	●
Eulamprus quoyii	Eastern Water Skink			●	-	-	-	●	-	-	-	●
Lampropholis delicata	Dark-flecked Garden Sunskink			-	-	-	-	●	-	-	-	●
Saiphos equalis	Three-toed Skink			●	-	-	-	-	-	-	-	-
AGAMIDAE												
Physignathus lesueurii	Eastern Water Dragon			●	●	-	-	●	-	-	-	-
Pogona barbata	Bearded Dragon			●	-	-	-	●	-	-	-	-
VARANIDAE												
Varanus varius	Lace Monitor			●	-	-	-	-	-	-	-	●
TYPHLOPIDAE												
Ramphotyphlops nigrescens	Blackish Blind Snake			-	-	-	-	●	-	-	-	-
BOIDAE												
Morelia spilota spilota	Diamond Python			-	-	-	-	-	-	-	-	●
ELAPIDAE												
Furina diadema	Red-naped Snake			●	-	-	-	-	-	-	-	-
Hemiaspis signata	Black-bellied Swamp Snake			-	●	-	-	-	-	-	-	-
Pseudechis porphyriacus	Red-bellied Black Snake			●	●	-	-	●	-	-	-	-
Pseudonaja textilis	Eastern Brown Snake			●	●	-	-	-	-	-	-	-

Table EE-1 (Continued)
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Birds												
PHASIANIDAE												
Coturnix ypsilophora	Brown Quail			-	-	-	-	-	●	-	-	-
ANATIDAE												
Chenonetta jubata	Australian Wood Duck			●	●	-	-	-	-	-	-	-
Anas superciliosa	Pacific Black Duck			●	●	-	-	-	●	-	-	-
Anas castanea	Chestnut Teal			●	-	-	-	-	-	-	-	-
Aythya australis	Hardhead			●	-	-	-	-	-	-	-	-
PODICIPEDIDAE												
Tachybaptus novaehollandiae	Australasian Grebe			●	-	-	-	-	-	-	-	-
THRESKIORNITHIDAE												
Threskiornis spinicollis	Straw-necked Ibis			●	●	-	-	-	-	-	-	-
ARDEIDAE												
Egretta novaehollandiae	White-faced Heron			●	●	-	-	-	●	-	-	●
PHALACROCORACIDAE												
Phalacrocorax melanoleucos	Little Pied Cormorant			●	-	-	-	-	-	-	-	-
ANHINGIDAE												
Anhinga melanogaster	Darter			●	-	-	-	-	-	-	-	-
FALCONIDAE												
Falco longipennis	Australian Hobby			-	●	-	-	-	-	-	-	-
Falco berigora	Brown Falcon			-	-	-	-	-	-	-	-	●
ACCIPITRIDAE												
Aviceda subcristata	Pacific Baza			●	-	-	-	-	-	-	-	-

Table EE-1 (Continued)
Vertebrate Fauna Records within the Duralie Coal Mine Area and Surrounds

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Birds (Continued)												
Elanus axillaris	Black-shouldered Kite			●	●	-	-	-	-	-	-	-
Accipiter novaehollandiae	Grey Goshawk			●	-	-	-	-	-	-	-	-
Accipiter cirrocephalus	Collared Sparrowhawk			-	-	-	-	-	-	-	-	●
Aquila audax	Wedge-tailed Eagle			●	●	-	-	●	●	-	-	-
RALLIDAE												
Porphyrio porphyrio	Purple Swamphen			-	-	-	-	-	●	-	-	-
Gallinula tenebrosa	Dusky Moorhen			-	-	-	-	-	●	-	-	-
TURNICIDAE												
Turnix varius	Painted Button-quail			-	-	-	-	-	●	-	-	-
CHARADIIDAE												
Vanellus miles	Masked Lapwing			●	●	-	-	-	●	-	-	●
COLUMBIDAE												
Columba leucomela	White-headed Pigeon			●	-	-	-	●	-	-	-	-
*Streptopelia chinensis**	Spotted Turtle-Dove*			-	●	-	-	-	-	-	-	-
Macropygia amboinensis	Brown Cuckoo-Dove			●	-	-	-	-	-	-	-	●
Phaps chalcoptera	Common Bronzewing			●	-	-	-	-	-	-	-	-
Ocyphaps lophotes	Crested Pigeon			-	●	-	-	-	-	-	-	-
Leucosarcia melanoleuca	Wonga Pigeon			●	-	-	-	-	-	-	-	●
Geopelia humeralis	Bar-shouldered Dove			●	-	-	-	-	-	-	-	●
Ptilinopus regina	Rose-crowned Fruit-Dove	V	-	-	-	-	●[11]	-	-	-	-	-
Lopholaimus antarcticus	Topknot Pigeon			-	-	-	-	-	●	-	-	-

Table EE-1 (Continued)
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Birds (Continued)												
PSITTACIDAE												
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	-	-	-	-	-	-	-	-	●
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo			●	●	-	-	-	●	-	-	●
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	-	-	-	-	-	-	-	-	●
Cacatua roseicapilla	Galah			●	-	-	-	-	-	-	-	●
Cacatua galerita	Sulphur-crested Cockatoo			-	●	-	-	-	-	-	-	●
Glossopsitta concinna	Musk Lorikeet			●	-	-	-	-	-	-	-	-
Platycercus elegans	Crimson Rosella			●	-	-	-	-	-	-	-	●
Platycercus eximius	Eastern Rosella			●	●	-	-	-	●	-	-	●
Lathamus discolor	Swift Parrot	E	E	●	-	-	-	-	-	-	-	-
Alisterus scapularis	Australian King-Parrot			●	●	-	-	-	●	-	-	●
CUCULIDAE												
Cacomantis flabelliformis	Fan-tailed Cuckoo			●	●	-	-	-	●	-	-	-
Chrysococcyx lucidus	Shining Bronze-Cuckoo			●	-	-	-	-	●	-	-	-
Eudynamys scolopacea	Common Koel			-	-	-	-	-	●	-	-	-
Scythrops novaehollandiae	Channel-billed Cuckoo			●	-	-	-	-	●	-	-	-
CENTROPODIDAE												
Centropus phasianinus	Pheasant Coucal			●	-	-	-	-	●	-	-	●
TYTONIDAE												
Tyto tenebricosa	Sooty Owl[12]	V	-	-	-	-	-	●	-	-	-	-
Tyto alba	Barn Owl			●	●	-	-	-	●	●	-	-

Table EE-1 (Continued)
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Birds (Continued)												
STRIGIDAE												
Ninox strenua	Powerful Owl	V	-	-	-	-	●	-	-	-	-	-
Ninox novaeseelandiae	Southern Boobook			●	-	-	-	●	●	●	-	●
PODARGIDAE												
Podargus strigoides	Tawny Frogmouth			●	●	-	-	●	●	-	-	●
CAPRIMULGIDAE												
Eurostopodus mystacalis	White-throated Nightjar			-	-	-	-	-	●	-	-	●
AEGOTHELIDAE												
Aegotheles cristatus	Australian Owlet-nightjar			-	-	-	-	-	-	-	-	●
APODIDAE												
Hirundapus caudacutus	White-throated Needletail		Mi	-	-	-	-	-	●	-	-	-
CORACIIDAE												
Eurystomus orientalis	Dollarbird			●	-	-	-	-	●	-	-	-
ALCEDINIDAE												
Dacelo novaeguineae	Laughing Kookaburra			●	●	-	-	-	●	-	-	●
Todiramphus sanctus	Sacred Kingfisher			●	-	-	-	-	●	-	-	-
Alcedo azurea	Azure Kingfisher			●	-	-	-	-	-	-	-	-
MEROPIDAE												
Merops ornatus	Rainbow Bee-eater		Mi	●	-	-	-	-	-	-	-	-
CLIMACTERIDAE												
Cormobates leucophaeus	White-throated Treecreeper			●	●	-	-	-	●	-	-	●

Table EE-1 (Continued)
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Birds (Continued)												
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	-	●	-	-	-	-	-	-	-	-
MALURIDAE												
Malurus lamberti	Variegated Fairy-wren			●	-	-	-	-	●	-	-	●
Malurus cyaneus	Superb Fairy-wren			●	●	-	-	-	●	-	-	●
Malurus melanocephalus	Red-backed Fairy-wren			-	-	-	-	-	-	-	-	●
Stipiturus malachurus	Southern Emu-wren			●	-	-	-	-	-	-	-	-
PARDALOTIDAE												
Pardalotus punctatus	Spotted Pardalote			●	●	-	-	-	●	-	-	●
Pardalotus striatus	Striated Pardalote			●	●	-	-	-	-	-	-	●
ACANTHIZIDAE												
Pyrrholaemus sagittata	Speckled Warbler	V	-	●	-	-	-	-	-	-	-	●
Sericornis citreogularis	Yellow-throated Scrubwren			●	-	-	-	-	●	-	-	●
Sericornis frontalis	White-browed Scrubwren			●	●	-	-	-	●	-	-	●
Sericornis magnirostris	Large-billed Scrubwren			●	-	-	-	-	●	-	-	●
Smicrornis brevirostris	Weebill			●	-	-	-	-	-	-	-	-
Gerygone mouki	Brown Gerygone			●	-	-	-	-	●	-	-	●
Gerygone olivacea	White-throated Gerygone			●	-	-	-	-	●	-	-	●
Acanthiza pusilla	Brown Thornbill			●	●	-	-	-	●	-	-	●
Acanthiza reguloides	Buff-rumped Thornbill			●	-	-	-	-	-	-	-	●
Acanthiza chrysorrhoa	Yellow-rumped Thornbill			●	-	-	-	-	●	-	-	●
Acanthiza nana	Yellow Thornbill			●	-	-	-	-	●	-	-	●

Table EE-1 (Continued)
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Birds (Continued)												
Acanthiza lineata	Striated Thornbill			●	-	-	-	-	●	-	-	●
MELIPHAGIDAE												
Lichenostomus chrysops	Yellow-faced Honeyeater			●	●	-	-	-	●	-	-	●
Lichenostomus fuscus	Fuscous Honeyeater			●	-	-	-	-	-	-	-	-
Lichenostomus penicillatus	White-plumed Honeyeater			●	-	-	-	-	-	-	-	-
Meliphaga lewinii	Lewin's Honeyeater			●	●	-	-	-	●	-	-	●
Manorina melanophrys	Bell Miner			-	-	-	-	-	-	-	-	●
Manorina melanocephala	Noisy Miner			●	●	-	-	-	●	-	-	●
Melithreptus brevirostris	Brown-headed Honeyeater			●	-	-	-	-	●	-	-	-
Melithreptus lunatus	White-naped Honeyeater			●	●	-	-	-	●	-	-	●
Philemon corniculatus	Noisy Friarbird			●	●	-	-	-	●	-	-	●
Anthochaera carnunculata	Red Wattlebird			●	-	-	-	-	-	-	-	●
Acanthorhynchus tenuirostris	Eastern Spinebill			●	●	-	-	-	-	-	-	●
Myzomela sanguinolenta	Scarlet Honeyeater			●	-	-	-	-	●	-	-	-
PETROICIDAE												-
Eopsaltria australis	Eastern Yellow Robin			●	●	-	-	-	●	-	-	●
Microeca fascinans	Jacky Winter			●	-	-	-	-	●	-	-	-
Petroica rosea	Rose Robin			●	●	-	-	-	-	-	-	●

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Birds (Continued)												
POMATOSTOMIDAE												
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	●	-	-	-	-	-	-	-	-
EUPETIDAE												
Psophodes olivaceus	Eastern Whipbird			●	●	-	-	-	●	-	-	●
NEOSITTIDAE												
Daphoenositta chrysoptera	Varied Sittella			●	-	-	-	-	●	-	-	●
PACHYCEPHALIDAE												
Pachycephala pectoralis	Golden Whistler			●	●	-	-	-	●	-	-	●
Pachycephala rufiventris	Rufous Whistler			●	-	-	-	-	●	-	-	●
Colluricincla harmonica	Grey Shrike-thrush			●	●	-	-	-	●	-	-	●
Falcunculus frontatus	Eastern Shrike-tit			-	-	-	-	-	●	-	-	●
DICRURIDAE												
Rhipidura rufifrons	Rufous Fantail			-	-	-	-	-	●	-	-	●
Rhipidura fuliginosa	Grey Fantail			●	●	-	-	-	●	-	-	●
Rhipidura leucophrys	Willie Wagtail			●	-	-	-	-	-	-	-	●
Monarcha melanopsis	Black-faced Monarch		Mi	-	-	-	-	-	●	-	-	●
Grallina cyanoleuca	Magpie-lark			●	●	-	-	-	●	-	-	●
Myiagra rubecula	Leaden Flycatcher			-	-	-	-	-	●	-	-	●
ARTAMIDAE												
Cracticus torquatus	Grey Butcherbird			●	-	-	-	-	●	-	-	●
Cracticus nigrogularis	Pied Butcherbird			●	●	-	-	-	●	-	-	●
Gymnorhina tibicen	Australian Magpie			●	●	-	-	-	●	-	-	●
Strepera graculina	Pied Currawong			●	●	-	-	-	●	-	-	●

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Birds (Continued)												
Artamus cyanopterus	Dusky Woodswallow			-	-	-	-	-	●	-	-	-
CAMPEPHAGIDAE												
Coracina tenuirostris	Cicadabird			-	-	-	-	-	●	-	-	●
Coracina novaehollandiae	Black-faced Cuckoo-shrike			●	●	-	-	-	●	-	-	●
Coracina papuensis	White-bellied Cuckoo-shrike			●	-	-	-	-	-	-	-	-
Lalage leucomela	Varied Triller			-	-	-	-	-	●	-	-	-
Lalage sueurii	White-winged Triller			●	-	-	-	-	●	-	-	-
ORIOLIDAE												
Oriolus sagittatus	Olive-backed Oriole			●	-	-	-	-	●	-	-	●
CORVIDAE												
Corvus orru	Torresian Crow			-	●	-	-	-	●	-	-	●
Corvus coronoides	Australian Raven			●	●	-	-	-	●	-	-	●
CORCORACIDAE												
Corcorax melanorhamphos	White-winged Chough			●	●	-	-	-	-	-	-	●
PTILONORHYNCHIDAE												
Sericulus chrysocephalus	Regent Bowerbird			-	-	-	-	-	-	-	-	●
Ptilonorhynchus violaceus	Satin Bowerbird			●	-	-	-	-	●	-	-	●
HIRUNDINIDAE												
Hirundo neoxena	Welcome Swallow			●	●	-	-	-	-	-	-	-
Hirundo nigricans	Tree Martin			●	-	-	-	-	-	-	-	-

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Birds (Continued)												
ZOSTEROPIDAE												
Zosterops lateralis	Silvereye			●	-	-	-	-	●	-	-	●
SYLVIIDAE												
Cisticola exilis	Golden-headed Cisticola			●	-	-	-	-	●	-	-	-
MOTACILLIDAE												
Anthus australis	Australian Pipit			-	●	-	-	-	●	-	-	-
ESTRILDIDAE												
Neochmia temporalis	Red-browed Finch			●	●	-	-	-	●	-	-	●
Taeniopygia bichenovii	Double-barred Finch			●	-	-	-	-	-	-	-	-
Mammals												-
TACHYGLOSSIDAE												-
Tachyglossus aculeatus	Short-beaked Echidna			●	-	-	-	-	-	-	-	-
DASYURIDAE												
Antechinus stuartii	Brown Antechinus			●	●	-	●	-	-	●	-	●
Antechinus swainsonii	Dusky Antechinus			●	-	-	-	-	-	-	-	-
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	●	-	-	●	-	-	●	-	-
Planigale maculata	Common Planigale	V	-	-	-	-	-	-	-	●	-	-
Sminthopsis murina	Common Dunnart			-	-	-	-	-	-	-	-	●
PERAMELIDAE												
Isoodon sp.	Unknown Bandiccot			-	-	-	-	-	-	-	-	●
Perameles nasuta	Long-nosed Bandicoot			-	●	-	●	●	-	-	-	-
PHASCOLARCTIDAE												
Phascolarctos cinereus	Koala	V	-	-	●	-	●	-	-	-	-	-

Table EE-1 (Continued)
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Mammals (Continued)												-
PETAURIDAE												
Petaurus breviceps	Sugar Glider			●	-	-	-	-	-	●	-	●
Petaurus norfolcensis	Squirrel Glider	V	-	●	-	-	-	-	-	●	●	●
PSEUDOCHERIRIDAE												
Pseudocheirus peregrinus	Common Ringtail Possum			●	●	-	●	●	-	●	-	-
ACROBATIDAE												
Acrobates pygmaeus	Feathertail Glider			-	-	-	-	-	-	●	-	-
PHALANGERIDAE												
Trichosurus vulpecula	Common Brushtail Possum			●	●	-	●	●	-	●	-	●
Trichosurus sp.	-			-	-	-	●	-	-	-	-	-
MACROPODIDAE												
Macropus giganteus	Eastern Grey Kangaroo			●	●	-	●	●	-	-	-	●
Macropus rufogriseus	Red-necked Wallaby			●	●	-	●	●	-	-	-	●
Macropus robustus	Euro			●	-	-	-	-	-	-	-	-
Wallabia bicolor	Swamp Wallaby			●	●	-	-	●	-	-	-	●
RHINOLOPHIDAE												
Rhinolophys megaphyllus	Eastern Horseshoe Bat			●	-	-	-	-	-	-	-	●
MOLOSSIADE												
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	●	-	-	●	-	-	-	-	-
Mormopterus ridei	-			●	-	-	-	-	-	-	-	-

Table EE-1 (Continued)
Vertebrate Fauna Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Conservation Status[1]		Reference								
		TSC Act	EPBC Act	EcoBiological (2009a)[2]	ERM Mitchell McCotter (1996)[3]	Fly By Night Bat Surveys (1996)[4]	Woodward-Clyde (1996)[5]	Paul Webber Consulting Services (1996)[6]	Debus (1995)[7]	Place Planning and Design (2003)[8]	Duralie Coal Pty Ltd (2007)[9]	EcoBiological (2009a)[10]
Mammals (Continued)												-
Tadarida australis	White-striped Freetail-bat			●	-	-	●	-	-	-	-	-
VESPERTILIONIDAE												
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	●	-	●	●	-	-	-	-	●
Miniopterus sp.[13]	-			-	-	-	●	-	-	-	-	-
Nyctophilus geoffroyi	Lesser Long-eared Bat			-	-	●	●	-	-	-	-	-
Nyctophilus gouldi	Gould's Long-eared Bat			●	-	●	●	-	-	-	-	-
Nyctophilus sp.	Unidentified Long-eared Bat			●	-	-	●	-	-	-	-	●
Chalinolobus gouldii	Gould's Wattled Bat			●	-	●	●	-	-	-	-	●
Chalinolobus morio	Chocolate Wattled Bat			-	-	●	●	-	-	-	-	●
Myotis macropus[14]	Large-footed Myotis	V	-	●	-	●	●	-	-	-	-	●
Scotorepens orion	Eastern Broad-nosed Bat			-	-	-	●	-	-	-	-	●
Vespadelus pumilis	Eastern Forest Bat			●	-	●	●	-	-	-	-	●
Vespadelus vulturnus	Little Forest Bat			●	-	●	●	-	-	-	-	●
MURIDAE												
Pseudomys novaehollandiae	New Holland Mouse			-	-	-	-	-	-	-	-	●
Rattus fuscipes	Bush Rat			●	●	-	●	-	-	●	-	●
Rattus rattus *	Black Rat*			●	-	-	-	-	-	●	-	-
Rattus sp.	-			-	-	-	●	-	-	-	-	-
CANIDAE												
*Canis lupus dingo**	Dingo*			-	-	-	●	-	-	-	-	-

Table EE-1 (Continued)
Vertebrate Fauna Records within the Duralie Coal Mine Area and Surrounds

Scientific Name	Common Name	Conservation Status[1]		Reference								
		TSC Act	EPBC Act	EcoBiological (2009a)[2]	ERM Mitchell McCotter (1996)[3]	Fly By Night Bat Surveys (1996)[4]	Woodward-Clyde (1996)[5]	Paul Webber Consulting Services (1996)[6]	Debus (1995)[7]	Place Planning and Design (2003)[8]	Duralie Coal Pty Ltd (2007)[9]	EcoBiological (2009b)[10]
Mammals (Continued)												-
*Canis lupus familiaris**	Domestic Dog*			-	-	-	●	-	-	-	-	-
*Vulpes vulpes **	Red Fox*			●	●	-	●	●	-	-	-	●
FELIDAE												
*Felis catus**	Cat*			-	-	-	-	●	-	-	-	-
LEPORIDAE												
*Lepus capensis **	Brown Hare*			●	●	-	●	●	-	-	-	●
*Oryctolagus cuniculus **	Rabbit*			●	●	-	●	●	-	-	-	●
BOVIDAE												
*Bos taurus**	European Cattle*			-	-	-	-	●	-	-	-	-
Total Fauna Species				**152**	**67**	**8**	**31**	**34**	**75**	**12**	**1**	**113**
Total Native Fauna Species				**148**	**64**	**8**	**26**	**29**	**75**	**11**	**1**	**110**
Total Introduced Fauna Species				**4**	**3**	**0**	**5**	**5**	**0**	**1**	**0**	**3**

Nomenclature consistent with CSIRO (2006) *CSIRO List of Australian Vertebrates - A Reference with Conservation Status.*

1 Threatened species conservation status under the NSW *Threatened Species Conservation Act, 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (as at 17 June 2009).
V = Vulnerable E = Endangered Mi = Migratory

2 EcoBiological (2009a) *Flora and Fauna Survey Report: Duralie Coal Mine, Gloucester, New South Wales.*

3 ERM Mitchell McCotter (1996) *Winter Fauna Survey for Proposed Duralie Coal Mine Near Gloucester.* Appendix Ga in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

4 Fly-by-Night Bat Surveys (1996) *Winter Survey of the Bat Fauna of the Proposed Duralie Coal Mine near Gloucester, New South Wales.* Attachment GaB in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

5 Woodward-Clyde (1996) *Summer Fauna Report.* Appendix Gb in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement*.

6 Paul Webber Consulting Services (1996) *Herptological Survey of the Proposed Duralie Coal Mine via Gloucester, NSW.* Appendix Gc in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

7 Debus, S. (1995) *Bird Survey of the Proposed Duralie Coal Mine Site, Stroud*. Appendix Gd in Duralie Coal Pty Ltd (1996) *Duralie Coal Project Environmental Impact Statement.*

8 Place Planning and Design (2003) *Duralie Coal Mine – Pre-clearance Survey and Habitat Assessment*.

9 Duralie Coal Pty Ltd (2007) Duralie *Annual Environmental Management Report - September 2007.*

10 EcoBiological (2009b) *Flora and Fuana Survey Report: Gloucester Coal Properties East of Bucketts Way, Gloucester, New South Wales*.

11 Recorded to the east of Duralie Coal Mine in 1996.