BIODIVERSITY ASSESSMENT

TECHNICAL PAPER 1

Wellington Gas-fired Peaking Power Station and Gas Pipeline

Environmental Assessment Technical Paper 1 – Biodiversity Assessment

April, 2008

ERM Power

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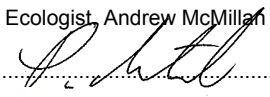
Signed: 

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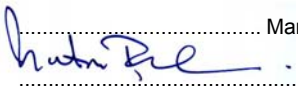
Signed: 

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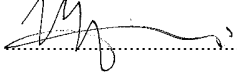
Signed: 

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Glossary

Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: ▪ genetic diversity – the variety of genes (or units of heredity) in any population ▪ species diversity – the variety of species ▪ ecosystem diversity – the variety of communities or ecosystems.
Bioregion (region)	A bioregion defined in a national system of bioregionalisation. For this study this is the NSW South-western Slopes bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).
Critical Habitat	The whole or any part or parts of an area or areas of land comprising the habitat of an Endangered species, an Endangered population or an Endangered ecological community that is critical to the survival of the species, population or ecological community (Department of Environment and Conservation 2004). Critical habitat is listed under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* and both the State (Department of Environment and Climate Change) and Federal (Department of the Environment and Water Resources) Directors-General maintain a register of this habitat. Capitalisation of the term 'Critical Habitat' in this report refers to the habitat listed specifically under the relevant State and Commonwealth legislation.
Department of Environment and Climate Change	The NSW Department of Environment and Climate Change formed on 27 April 2007 incorporating the former NSW Department of Environment and Conservation in addition to some functions of the former Department of Natural Resources, Department of Energy, Utilities and Sustainability and The Greenhouse Office.
Department of the Environment and Heritage	The former name for the Commonwealth Department of the Environment, Water, Heritage and the Arts.
Department of the Environment and Water Resources	The former name for the Commonwealth Department of the Environment, Water, Heritage and the Arts.
Department of the Environment, Water, Heritage and the Arts	The Commonwealth Department of the Environment, Water, Heritage and the Arts changed their name from the Department of the Environment and Water Resources in 2007, which was previously the Department of the Environment and Heritage. The department develops and implements national policy, programs and legislation to protect and conserve Australia's natural environment and cultural heritage and administers the *Environment Protection and Biodiversity Conservation Act 1999*.
Department of Water and Energy	The NSW Department of Water and Energy formed on 27 April 2007 and incorporates most of the functions of the former Department of Energy, Utilities and Sustainability, water-related functions of the former Department of Natural Resources and the Metropolitan Water Directorate from the former NSW Cabinet Office.
Ecological community	An assemblage of species occupying a particular area.
Environmental weed	Any plant that is not native to a local area that has invaded native vegetation.
Habitat	An area or areas occupied, or periodically or occasionally occupied by a species, population or ecological community, including any biotic or abiotic components.
Key Threatening Processes	A process that threatens, or could threaten, the survival, abundance or evolutionary development of native species, populations or ecological communities (Department of Environment and Conservation 2004). Key threatening processes are listed under the *Threatened Species Conservation Act 1995,* the *Fisheries Management Act 1994* and the *Environment Protection and Biodiversity Conservation Act 1999.* Capitalisation of the term 'Key Threatening Processes' in this report refers to those processes listed specifically under the relevant State and Commonwealth legislation.
Likely	Taken to be a real chance or possibility (Department of Environment and Conservation 2004).

Local population	The population that occurs within the study area, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary can be demonstrated (as defined by NSW National Parks and Wildlife Service 1996).
Subject site	The area to be directly impacted by the construction and/or operation of the proposal. For the Wellington Gas-fire Power Station and Gas Pipeline project the subject site is taken to include a 25-30 m corridor necessary for construction of the gas pipeline as well as the footprint of the power station itself.
Study area	The subject site and an additional area of investigation around the study site that could potentially be affected by the proposal indirectly. This is taken to include a 1 km buffer around the subject site.
Locality	The area within a 10 kilometre radius of the study area.
Migratory species	Species listed as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999.* Capitalisation of the term 'Migratory' in this report refers to those species listed as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999*.
Protected species	Those species defined as protected under the *National Parks and Wildlife Act 1974*. Includes all native animals, and all native plants listed on Schedule 13 of the *National Parks and Wildlife Act 1974*.
Recovery plan	A plan prepared under the *Threatened Species Conservation Act 1995* or the *Environment Protection and Biodiversity Conservation Act 1999* to assist the recovery of a Threatened species, population or ecological community.
Significant	Important, weighty or more than ordinary (as defined by NSW National Parks and Wildlife Service 1996).
Threatened biodiversity	Threatened species, populations or ecological communities, or their habitats as listed under either the *Threatened Species Conservation Act 1995* or the *Environment Protection and Biodiversity Conservation Act 1999*.
Threatened species, populations and ecological communities	Species, populations and ecological communities listed as Vulnerable, Endangered or Critically Endangered (collectively referred to as Threatened) under the *Threatened Species Conservation Act 1995*, *Fisheries Management Act 1994* or the *Environment Protection and Biodiversity Conservation Act 1999*. Capitalisation of the terms 'Threatened', 'Vulnerable', 'Endangered' or 'Critically Endangered' in this report refers listing under the relevant State and/or Commonwealth legislation.
Viable local population	A population that has the capacity to live, develop and reproduce under normal conditions, unless the contrary can be conclusively demonstrated through analysis of records and references (as defined by NSW National Parks and Wildlife Service 1996).

1. Introduction

1.1 Background

ERM Power propose to develop a 600 megawatt (MW) open-cycle gas-fired power station that would operate as a peaking plant to supply energy at short notice during periods of peak electricity demand. The power station would be built approximately 2 km north-north-east of the outskirts of Wellington in Central Western New South Wales. Gas supply for the power station would be provided via a new 100 km underground pipeline between the proposed power station site and the Central West Pipeline at Alectown West, which connects to the Sydney–Moomba Gas Pipeline.

PB has prepared this biological assessment on behalf of ERM Power for the proposed development of a gas-fired power station and associated 100 km natural gas pipeline. This Environmental assessment has been prepared to identify the potential impacts of constructing and operating the project relating to biodiversity and to develop mitigation and management measures to minimise those impacts.

1.2 Project description

1.2.1 The power station

The proposed power station would be located off Gulgong Road approximately 2 km north-north-east of the outskirts of Wellington (refer Figure 1-1). The project site is immediately south of TransGrid's 330/132 kV substation, which provides a major electricity hub for the region.

The power station site comprises an undulating area of cleared land with scattered trees. The site drains to the south, and is currently used for the grazing of sheep and/or cattle. Approximately 35 ha would be retained for the power station, which would have a footprint of approximately 12 ha. The land is currently zoned Rural 1(a) under the Wellington Local Environmental Plan (LEP) 1995.

The proposed power station would operate as a peaking plant, supplying electricity at short notice during periods of peak electricity demand such as hot summer and cold winter days. It is expected that the power station would operate for between approximately 350 hours (with all four gas turbines operating) and 1,400 hours (with one gas turbine operating) per year, providing a combined generating capacity of approximately 600 MW.

The facility would include other ancillary plant items, such as generator-transformers, a demineralised water treatment plant, air-cooled condensers, evaporation pond, plant control system, emergency diesel generator, water tanks, exhaust stacks and silencers, and an office building and workshop.

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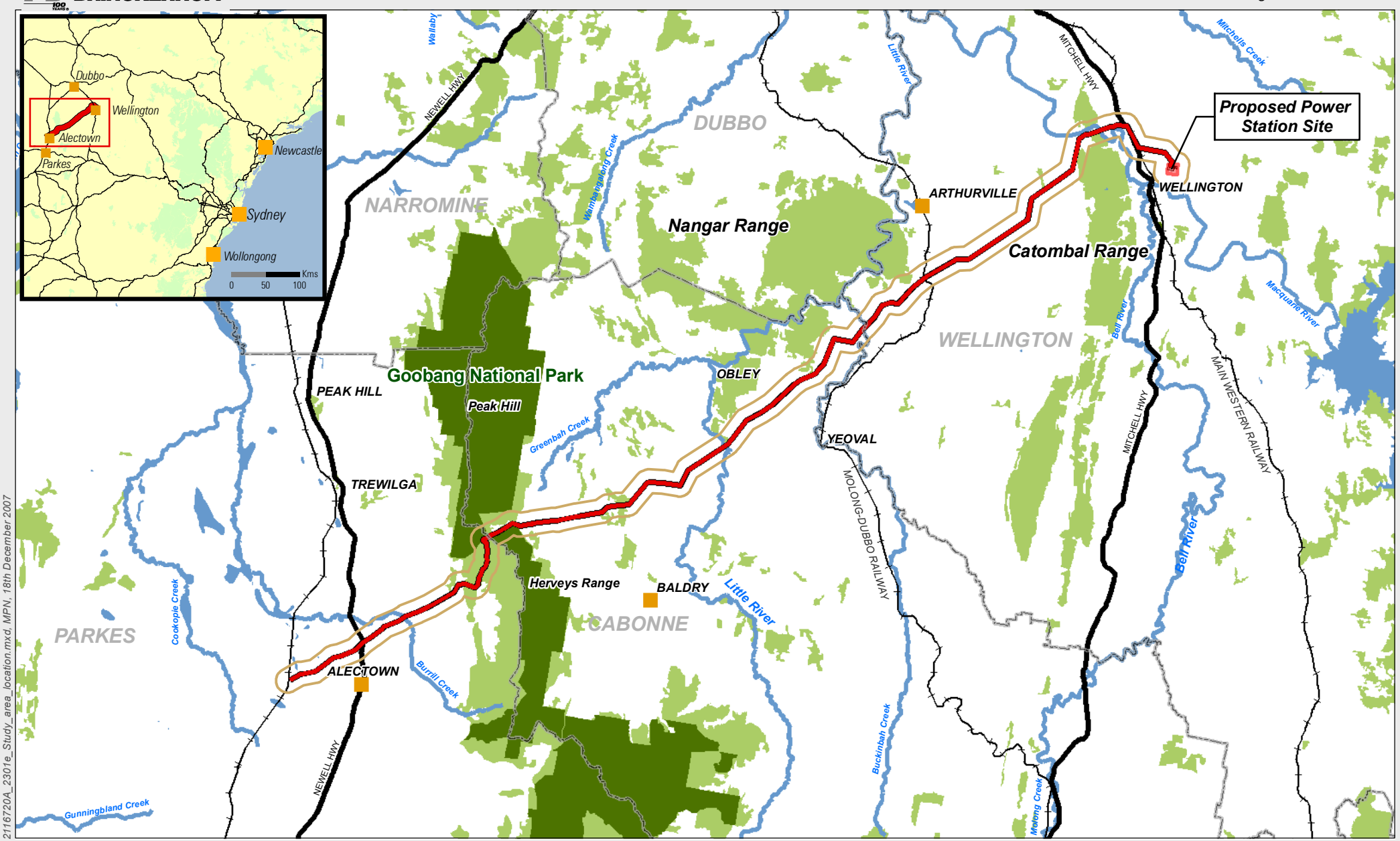
Wellington Power Station



Gas pipeline
Major roads
Major drainage
National Park Estate
Study area
Rail line
Water body
Vegetation
(1:250,000 Topographic data)
Towns
LGA
Local government area

Figure 1-1 Study area location

0 5 10 15 Kms

2116720A_2301e_Study_area_location.mxd, MPN, 18th December 2007

1.2.2 The gas supply pipeline

Gas supply for the power station would be provided via a new 100 km underground pipeline between the proposed power station site and the Central West Pipeline at Alectown West, which connects to the Sydney–Moomba Gas Pipeline (refer Figure 1-1).

The proposed underground pipeline would traverse three local government areas: Wellington, Parkes and Cabonne. The pipeline route would traverse predominantly cleared agricultural land. It would cross under the Macquarie River and would align with Peak Hill Road between the northern and southern parcels of Goobang National Park.

The pipeline easement would be 25–30 m wide. The pipe itself would be approximately 1 m wide and would be installed mostly using open-cut trenching. Directional drilling or micro-tunnelling would be used to cross major roads, railways and watercourses.

Figure 1-1 provides an overview of the proposed power station in the context of the site and the alignment of proposed gas pipeline.

1.3 Legislative context

The project will be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*.

Further Commonwealth and NSW legislation and planning policies relevant to the protection of biodiversity include:

- *(Commonwealth) Environment Protection and Biodiversity Conservation Act 1999*
- *Threatened Species Conservation Act 1995*
- *Fisheries Management Act 1994*
- *National Parks and Wildlife Act 1974*
- *Native Vegetation Act 2003*
- *Water Management Act 2000* and *Rivers and Foreshores Improvement Act 1948*.

Although licences and approvals under these and other state Acts and policies are not required in addition to approval under Part 3A of the *Environmental Planning and Assessment Act 1979*, consideration has been given to their intent.

The *Environment Protection and Biodiversity Conservation Act 1999* applies to the project.

1.4 Scope of the Technical Paper

The Director-General of the Department of Planning has issued requirements for the Environmental Assessment. Requirements relating specifically to flora and fauna state:

'*The Environmental Assessment must include a flora and fauna impact assessment in accordance with the DEC's*[1] *Guidelines for Threatened Species Assessment. In particular, the Environmental Assessment must clearly demonstrate how it meets the key thresholds set out in Step 5 of this document. The Environmental Assessment must specifically identify and consider and critical habitats, threatened species, populations or ecological communities*

[1] DEC (The Department of Environment and Conservation) is now known as the Department of Environment and Climate Change

listed under both State and Commonwealth legislation recorded on the site, along the gas pipeline route or in the surrounding area. The Environmental Assessment must also detail measures to avoid or mitigate impacts associated with siting and construction of any access roads and other infrastructure. An assessment of the feasibility, effectiveness and reliability of proposed measures and any residual impacts after these measures have been implemented must be included.'

The draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005a) state that the objective of the biodiversity assessment process under Part 3A is to provide information to enable decision-makers to ensure that developments deliver the following environmental outcomes:

1. Maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation).
2. Conserve biological diversity and promote ecologically sustainable development.
3. Protect areas of high conservation value (including areas of critical habitat).
4. Prevent the extinction of threatened species.
5. Protect the long-term viability of local populations of a species, population or ecological community.
6. Protect aspects of the environment that are Matters of National Environmental Significance.

With these objectives in mind, the aims of this technical paper are to:

- determine and describe the characteristics and condition of the vegetation communities and flora and fauna habitats within the study area
- determine the occurrence, or likelihood of occurrence, of Threatened species, populations and communities (biodiversity) listed under the *Threatened Species Conservation Act 1995, Fisheries Management Act 1994* and *Environment Protection and Biodiversity Conservation Act 1999* within the study area
- undertake significance assessments for Threatened biodiversity that occur or have potential habitat within the study area
- propose further investigations and/or amelioration measures to avoid or mitigate impacts on the ecological values of the study area.

1.5 Structure of the Technical Paper

The structure and content of this Technical Paper is described below:

- Chapter 2 details the desk-based and field methods used in surveying the current environment as well as the assessment methods.
- Chapter 3 describes the study area and localities in terms of their existing environment, including vegetation communities, terrestrial flora and fauna, based on the results of the desk-based and field assessments.
- Chapter 4 describes the Threatened biodiversity occurring within the study areas as well as other significant ecological features requiring consideration, such as those covered under the *Environment Protection and Biodiversity Conservation Act 1999*.

- Chapter 5 describes the potential impacts of the Proposal on the biological environment including loss of vegetation and habitats and impacts on Threatened species.
- Chapter 6 describes recommended mitigation measures that to be incorporated into the final design and construction program.
- Chapter 7 summarises the assessment of significance of the potential impacts following the requirements of the Environmental Planning and Assessment Act 1979 (draft Guidelines for Threatened Species Assessment under Part 3A of the Environmental Planning and Assessment Act 1979) and the Environment Protection and Biodiversity Conservation Act 1999.
- Chapter 8 presents conclusions and recommendations.

2. Methods

The biological impacts assessment included both desk-based assessment of the literature and relevant databases, as well as field survey of the study areas and surrounding landscape.

2.1 Contributors and qualifications

The contributors to the preparation of this Technical Paper, their qualifications and roles are listed in Table 2-1.

Table 2-1 Contributors and their roles

Name	Qualification	Role
Peter Monsted	BSc	Botanist – field surveys and report preparation
Andrew McMillan	BSc (Hons)	Zoologist – field surveys and report preparation
Rob Gration	MWldMgt (Habitat)	Zoologist – field surveys and bat call analysis
Selga Harrington	BSc (Hons)	Botanist – field surveys
Dr. Martin Predavec	BSc (Hons), PhD	Principal Ecologist – ecology lead and review
Chris O'Dell	BAppSc	GIS Operator – mapping

All work was carried out under the appropriate licences, including scientific licences as required under Clause 22 of the National Parks and Wildlife Regulations 2002, Section 132C of the *National Parks and Wildlife Act 1974,* as well as animal research authorities issued by the Department of Primary Industries (Agriculture).

2.2 Terrestrial biota

2.2.1 Nomenclature

The names of plants used in this document follow Harden (Harden 1992, 1993, 2000, 2002) with updates from PlantNet (Royal Botanic Gardens 2007). Scientific names are used for species of plant in the body of the report. Common names are provided in the body of the report for canopy species used in the vegetation community names and all species (where available) in species lists found in Attachments A and C.

The names of vertebrates follow the Census of Australian Vertebrates (CAVS) database maintained by the (now) Department of the Environment, Water, Heritage and the Arts (Department of the Environment and Water Resources 2007a) and as used by the Department of Environment and Climate Change in the *Atlas of NSW Wildlife* (Department of Environment and Climate Change 2007a). Common names are used in the report for species of animal. Scientific names are included the first time that the species is mentioned and are also used in species lists found in Attachments B and D.

2.2.2 Literature and database review

Records of threatened biodiversity recorded previously, or predicted to occur, in the project locality were obtained from various databases as part of the preliminary ecological assessments and reviewed and updated for this assessment, including:

- Department of Environment and Climate Change *Atlas of NSW Wildlife* (Department of Environment and Climate Change 2007a, data received on the 24 October 2007)
- Department of Environment and Climate Change *Threatened Species, Populations and Ecological Communities* website (Department of Environment and Climate Change 2007b, searches on the 25 October 2007)
- Department of the Environment and Water Resources *Protected Matters Search Tool* (Department of the Environment and Water Resources 2007b, searches on the 25 October 2007).

Registers of critical habitat maintained by the Department of Environment and Climate Change (2007) and the (then) Department of the Environment and Water Resources (2007c) were reviewed to identify critical habitat in the locality (reviewed on the 25 October 2007).

Listings of key threatening processes were obtained from the Department of Environment and Climate Change *List of Key Threatening Processes* website (Department of Environment and Climate Change 2007c, reviewed on the 25 October 2007) and the Department of the Environment and Water Resources *Listed Key Threatening Processes* website (Department of Environment and Water Resources 2007, reviewed on the 25 October 2007).

2.3 Terrestrial flora

No broad scale vegetation mapping was identified that covered the study region, therefore the following techniques were used to identify and describe vegetation communities in the study area and the species that occurred within them.

2.3.1 Aerial photographic Interpretation

For the purpose of this study, the extent of native woodland in the locality was derived from the forested areas of the Narrabri and Dubbo map sheets of the GEODATA TOPO 250K Series 2 (Geoscience Australia 2003) which captures patches greater than or equal to 2.5 ha.

Within a 1 km buffer of the subject site (the study area), Aerial Photographic Interpretation (API) was used to improve the accuracy of the forested areas of the Narrabri and Dubbo map sheets of the GEODATA TOPO 250K Series 2 (Geoscience Australia 2003) and capture patches of woodland habitat less than 2.5 ha.

For the purpose of this study, a ‘patch’ of woodland or forest habitat is a wooded areas ≥0.05 ha; with a minimum width of 10 m (such as roadside vegetation); and an average tree density >20 trees per hectare. Sparsely scattered paddock trees are considered to form part of the landscape matrix and did not contribute to calculations of vegetation cover.

This technique is unable to identify derived native grasslands however, as none were identified along in the subject site, no attempt was made to calculate their possible extent within the study area.

2.3.2 Flora surveys

Ground truthing of the patches of vegetation identified from the API within the study area was undertaken to determine the vegetation structure, dominant species, native diversity, age estimate and condition. All patches along the route, for which property access was available, were assessed using one of the following ground truthing techniques (refer to Figure 2-1 for locations of flora surveys). Based on these surveys, all vegetation within the study area was mapped and characterised.

- **Quadrat surveys**: one 400m^2 quadrat survey was completed in each vegetation community identified in accordance with the survey requirements of the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)* (Department of Environment and Conservation 2004). Quadrat sites were positioned in patches of above average condition. At each site, the vegetation community was determined based on the dominant canopy species and the structure formation in accordance with Specht (1981) and cover abundance of each species was recorded. Additional information recorded at each quadrat site included position using GPS (accuracy ± 5 m), slope, aspect, landform, soil type/geology, evidence of disturbance, condition (refer below), estimate of community age and evidence of canopy recruitment (i.e. were a range of canopy species age classes present).
- **Random meander/transect surveys:** these surveys were completed in all patches of native vegetation traversed by the proposal. At each of these sites, the vegetation community was determined based on the dominant canopy species and the structure formation in accordance with Specht (1981). Presence / absence data of species within the study site was also recorded using a random meander or transect technique in accordance with the method described by Cropper (1993). Additional information recorded at each transect site included position using GPS (accuracy ± 5m), slope, aspect, landform, soil type/geology, evidence of disturbance, condition, estimate of community age and evidence of canopy recruitment.
- **Vegetation confirmation:** the community type of all remaining patches of woodland along the proposal (i.e. patches in paddocks that are routinely grazed or cropped), and other vegetation that surrounding the proposal that could be seen with binoculars, was confirmed based on the dominant canopy species and general condition (where possible).

2.3.3 Vegetation condition

The condition of vegetation communities is an important criterion to determine suitable habitats for Threatened species and the conservation status of certain ecological communities. All patches where a quadrat or random meander / transect survey was done were assigned to one of the following condition classes based on the Box Gum Woodland condition classes described in the *Identification guidelines for endangered ecological communities: White box - Yellow box - Blakely's red gum (box gum) woodland* (NSW National Parks and Wildlife Service 2002b). These classes were also adapted for other vegetation communities in the study area (refer Table 2-2).

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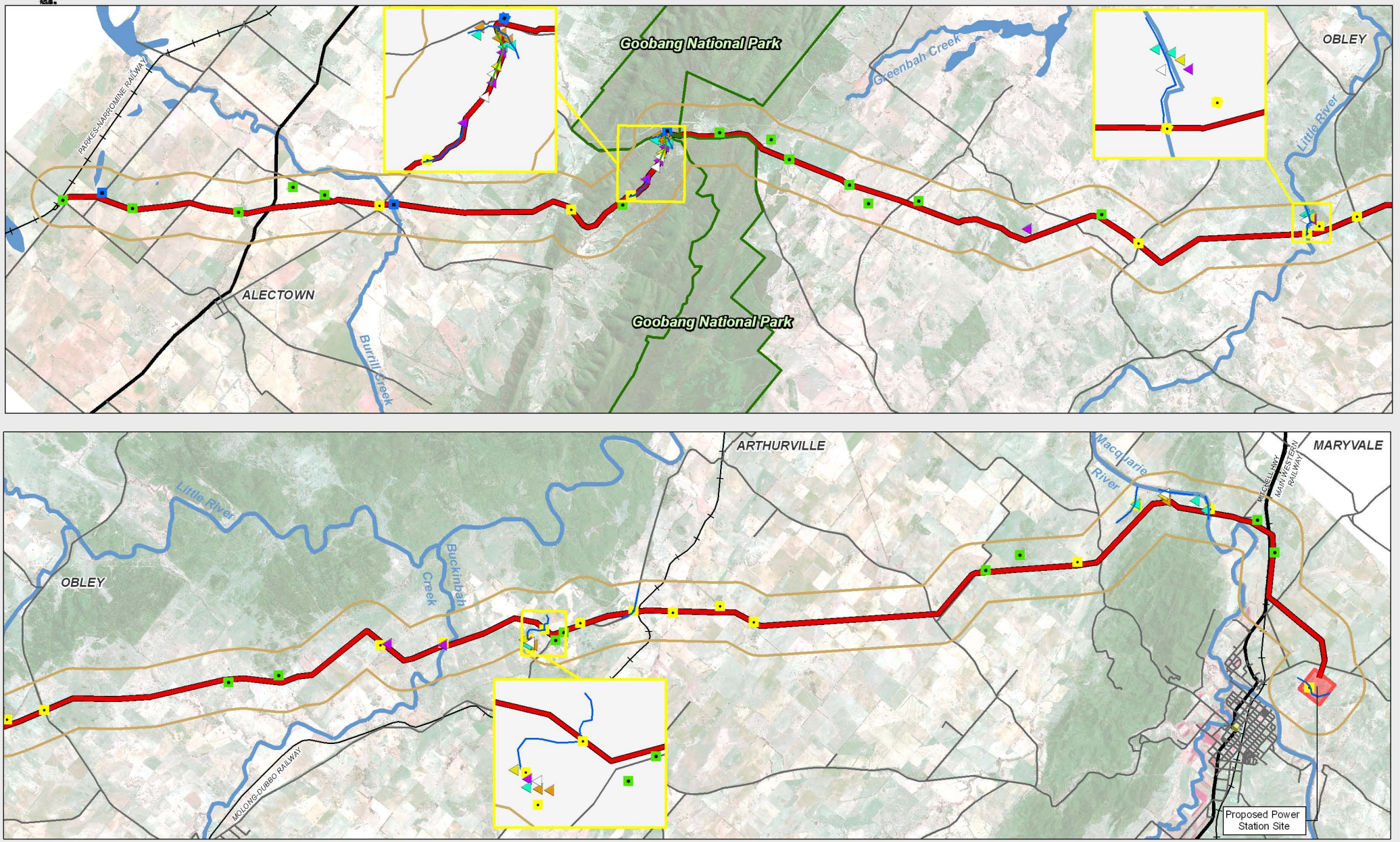


Figure 2-1 Location of survey sites

Table 2-2 Vegetation community condition classes

Condition class	For Box Gum Woodlands[1]	For other vegetation communities
Class 1	Multi-aged overstorey with a grassy, herb-rich understorey.	Multi-aged overstorey with a native dominated understorey, and naturally grassy or shrubby understorey.
Class 2	Partially cleared/thinned stands with a mixture of native and exotic understorey species.	Partially cleared/thinned stands with a mixture of native and exotic understorey species.
Class 3	Stands where White Box, Yellow Box or Blakely's Red Gum have been killed and other species dominate the canopy (such as Cypress Pine) Understorey in reasonable to very good condition.	Stands where characteristic canopy species have been removed killed and an other species dominate the canopy at unnatural densities such as Cypress Pine or *Acacia* spp.
Class 4	Grasslands (secondary or derived grasslands), where the tree overstorey has been removed and only the Box-Gum Woodland understorey is present.	Grasslands (secondary or derived grasslands), where the tree overstorey has been removed and only the Box-Gum Woodland understorey is present.
Class 5	Degraded remnants that have few, if any, native species in the understorey (sites that were unlikely to have potential for native regeneration were also grouped in this class).	Degraded remnants that have few, if any, native species in the understorey (sites that were unlikely to have potential for native regeneration were also grouped in this class).

1. Based on condition classes described in the *Identification guidelines for endangered ecological communities: White box - Yellow box - Blakely's red gum (box gum) woodland* (NSW National Parks and Wildlife Service 2002b).

2.3.4 Identification of Threatened ecological communities

Ecological communities (assemblages of species) may be listed as Endangered or Critically Endangered under Table 2-3 and/or Table 2-4. The definition of most ecological communities is based on the composition and structure of the dominant stratum of vegetation in conjunction with their range (usually defined by bioregion or Local Government Area) as defined in the community's final determination. Additional determining criteria may also be specified by the Department of Environment and Climate Change or the Department of the Environment and Water Resources.

White Box, Yellow Box, Blakely's Red Gum Woodland is a Threatened ecological community listed under Table 2-3 and Table 2-4 that has prescriptive identification guidelines under both Acts (Australian Government 2004; 1995; Department of the Environment and Heritage 2006a; 1993; NSW National Parks and Wildlife Service 2002b; NSW Scientific Committee 2002b). The current assessment aimed to determine the conservation status of each patch of Box Gum Woodland in accordance with these identification guidelines. The definition of the communities under each set of guidelines differs subtly; as such patches that qualify under one Act do not automatically qualify under the other. The criteria under Table 2-4 are less inclusive than those under Table 2-3 due to the restriction on minimum size of patches and the requirement to have a 12 or more native species present.

The following keys was used to determine if patches of Box Gum Woodland were consistent with the ecological community listings in Table 2-3 and Table 2-4.

Table 2-3 Identification key for White Box, Yellow Box, Blakely's Red Gum Woodland under the Threatened Species Conservation Act 1995

1	The site is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions.	2
1*	The site is outside the above bioregions.	The site is not Box-Gum Woodland
2	There are no native species in the understorey, and the site is unlikely to respond to assisted natural regeneration.	The site is not Box-Gum Woodland
2*	The understorey is otherwise.	3
3	The site has trees.	4
3*	The site is treeless, but is likely to have supported White Box, Yellow Box or Blakely's Red Gum prior to clearing.	4
3**	The site is otherwise.	The site is not Box-Gum Woodland
4	White Box, Yellow Box or Blakely's Red Gum, or a combination of these species, are or are likely to have been present previously.	5
4	White Box, Yellow Box or Blakely's Red Gum have never been present: the site is not Box-Gum Woodland.	The site is not Box-Gum Woodland
5	The site is predominantly grassy.	The site is Box-Gum Woodland
5	The understorey of the site is dominated by shrubs excluding pioneer species.	The site is not Box-Gum Woodland

Based on the key provided in the *Identification guidelines for endangered ecological communities: White box - Yellow box - Blakely's red gum (box gum) woodland*(NSW National Parks and Wildlife Service 2002b).

Table 2-4 Identification key for White Box, Yellow Box, Blakely's Red Gum Woodland and derived grasslands under the Environment Protection and Biodiversity Conservation Act 1999

1	Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum?	2
1*	Are none of the existing, or previously occurring, overstorey species White Box, Yellow Box or Blakely's Red Gum or unlikely to have?	The site is not Box-Gum Woodland
2	Does the patch have a predominantly native understorey?	3
2*	Is the understorey dominated by exotic species (>50% of the perennial foliage cover)?	The site is not Box-Gum Woodland
3	Is the patch 0.1 ha or greater in size?	4
3*	Is the patch less than 0.1 ha in size?	The site is not Box-Gum Woodland
4	Are there 12 or more native understorey species present (excluding grasses) including 1 important species (as defined in the *EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands* (Department of the Environment and Heritage 2006a)?	**The site is Box-Gum Woodland**
4*	Are there less than 12 native understorey species present (excluding grasses) and/or no important species (as defined in the *EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands* (Department of the Environment and Heritage 2006a)?	5
5	Is the patch 2ha or greater in size?	6
5*	Is the patch less than 2ha in size?	The site is not Box-Gum Woodland

6	Does the patch have an average of 12 mature trees per hectare, or is there natural regeneration of canopy species?	**The site is Box-Gum Woodland**
6*	Does the patch have an average of less than 12 mature trees per hectare or lack is natural regeneration of canopy species?	The site is not Box-Gum Woodland

Based on the key provided in the *EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands* (Department of the Environment and Heritage 2006a).

2.3.5 Data analysis

Data collected from the random meander / transect surveys was used to determine the species richness for each vegetation community and frequency profiles for each species within each community.

Determining the frequency profiles involved grouping the data from each random meander / transect surveys in each ecological community and counting the number of times each species was recorded. The counts were then divided by the number of sample plots to provide an index (0-1) of detection frequency. A score of 1 indicated the species was recorded at every site in a community: a score of 0 indicated the species was not recorded at any sites within the community. The frequency profiles were used in describing the dominant and associated species for each vegetation community.

Each community was also characterised based on the mean, maximum and minimum scores of the following criteria calculated across all patches:

- total species present
- native species richness (count and percentage of total)
- weed species richness (count and percentage of total)
- % cover of understorey species that are exotic
- presence of large trees
- canopy cover (% foliage cover)
- canopy recruitment.

2.4 Terrestrial vertebrate fauna

2.4.1 Fauna habitats

Fauna habitat assessments were undertaken to assess the likelihood of Threatened species of animal (identified from the literature and database review) to occur in the study area and to identify areas where they would be most likely to occur. Patches of vegetation within the study area that were identified by Aerial Photographic Interpretation (refer Section 2.3.1) were assessed for fauna habitat characteristics.

Fauna habitat characteristics assessed included:

- structure and floristics of the canopy, understorey and ground vegetation, including the presence of flowering and fruiting trees providing potential foraging resources
- presence of hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, birds and reptiles

- density of ground cover with shrubs, grasses, or leaf litter and fallen timber to provide protection for ground-dwelling mammals, reptiles and amphibians
- structure and composition of the litter layer
- presence of waterways (ephemeral or permanent) and water bodies.

The assessment of these fauna habitat characteristics enabled an overall assessment of fauna habitat condition within the study area. The following criteria were used to evaluate the condition of fauna habitats:

- **Good**: A full range of fauna habitat components are usually present (e.g. old-growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- **Moderate**: Some fauna habitat components may be missing (e.g. old growth trees, fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- **Poor**: Many fauna habitat elements in low quality remnants have been lost, including old-growth trees (e.g. due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive past clearing.

2.4.2 Fauna survey

The presence of faunal species in the study area was determined primarily through consideration of suitable habitats, with species of animal present on the site recorded opportunistically during the habitat assessments and through targeted survey. Although recording Threatened species during field survey can confirm their presence in an area, alack of Threatened species records does not necessarily indicate the absence of the species from the site when suitable habitat is present. By the very nature of their rarity, Threatened species are often difficult to detect. Suitable habitat is, therefore, an important factor to consider when determining the potential presence of Threatened species.

The fauna survey methodology involved two encompassing types of fauna survey, standard sites and supplementary sites. Standard sites were implemented to survey broad habitat types in the study area and comprised an array of survey techniques such as small and large Elliott, cage and harp trapping, bird survey, herpetofauna searches, anabat detection, call broadcast and spotlighting.

Supplementary sites were selected opportunistically throughout the area based on specific habitat features for rare or threatened fauna. Supplementary sites aimed to increase the spatial coverage of survey across the study area and to include survey of discrete habitat types, which are unlikely to be the focus of standard sites but that warrant some form of survey (e.g. rocky outcrops, wetland/drainage habitats, patches of flowering eucalypts). Supplementary sites involved survey techniques such as anabat bat detection, spotlighting, herpetofauna searches, bird survey, call broadcast and fauna features traverse.

Targeted fauna surveys were completed in the study area following the methods described generally below. Survey effort is described in Section 2.5.3 and the location of surveys is shown in Figure 2-1.

Diurnal bird census

Diurnal birds were recorded in various fauna habitat types within the study area during 5 minute census periods with one minute intervals between two census periods. This process was continued until two 5 minute periods were completed without observing a new species (refer Table 2-5). Birds were identified either from sightings or characteristic calls. The number of each species and the activity at the time of sighting (foraging, breeding, or flying) was also recorded. Birds were also opportunistically recorded throughout the study area.

Call playback

Animals were surveyed using a call broadcast method, where recordings of their calls are broadcast in order to elicit a response, either vocal or behavioural. Call playback surveys were undertaken using the methods of Kavanagh and Peake (National Parks and Wildlife Service 2007) and Debus (Department of Environment and Conservation 2004). An initial listening period of 10-15 minutes was undertaken, followed by a spotlight search for 10 minutes to detect any animals in the immediate vicinity. The calls of the target species were then played intermittently for 5 minutes followed by a 10 minute listening period. Another 10 minutes of spotlighting and listening was conducted in the vicinity to check for bird and mammals attracted by the calls but not vocalising. Calls were broadcast using a portable compact disc player and amplified through a megaphone.

Species targeted using this survey method included the Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*), Bush Stone Curlew (*Burhinus grallarius*), Squirrel Glider (*Petaurus norfolcensis*), Sugar Glider (*Petaurus breviceps*) and Koala (*Phascolarctos cinereus*).

All species responding to calls, including non-target species, were recorded.

Spotlighting

The objective of this survey technique was to target arboreal, flying and large ground-dwelling mammals. Spotlighting was done after dusk at each of the standard and supplementary sites across the study area (Figure 2-1). One hour of survey effort was undertaken at each site on foot using two handheld 100 watt vari-beam spotlights (refer Table 2-5 and Figure 2-1). The speed of the spotlighting surveys was approximately 1 km per hour. Surveys concentrated on areas that contained suitable habitat for nocturnal species, such as woodland that formed parts of larger areas, or fragmented habitats located nearby. Any sighted animal was identified to the species level.

Anabat bat detection

Microchiropteran bats were surveyed using an Anabat II Bat detector (Titley Electronics Pty Ltd). Anabat Bat detectors were attached to a time delay switch with the potential to record bats over a full night, with the recording starting at dusk. Calls of echo-locating bats were interpreted by Rob Gration (PB) (refer Attachment F).

Given that recording bat calls over a full night may not identify all species within a given area an Anabat II Bat detector (Titley Electronics Pty Ltd) was also used to record microchiropteran bats during spotlight surveys.

Following the Australasian Bat Society recommendations for "Reporting Standards for bat detector use in Insectivorous Bat Survey" (2007) a sample of 'frequency vs. time' graph for each species used as a reference library in the identification process has been provided in Attachment F. This attachment also provides an indication of the number of calls processed and the percentage of these that were identified.

Harp trapping

Harp traps were used to survey microchiropteran bats. Traps were erected within fly-ways close to open water bodies, creek lines and access tracks where microchiropteran bat activity was likely to be greatest. Traps were checked nightly (to release reproductive females) and daily after sunrise, with captured bats identified to species level and released at the site of capture the following night.

Elliott trapping

Elliott traps (size A and B) were used to target small ground-dwelling and arboreal mammals. Type A Elliott traps were positioned on the ground either near the base of trees, within understorey vegetation, or amongst dead wood. Type B Elliott traps were positioned on platforms 2 m above ground in habitat trees with small to medium sized hollows suitable for arboreal mammals.

Elliott traps were baited with soft fruit muesli bars, which were replaced each night of trapping. Honey water was sprayed on the trunk of trees where type B Elliott traps were located. Traps were left open for four nights and checked each morning at sunrise, with captured animals identified to species level and released at the site of capture.

Elliott trapping followed the Department of Primary Industry's *Director-General's Policy of Cage Trapping* and *Animal Care Guidelines for Wildlife Surveys* (Department of Environment and Conservation 2005a).

Cage trapping

Cage traps (collapsible platform type) were used to target small to medium ground dwelling mammals and reptiles. Cage traps were positioned in fauna habitats providing good mid strata vegetation cover, near the base of trees or adjacent fallen timber and branches.

Cage traps were baited with soft fruit muesli bars, which were replaced each night of trapping. Traps were left open for four nights and checked each morning at sunrise, with captured animals identified to species level and released at site of capture.

Cage trapping followed the Department of Primary Industry's *Director-General's Policy of Cage Trapping* and *Animal Care Guidelines for Wildlife Surveys* (Department of the Environment and Heritage 2006b).

Herpetofauna searches

All species of herpetofauna were targeted during 1 ha diurnal searches. Species were recorded by sightings, call characteristics, by searching under logs and leaf litter (for cryptic reptile and amphibian species). Incidental sightings outside of standardised searches were recorded and the location described.

Species of frog were targeted during diurnal searches after periods of rainfall within each of the survey zones and identified by their characteristic calls.

Fauna features traverse

Fauna features traverse included two zoologists conducting traverses on foot through various habitat types to detect and collect information on the likelihood of Threatened species occurring in the study area. Fauna features traverse were conducted at all standard and supplementary sites. This technique involved hollow bearing tree assessment, identification of feeding signs by Glossy Black-cockatoos (*Calyptorhynchus lathami*), nest/roost sites of large forest owls and bats, identifying fauna scats and measures of Koala feed tree presence. Location of significant habitat features during the fauna features traverse also formed the basis for selecting many supplementary survey sites.

2.4.3 Survey effort

A summary of the survey effort and location of the fauna surveys completed for this assessment is provided in Table 2-5.

Table 2-5 Fauna survey effort within the study area

Date	Survey type	Survey effort	Location description (fauna habitat / vegetation type)
30/10/2007	Diurnal bird census	38 minutes (76 person minutes)	Riparian/riverine. Macquarie River.
30/10/2007	Diurnal bird census	25 minutes (50 person minutes)	Open forest. Dry tributary of Macquarie River.
31/10/2007	Diurnal bird census	67 minutes (134 person minutes)	Open forest.
01/11/2007	Diurnal bird census	43 minutes (86 person minutes)	Riparian/riverine. Macquarie River.
01/11/2007	Diurnal bird census	45 minutes (90 person minutes)	Open forest. Dry tributary of Macquarie River.
02/11/2007	Diurnal bird census	51 minutes (102 person minutes)	Open forest.
02/11/2007	Diurnal bird census	52 minutes (104 person minutes)	Open forest (road reserve).
3/11/2007	Diurnal bird census	55 minutes (110 person minutes)	Open forest (Ironbark, adjacent Goobang National Park).
04/11/2007	Diurnal bird census	53 minutes (106 person minutes)	Open forest (Ironbark, adjacent Goobang National Park).
06/11/2007	Diurnal bird census	48 minutes (96 person minutes)	Riparian/riverine. Little River.
30/10/2007	Call playback	30 minutes	Riparian/riverine. Dry tributary of Macquarie River.
30/10/2007	Call playback	30 minutes	Riparian/riverine. Macquarie River.
31/10/2007	Call playback	30 minutes	Riparian/riverine. Macquarie River.

Date	Survey type	Survey effort	Location description (fauna habitat / vegetation type)
31/10/2007	Call playback	30 minutes	Open woodland. Proposed Power Station site.
01/11/2007	Call playback	30 minutes	Open forest (road reserve).
01/11/2007	Call playback	30 minutes	Open forest.
4/11/2007	Call playback	30 minutes	Open forest (Ironbark, adjacent Goobang National Park).
5/11/2007	Call playback	30 minutes	Open forest (Ironbark).
6/11/2007	Call playback	30 minutes	Riparian/riverine. Little River.
30/10/2007	Spotlight and anabat walk traverse	30 minutes (1 person hour)	Riparian/riverine. Macquarie River.
30/10/2007	Spotlighting and anabat walk traverse	30 minutes (1 person hour)	Riparian/riverine. Dry tributary of Macquarie River.
31/10/2007	Spotlight and anabat walk traverse	30 minutes (1 person hour)	Riparian/riverine. Macquarie River.
31/10/2007	Spotlight and anabat walk traverse	30 minutes (1 person hour)	Open woodland. Proposed Power Station site.
01/11/2007	Spotlight and anabat walk traverse	30 minutes (1 person hour)	Open forest (road reserve).
01/11/2007	Spotlight and anabat walk traverse	30 minutes (1 person hour)	Open forest.
05/11/2007	Spotlight and anabat walk traverse	30 minutes (1 person hour)	Open forest (Ironbark, adjacent Goobang National Park).
06/11/2007	Spotlight and anabat walk traverse	30 minutes (1 person hour)	Riparian/riverine. Little River.
30/10/2007	Herpetofauna search	30 minutes (1 person hour)	Open woodland. Buckinbah creek.
31/10/2007	Herpetofauna search	30 minutes (1 person hour)	Open woodland/Rocky outcrop.
01/11/2007	Herpetofauna search	30 minutes (1 person hour)	Closed forest / Rocky outcrop.
01/11/2007	Herpetofauna search	30 minutes (1 person hour)	Closed forest / Rocky outcrop.
02/11/2007	Herpetofauna search	30 minutes (1 person hour)	Closed forest / Rocky outcrop.
02/11/2007	Herpetofauna search	30 minutes (1 person hour)	Riparian/riverine. Little River.
05/11/2007	Herpetofauna search	30 minutes (1 person hour)	Open forest/Rocky outcrop.
05/11/2007	Herpetofauna search	30 minutes (1 person hour)	Open forest/Rocky outcrop.
05/11/2007	Herpetofauna search	30 minutes (1 person hour)	Open forest/Rocky outcrop.

Date	Survey type	Survey effort	Location description (fauna habitat / vegetation type)
29/10/2007	Harp Trapping	2 harp traps (4 trap nights)	Riparian riverine. Dry tributary of Macquarie River.
31/10/2007	Harp Trapping	2 harp traps (4 trap nights)	Open woodland.
02/11/2007	Harp Trapping	2 harp traps (4 trap nights)	Open forest (Ironbark, adjacent Goobang National Park).
04/11/2007	Harp Trapping	2 harp traps (4 trap nights)	Open forest (Ironbark, adjacent Goobang National Park).
29/11/2007	Anabat	24 hours	Riparian/riverine habitat adjacent Macquarie River.
29/11/2007	Anabat	24 hours	Riparian/riverine. Dry tributary of Macquarie River.
31/11/2007	Anabat	12 hours	Riparian/riverine habitat adjacent Macquarie River.
31/11/2007	Anabat	12 hours	Open forest. Dry tributary of Macquarie River.
01/11/2007	Anabat	24 hours	Open forest (Ironbark/Black Cyprus Pine).
03/11/2007	Anabat	24 hours	Open forest (Tumbledown and Dwyers Red Gum).
03/11/2007	Anabat	24 hours	Riparian/riverine. Little River.
05/11/2007	Anabat	24 hours	Open forest (Ironbark).
05/11/2007	Anabat	24 hours	Open forest (Ironbark).
30/10/2007	Elliott traps (Type A and B)	25 Type A (100 trap nights) 10 Type B (40 trap nights)	Riparian/riverine. Dry tributary of Macquarie River.
30/10/2007	Elliott traps (Type A and B)	25 Type A (100 trap nights) 10 Type B (40 trap nights)	Open forest. Ironbark/Black Cyprus Pine Woodland.
03/11/2007	Elliott traps (Type A and B)	25 Type A (100 trap nights) 10 Type B (40 trap nights)	Riparian/riverine. Little River.
03/11/2007	Elliott traps (Type A and B)	25 Type A (100 trap nights) 10 Type B (40 trap nights)	Open forest. Ironbark/Black Cyprus Pine woodland.
30/10/2007	Cage traps	2 traps (8 trap nights)	Riparian/riverine. Dry tributary of Macquarie River.
30/10/2007	Cage traps	1 trap (4 trap nights)	Open forest. (Ironbark/Black Cyprus Pine).

Date	Survey type	Survey effort	Location description (fauna habitat / vegetation type)
03/11/2007	Cage traps	1 trap (4 trap nights)	Riparian/riverine. Little River.
03/11/2007	Cage traps	2 traps (8 trap nights)	Open forest. (Ironbark/Black Cyprus Pine).
TOTALS	Diurnal bird census	954 person minutes	
	Call Playback	270 minutes	
	Spotlight and Anabat walk traverse	480 minutes	
	Herpetofauna search	270 minutes	
	Harp trapping	16 trap nights	
	Anabat	144 hours	
	Elliott type A	400 trap nights	
	Elliott type B	160 trap nights	
	Cage traps	24 trap nights	

2.4.4 Aquatic habitat assessment

The aquatic habitat assessment of each site followed the relevant NSW Fisheries Policy and Guidelines (Fairfull & Witheridge 2003) and involved a description of the following habitat features:

- type and condition of vegetation in the riparian zone
- type and condition of in-stream vegetation
- presence of fish habitat, including large woody debris
- bank undercuts and scouring
- presence of barriers to fish passage into and beyond the site.

A description of the aquatic habitat of each of the waterways in the study area is provided in Section 3.4.2 Aquatic habitat.

2.4.5 Conservation significance

The conservation significance of native terrestrial flora, fauna and their habitats is generally categorised according to the following hierarchy:

- National
- State
- Regional
- Local.

Meaningful comparisons of significance or value at a variety of scales rely on widely accepted criteria. The following criteria were used to assign the biodiversity within the study area to an appropriate conservation significance category:

- **National:** Where part of the study area contained features listed as matters of national environmental significance, it was considered to be of national significance. Matters dealt with under the *Environment Protection and Biodiversity Conservation Act 1999* include:
  - Important areas of habitat for migratory species covered under international agreements to which Australia is a signatory, such as the *China Australian Migratory Bird Agree*ment (CAMBA), *Japan Australian Migratory Bird Agreement* (JAMBA) and the Bonn Convention.
  - Ramsar wetlands.
  - World Heritage properties that contain natural heritage considered to be of outstanding value to humanity, as listed under the Convention Concerning the Protection of the World Cultural and Natural Heritage.
  - Species, populations or communities listed as vulnerable or endangered under the *Environment Protection and Biodiversity Conservation Act 1999*.

  This category also includes:
  - Species listed as threatened and rare in *Rare or threatened Australian Plants* (NSW National Parks and Wildlife Service 2003).
  - Species listed as endangered, vulnerable or rare in Australia in an *Action Plan* published by the Department of the Environment and Water Resources.
- **State:** State significance refers to habitat containing populations of plant or animal species, or vegetation or animal communities considered threatened in NSW, including species and communities listed pursuant to the *Threatened Species Conservation Act 1995*. This category also includes species of plant listed as 'poorly known' in Australia in *Rare or Threatened Australian Plants* (Briggs and Leigh 1996).
- **Regional:** The State is divided into bioregions (Thackway and Cresswell 1995) and many of the listings of Endangered Ecological Communities under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* are based around these regions. Also, numerous published studies and vegetation mapping projects (NSW National Parks and Wildlife Service 2003) have indicated the importance of vegetation and species at various spatial scales.
- **Local:** All remnant native vegetation and fauna habitat that does not fall into the categories above is considered to be of at least local significance as most of these areas have been reduced in extent since European settlement. A site is considered to be of local significance for nature conservation if it provides ecological resources and habitat for species, populations and communities in the local area. An accepted definition of local area is within a 10 kilometre radius. The overall significance of a site on a local scale can consider factors such as the size of remnants, degree of intactness and connectivity.
- **Potentially significant:** Often the limitations of field methods, seasonal factors or time constraints make it impossible to confirm the presence of a significant species or population. However, the habitat of an area being investigated may closely match that used by a significant species in areas nearby where it is known to occur (NSW National

Parks and Wildlife Service 2001). In these circumstances, the level of significance that would otherwise apply is qualified by the term 'potential'.

2.5 Impact significance assessment

Impact assessments were completed for all the following threatened biodiversity recorded or with the potential to occur in the subject site or that have potential to be indirectly affected within the study area.

For species, populations and communities listed under the *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994* that have the potential to occur in the study area, the significance of impacts was assessed based on the *Draft Guidelines for Threatened Species Assessment under Part 3A* (NSW National Parks and Wildlife Service 2002a).

For species listed under the *Environment Protection and Biodiversity Conservation Act 1999,* significance assessments were completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (NSW Department of Environment and Conservation 2005).

Species listed under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* were assessed separately using both the Department of Environment and Conservation (2005b) and the Department of Environment and Heritage (2006a) guidelines; although there is considerable overlap between the two assessment processes.

2.6 Limitations

The present surveys were confined to a one kilometre radius of the proposed route of the gas pipeline and the proposed power station site within most flora and fauna sample sites located within 100 m of the proposed subject site. Reference as to the likely impact on flora, fauna and ecological communities in the study area is based on desktop review, targeted surveys, incidental observations and presence of suitable habitat. Given, that only 2 patches of vegetation identified by API could not be accessed along the length of the pipeline route during the current survey a high level of confidence in identifying the likely impact of the proposal on biodiversity within the study area was achieved.

On all sites, varying degrees of non-uniformity of flora and fauna habitats are encountered. Hence no sampling technique can totally eliminate the possibility that a species is present on a site (e.g. species of plant present in the seed bank). The present surveys were undertaken following a prolonged period of drought and many of the sites are located in paddocks that were overgrazed.

The conclusions in this report are based upon data acquired for the site and the environmental field surveys and are, therefore, merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of species. Also, it should be recognised that site conditions, including the presence of Threatened species, can change with time.

Where survey was done outside the optimal time for detecting species, a precautionary approach was taken and it was assumed that the species was present if suitable habitat was observed.

3. Description of the existing environment

3.1 Landscape context

The proposed project lie at the northern limit of the NSW South-western Slopes bioregion (NSW Department of Natural Resources 2005). This bioregion consists of 8,070,608 ha of foothills and ranges, comprising the western fall of the Great Dividing Range to the edge of the Riverina Bioregion. It has hot summers, with summer and winter rainfall. Remaining native vegetation is dominated by Eucalypt woodlands, Callitris forests and woodlands, and Eucalypt tall open forests. Patches of low closed forests and closed shrublands, Eucalypt open woodlands, grasslands and Acacia forests and woodlands occur (NSW National Parks and Wildlife Service 2002b; NSW Scientific Committee 2002a).

Major land uses are grazing of native and modified pastures, native forests and nature conservation (NSW Scientific Committee 2004).

The pipeline route passes close to Goobang National Park. The park was gazetted in 1995 and includes areas formerly used of forestry purposes however, is one of the largest remaining areas of natural vegetation in the central west of New South Wales. The park contains flora and fauna species associated with western New South Wales as well as those more commonly found on or east of the Great Dividing Range. Eleven native plant communities, nine of which are considered not adequately conserved within the Service estate, are located in the park. Many of the plant species found in the park are regarded as regionally significant because they occur at the limit of their known range. The park is also home to over 200 species of animal, 74 of which are recorded as being at the limits of their known range (1997).

Major landforms in the study region are rocky ranges and slopes associated with the Hervey, Catombal and Nangar Ranges; low ranges and rounded hills with common granite outcrops; and alluvial plains associated with the Macquarie River and its tributaries (NSW National Parks and Wildlife Service 2002a).

The proposed gas pipeline intersects a number of waterways within the project locality (refer Figure 1-1). These waterways include:

- Macquarie River — located in the northern half of the study area approximately 15 km to the west of the town of Wellington.
- Buckinbah Creek — located adjacent to the town of Yeoval in the centre of the pipeline route.
- Little River — located adjacent to Obley road in the centre of the pipeline route.
- Burrill Creek — located in the southern half of the study area approximately 25 km west of Goobang National Park.

Overall, the locality has been largely cleared of Eucalypt woodlands for grazing and dryland agriculture, with the larger remaining areas of vegetation now occurring on the rockier hilly areas, or as roadside vegetation.

3.1.1 Mitchell landscapes

Mitchell Landscapes are a system of ecosystem classification mapped at the 1:250,000 scale, based on a combination of soils, topography and vegetation (1997).

The proposed project lies across eight landscapes that are described below based on the *BioMetric Assessment Tool* (1997), including an estimation of clearing across each landscape. Under the *Environmental Outcomes Methods* of the *Native Vegetation Act* (1997), a landscape that is greater than 70% cleared is considered to be over-cleared.

Mullion Slopes – 92% cleared

This landscape consists of steep hills and strike ridges on tightly folded Ordovician andesite, conglomerate and tuff, Silurian rhyolite and shale, Devonian quartz sandstones, slate and minor limestone. It has a general elevation between 500 and 830 m and a local relief of 200 m. Along crests there exists stony uniform sand and loam in extensive rock outcrop, while stony red and brown texture-contrast soil on are present on slopes and yellow harsh texture contrast soil in valleys with some evidence of salinity. Gravel and sand is found in streambeds. Vegetation consists generally of open forest to woodland of *Eucalyptus mannifera*, *E. dives*, *E. polyanthemos*, *E. cypellocarpa*, *E. albens* with *E. melliodora* on lower slopes and river oak along the streams.

This landscape occurs in the east of the pipeline route and on the site of the power station.

Macquarie Alluvial Plains – 60% cleared

This landscape consists of holocene fluvial sediments of backplain facies of the Marra Creek Formation associated with the Macquarie River main alluvial fan and distributary stream system. It has a relief of 1 to 3 m. Soils consist of dark yellow-brown silty clay with patches of sand and carbonate nodules deposited from suspended sediments in floodwater, often with gilgai. Slightly elevated areas contain red-brown texture-contrast soils. Vegetation consists generally of open grasslands with scattered *Eucalyptus coolabah*, *E. largiflorens*, *E. populnea*, *Acacia stenophylla* and *Casuarina cristata*.

This landscape occurs surrounding the Macquarie River and its tributaries in the east of the pipeline route as well as in the central section next to Greenbah Creek to the east of Goobang National Park (refer Figure 1-1).

Molong Ridges – 82% cleared

This landscape is characterised by steep hills and strike ridges on tightly folded Devonian quartz and lithic sandstones, shale and conglomerate with some limestone and minor chert and tuff. The general elevation ranges from 530 to 780 m, with local relief of 200 m. Soils consist of stony uniform sand and loam in extensive rock outcrop along crests and upper slopes, stony brown texture-contrast soil on lower slopes, red harsh texture contrast soil on flanks and gravel in stream beds. Vegetation consists of *Callitris endlicheri*, *Eucalyptus blakelyi*, *E. macrorhyncha, E. fibrosa* with numerous shrubs on crests, *E. microcarpa*, *E. bridgesiana* and *E. albens* on slopes, *E. melliodora* and *E. microcarpa* on flats, *E. camaldulensis* and *Casuarina cunninghamiana* on larger streams, scattered *Brachychiton populneus* and *Eucalyptus albens* on limestone.

Molong Ridges occur in the east of the pipeline route.

Nangar Slopes and Ranges – 80% cleared

This landscape is characterised by steep structurally controlled ridges and peaks with low cliffs on Devonian and Silurian lithic sandstones, shales and occasional conglomerates. Small areas of granitic intrusions occur also. This landscape has a strong dendritic drainage pattern. General elevation is between 500 and 770 m, with a local relief to 300 m. Soils include shallow stony soils on steep slopes with rubbly debris in gully lines, yellow texture contrast soils on lesser slopes. Vegetation consists of *Eucalyptus microcarpa* woodlands with *E. macrorhyncha*, *E. fibrosa* and *E. dealbata*. *Callitris endlicheri* is common on stony sites with white cypress pine is found in lower positions on better soils.

This landscape occurs in the eastern quarter of the pipeline route.

Geurie Granites – 63% cleared

This landscape is characterised by low ranges and rounded hills with common rock outcrop and tors on massive Devonian granite. The general elevation is between 400 and 610 m, with local relief of 180 m. Soils consist of gritty gradational red earth on the crests, red texture-contrast soil on upper slopes grading to yellow harsh texture-contrast soil along valley floors. Vegetation consist of open forest of *Eucalyptus fibrosa, Callitris glaucophylla, Eucalyptus macrorhyncha, E. melliodora, E. blakelyi* and a shrubby understorey.

This landscape occurs in the central region of the pipeline route.

Harvey Ranges and Slopes – 52% cleared

This landscape is characterised by prominent strike ridges and ranges with structurally controlled dip slope and escarpment features on folded, moderately dipping Devonian conglomerate, sandstones, shale, rhyolite and dacite. The general elevation is between 400 and 770 m, with local relief of 300 m. Thin sands occur on crests amongst abundant rock outcrop. Oils consist of shallow red texture-contrast soils on shale benches, bouldery debris slopes with sandy loam matrix merging with red-brown earths on lower slopes with sand and gravel in streambeds. Vegetation is characterised by woodlands and low forest of *Eucalyptus dealbata, E. macrorhyncha, Callitris endlicheri, Eucalyptus fibrosa,* patches of *Eucalyptus viridis* and heath on crests. *Eucalyptus blakelyi*, and *Callitris glaucophylla* on lower slopes, *Eucalyptus melliodora* in streams and flats.

The landscape occurs in the western half of the pipeline route and includes Goobang National Park.

Goonumbla Hills – 94% cleared

This landscape is characterised by rounded low hills on Ordovician and Silurian sandstone, andesite, siltstone and phyllite with a partial blanket of Tertiary quartz gravels and sands. General elevation is between 290 to 390 m, with local relief of 70 m. Soils consist of stony yellow earths on the sands, thin brown structured loams on the hills merging with red-brown and red texture contrast soils on the flats. Vegetation consists of open forest of *Eucalyptus microcarpa, Callitris glaucophylla*, with *E. populnea* in the creeks and *E. fibrosa* with shrubs on the gravels. This landscape is extensively cleared, grazed and cultivated.

This landscape is found at the western end of the pipeline route.

Bogan Alluvial Plains – 57% cleared

Bogan Alluvial Plains ecosystem includes parts of five land systems: Budenda, Eurie, Geera, Nidgery and Pendia. This landscape consist of partly scalded, higher level plains along the Bogan River of Holocene alluvium represented by the meander plain and backplain facies of the Marra Creek Formation. It also contains narrow, defined drainage lines and swamps, extensive gilgai in grey and brown clays, occasional lagoons, swamps and remnant lakes, some with low lunettes, with relief to 3 m. Soils consist of red brown texture-contrast soils on plains with brown and grey cracking clays in sinuous patterns on backplains and light orange-brown fine to medium sands in channels and occasional source bordering dunes. Very small flat top hills and rises of Tertiary quartz sandstone and conglomerate that are probably fluvial terrace remnants in the Barwon Channel and Floodplain ecosystem. Isolated by floodwaters, expected to have red-brown texture-contrast soils and different vegetation, but no specific data is available.

This landscape is found at the western end of the pipeline route.

3.2 Vegetation communities

Six vegetation communities were identified within the study area based on assessment of the dominant canopy species and structural form. Detailed summaries of the species recorded in each vegetation community and the vegetation habitat assessments of each vegetation community are summaries in Attachment A.

Two of these communities generally align with description of Threatened Ecological Communities described by the NSW Scientific Community (White Box, Yellow Box, Blakely's Red Gum Woodland and Fuzzy Box Woodland); and three correspond with communities described by Porteners (1997) as occurring within Goobang National Park (adjacent to the part of the study area where these communities were identified).

Table 3-1 Vegetation communities identified in the study area

Vegetation Community (this study)	Source of community title and description
White Box, Yellow Box, Blakely's Red Gum Woodland	TSC Act Endangered ecological community determination
Fuzzy Box Woodland	TSC Act Endangered ecological community determination
River Red Gum Woodland	-
Ironbark, Black Cypress Pine Open Forest	Porteners (1997)
Tumbledown Red Gum, Dwyer's Red Gum Woodland	Porteners (1997)
Red Ironbark, Red Stringybark Woodland	Porteners (1997)

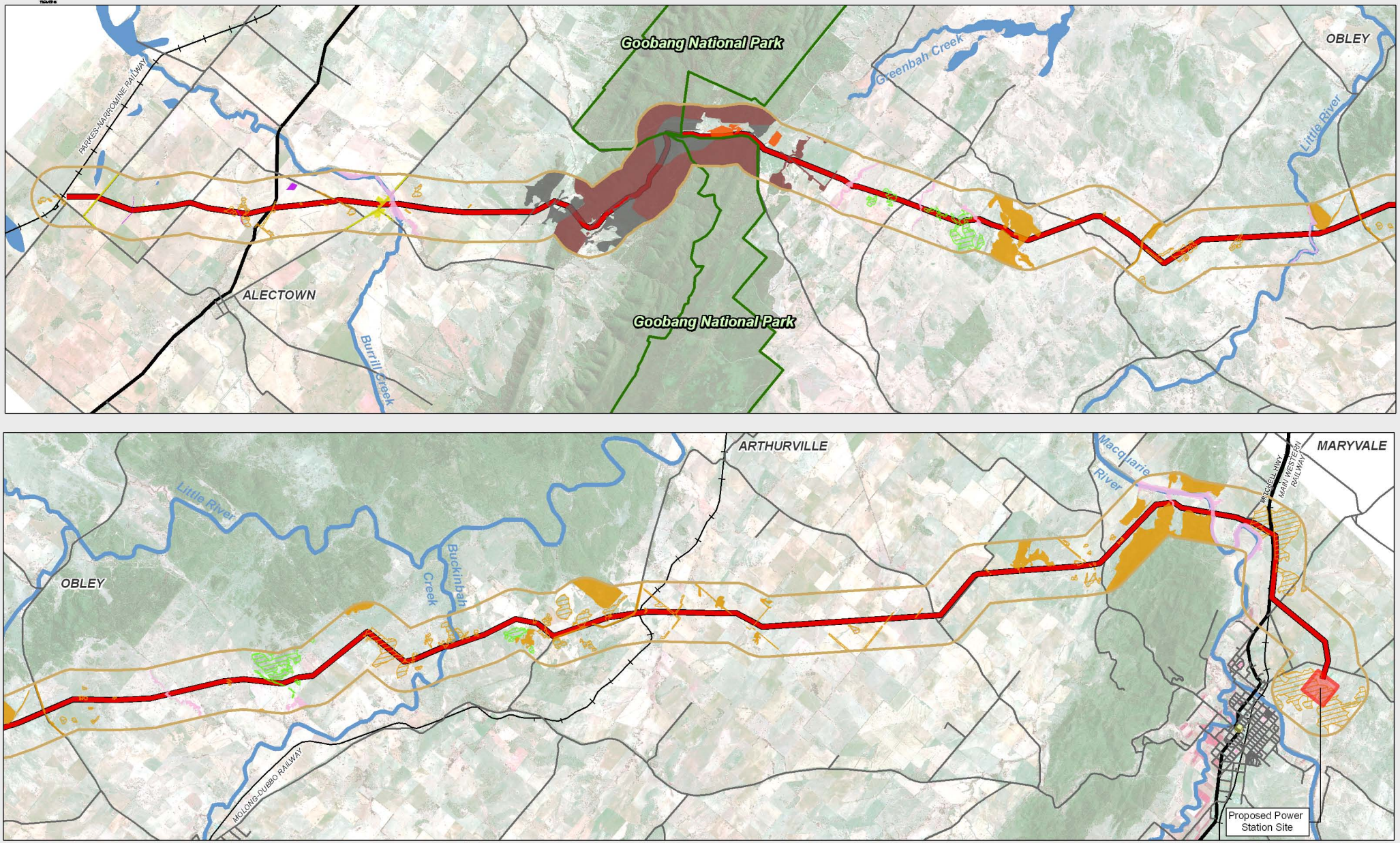


Figure 3-1 Vegetation communities in the study area

3.2.1 White Box, Yellow Box, Blakely's Red Gum Woodland

White Box, Yellow Box, Blakely's Red Gum Woodland (Box Gum Woodland) is a grassy woodland or open woodland with a canopy cover from <10-30% and height range of 14-30 m. In this community the canopy is dominated by one or more of the following species: *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and/or *E. blakelyi* (Blakely's Red Gum). Other dominant species in this community are summarised in Table 3-2.

Table 3-2 Dominant species in the Box Gum Woodland

Strata	Dominant species and description
Canopy	*Eucalyptus albens* and/or *Eucalyptus melliodora* dominate the canopy with *Eucalyptus blakelyi, Eucalyptus microcarpa, Eucalyptus conica* and/or *Eucalyptus dealbata* occurring less frequently. A low tree layer is present at some sites which includes juvenile canopy species in addition to *Callitris glaucophylla, Brachychiton populneus* ssp. *populneus, Allocasuarina luehmannii.* Close to and Hervey Range *Callitris glaucophylla* is replaces by *Callitris endlicheri*.
Understorey	Absent from all Box Gum Woodland patches within paddocks. Within the road corridors however, some sparsely scattered shrubs occur including *Acacia* spp., *Senna barclayana*, and *Dodonaea* spp.
Ground stratum	The foliage ground cover in most patches of this community was generally low (average 26% vegetative cover), however the patches in the road corridors generally have higher foliage ground cover (up to 80%). Common native ground cover species included seventeen species of grass with *Einadia nutans*, *Rumex brownii*, *Desmodium varians*, *Cheilanthes sieberi*, *Calotis cuneifolia* and *Lomandra* spp.
	The groundcover in the patches in paddocks were dominated by dead annual exotic grasses (mainly *Hordeum leporinum** and *Bromus diandrus**) and other introduced grasses (*Lolium rigidum*, Hordeum leporinum*, Bromus* spp.**, Vulpia ciliate**). Mustard weeds (*Capsella bursa-pastoris*, Hirschfeldia incana*, Sisymbrium orientale*, Sisymbrium irio*, Sisymbrium officinale**), and thistles (*Silybum marianum**, *Carduus tenuiflorus** and *Carthamus lanatus**) are also common.

Box-Gum Woodland occurs in the tablelands and western slopes on a range of moderate to highly fertile soils of NSW from the Queensland to Victorian borders (Lindenmayer & Fischer 2006). White Box, Yellow Box, Blakely's Red Gum Woodland is an Endangered ecological community under the *Threatened Species Conservation Act 1995* and a Critically Endangered ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (dependant on criteria discussed in Section 2.4.3).

Within the study area, Box Gum Woodland occur along the low ranges, rounded hills and alluvial plains, which have been extensively cleared for agricultural land uses. These patches are generally linear patches adjacent to road or small patches in paddocks, particularly amongst local granite outcrops that are unsuitable for cropping (refer Figure 3-1). All patches of Box Gum Woodland in paddocks that are actively cropped or heavily grazed are of condition Class 5 due to modification of the natural soil, native seed bank and ground cover; lack of recruitment of canopy species; and lack of potential for natural or assisted regeneration. These patches were of condition Class 5.

The Box Gum Woodland patches of highest native diversity occur in the road corridors (refer Photograph 3-1), which are subject to pulse grazing only and no cropping. These patches have a naturally grassy understorey with a few sparsely scattered shrubs; native species dominated the ground cover and there is recruitment of canopy species. These patches are generally of condition Class 2.

A total of 136 species of plant were recorded in the Box Gum Woodland in the study area across 21 sites, of which 65% were native (refer to Attachment A). Native diversity was highest in the ground stratum (73% of all native species). The average number of native species per patch however, was generally low in this community at only 12 species including canopy species: 28 native species was the highest native diversity recorded in this community.

Box Gum Woodland within paddocks were highly modified by routine cropping, grazing, weed intrusion and/or pasture improvement (introduction of non-endemic grasses for domestic livestock, nitrogen-fixing legumes and/or fertilising) and there was little to no recruitment of new canopy trees (refer Photograph 3-2). These patches are unlikely regenerate from the extensive disturbance and have been mapped as 'scattered paddock trees' (refer Figure 3-1) to differentiate them from patches of the community with potential to regenerate (given suitable management).

Photograph 3-1 White Box, Yellow Box, Blakely's Red Gum Woodland in road corridor

Photograph 3-2 **White Box, Yellow Box, Blakely's Red Gum Woodland in paddocks (scattered paddock trees)**

3.2.2 Fuzzy Box Woodland

Fuzzy Box Woodland is a community dominated by *Eucalyptus conica* (Fuzzy Box) with co-dominant *E. microcarpa, E. melliodora* and *Brachychiton populneus* ssp. *populneus*. The structure of this community was a woodland (canopy cover ~30% and height range of 14-20 m, refer Photograph 3-3). Two patches were identified in the study area of which one was grassy and one was shrubby. Other dominant species in this community are summarised in Table 3-3.

Fuzzy Box Woodland is an Endangered ecological community listed under the *Threatened Species Conservation Act 1995* in the South West Slopes, Darling Riverine Plains & the Brigalow Belt South bioregions. This community occurs on alluvial soils of the South West Slopes, Brigalow Belt South and Darling Riverine Plains Bioregions, mainly in the Dubbo-Narromine-Parkes-Forbes area (Gibbons & Lindenmayer 2002). *Eucalyptus conica* is more widely distributed than the listed ecological community however, and may occur in association with other eucalypt species to form other communities.

Fuzzy Box Woodland may also be consistent with the *Environment Protection and Biodiversity Conservation Act 1999* listing of White Box, Yellow Box, Blakely's Red Gum Woodland and derived grasslands where *Eucalyptus melliodora* is co-dominant (discussed in Section 4.1).

Table 3-3 Dominant species in the Fuzzy Gum Woodland

Strata	Dominant species and description
Canopy	Eucalyptus conica, Eucalyptus melliodora and Eucalyptus polyanthemos dominates the canopy in the Fuzzy Box Woodland. The low tree layer is present which includes Callitris endlicheri, Geijera parviflora, Santalum acuminatum and Brachychiton populneus ssp. Populneus.
Understorey	The understorey is generally absent from one of the Fuzzy Box Woodland patches, however the other patch has a dense shrub stratum consisting of *Senna* form taxon *'artemisioides"*, *Acacia deanei* ssp. *paucijuga* and *Dodonaea viscosa*.
Ground stratum	The foliage ground cover is high in the grassy patch (60% vegetative cover) and low in the shrubby patch (18% vegetative cover). The ground cover diversity was also high with 37 species recorded across the two patches of which 70% were natives that were predominantly herbs and small shrubs: *Atriplex pseudocampanulata*, *Maireana enchylaenoides*, *Sclerolaena* sp., *Dichondra repens*, *Goodenia hederacea*, *Lomandra bracteata*, *Sida corrugate*, *Eremophila debilis*. Native grasses included *Chloris divaricata* var. *divaricata*, *Aristida behriana*, *Austrodanthonia* spp. and *Austrostipa scabra*.

Photograph 3-3 Fuzzy Box Woodland in road corridor

Fuzzy Box Woodland occurs on alluvial soils that have been extensively cleared for agricultural land uses. Similar to Box Gum Woodland, the remaining Fuzzy Box Woodland in the study area only occurs in linear patches within road corridors west of Hervey Range (refer to Figure 3-1) which are modified by fragmentation, edge effects and weeds and were of condition Class 2. Fifty species of plant were recorded in this community of which 76% were native (refer to Attachment A). Native diversity was highest in the ground stratum (65% of all native species).

3.2.3 River Red Gum Woodland

River Red Gum Woodland is a community with a canopy dominated by *Eucalyptus camaldulensis* (River Red Gum) associated with *Casuarina cunninghamiana* and *Angophora floribunda*. This community occurs exclusively on alluvial soils along major rivers and larger creek lines (refer Figure 3-1) which are generally within paddocks that are grazed by domestic livestock. The adjoining floodplains are cleared of native vegetation. Other dominant species in this community are summarised in Table 3-4.

Table 3-4 Dominant species in the River Red Gum Woodland

Strata	Dominant species and description
Canopy	*Eucalyptus camaldulensis* with *Casuarina cunninghamiana* and *Angophora floribunda* along Macquarie River and Little River (the larger rivers with permanent freestanding water). *Salix babylonica** and *Salix nigra** are also present in the canopy of this community along Macquarie River and Little River. Along the smaller creeks which support this community, canopy species from the adjoining (former) woodland communities may also occur in the canopy including *E. microcarpa, E. melliodora* and *Brachychiton populneus* ssp. *populneus*.
Understorey	The shrub stratum was generally absent from River Red Gum Woodland.
Ground stratum	The ground stratum along Burrill Creek was dominated by *Carex inversa, Lomandra longifolia* and a mix of other native and exotic grasses and herbs. Along Little River the ground cover was dominated by *Cynodon dactylon, Juncus* sp. and other paddock weeds. Along Macquarie River the ground cover was dominated by exotic species including *Silybum marianum**, *Conium maculatum*, Echium plantagineum*, Silybum marianum*, Marrubium vulgare*, Carduus tenuiflorus*, Carthamus lanatus*, Hirschfeldia incana*, Cirsium vulgare*, Verbena bonariensis*, Sisymbrium orientale*, Sisymbrium officinale** and *Centaurea solstitialis**.

The structure of this community was woodland to tall woodland with canopy cover <30% and height range of 10-30m (refer photograph 3-4). In-stream vegetation is dominated by *Cyperus* spp., *Juncus* spp. As a result of grazing, the shrub stratum was either absent or dominated by non-palatable weeds such as *Silybum marianum** and *Conium maculatum** and were of condition Class 5. Sixty-six species of plant were recorded in the River Red Gum Woodland (across 3 sites) of which only 42% were native (refer to Attachment A).

Photograph 3-4 River Red Gum Woodland along Little River

3.2.4 Ironbark, Black Cypress Pine Open Forest

Ironbark, Black Cypress Pine Open Forest is an open forest with a canopy cover 30-70% and height range of 10-24 m (refer Photograph 3-5) that is the dominant vegetation community along the rocky ranges and slopes of Hervey Range (refer to Figure 3-1). This community is described by Porteners (1997) as occurring in Goobang National Park.

Ironbark, Black Cypress Pine Open Forest was dominated by *Eucalyptus fibrosa* (Red Ironbark) and/or *Eucalyptus sideroxylon* (Mugga Ironbark) in association with *Callitris endlicheri* (Black Cypress Pine) and other *Eucalyptus* spp. Other dominant species in this community are summarized in Table 3-5.

Table 3-5 Dominant species in the Ironbark, Black Cypress Pine Open Forest

Strata	Dominant species and description
Canopy	Eucalyptus sideroxylon and Eucalyptus fibrosa and commonly co-dominated by Eucalyptus microcarpa, Eucalyptus dealbata or Eucalyptus macrorhyncha. Eucalyptus albens and Eucalyptus melliodora also occur on the fringes of the community towards the deeper soils on the lower slopes and valley floor.
Understorey	The shrubby areas are dominated by *Acacia mollifolia*, *Leptospermum trivalve* and *Allocasuarina verticillata*. In other areas with a clearer understory, *Acrotriche rigida* was the dominant shrub species. Other shrub species in this community included *Hibbertia empetrifolia, Hibbertia obtusifolia, Acacia paradoxa, Acacia doratoxylon, Melichrus erubescebs, Cassinia compacta, Calytrix tetragona* and *Dodonaea viscosa* ssp. *spatulata.*
Ground stratum	Vegetation on the ground cover is generally sparse (around 25% foliage cover) and dominated by leaf litter, fallen logs and branches. *Cheilanthes sieberi* and *Lomandra* spp. were the most frequently occurring species. Other common ground cover species included *Daucus glochidiatus, Goodenia hederacea ssp. hederacea, Rumex brownii, Arthropodium milleflorum, Hydrocotyle laxifolia, Dianella longifolia* var*. longifolia, Gahnia aspera, Wahlenbergia multicaulis, Austrostipa scabra, Aristida ramosa, Elymus scaber* and *Austrodanthonia* spp*. Xanthorrhoea* sp. and *Macrozamia communis* that were not recorded elsewhere.

Photograph 3-5 Ironbark, Black Cypress Pine Open Forest in Hervey Range

The Ironbark, Black Cypress Pine Open Forest has been modified through clearing, logging, altered fire regimes and grazing by sheep and feral goat which have reduced the abundance of large mature trees. Recruitment of canopy species however is occurring. This community was of condition Class 2.

Seventy-one species of plant were recorded in the Ironbark, Black Cypress Pine Open Forest (across 3 sites) of which 88% were native (refer to Attachment A). This community also included one ROTAP (Rate or Threatened Australian Plants) species: *Lomandra patens* (listed 3Ra).

3.2.5 Tumbledown Red Gum, Dwyer's Red Gum Woodland

Tumbledown Red Gum, Dwyer's Red Gum Woodland occurs on rocks slopes along Hervey Range (refer to Figure 3-1), that is also likely to occur on Catombal and Nangar Ranges, and is a community described by Porteners (Porteners 1997) as occurring in Goobang National Park. This community is a shrubby woodland with a canopy cover to 30% and height range of 10-15 m) dominated by *Eucalyptus dealbata* (Tumbledown Red Gum) in association with combinations of other *Eucalyptus* spp (refer Photograph 3-6). The understorey ranged from low and shrubby to near heath like. Other dominant species in this community are summarised in Table 3-6.

Table 3-6 Dominant species in the Tumbledown Red Gum, Dwyer's Red Gum Woodland

Strata	Dominant species and description
Canopy	The canopy in this community was dominated by *Eucalyptus dealbata* in association with combinations *Eucalyptus dwyeri* (Dwyer's Red Gum), *Eucalyptus fibrosa, Eucalyptus sideroxylon* and *Eucalyptus macrorhyncha*.
Understorey	The understorey in this community ranges from low diversity heath like form dominated by *Leptospermum trivalve*, *Acacia mollifolia* and *Acacia paradoxa* (refer Photograph 3-6) to a low diverse grass, forb and herb cover.
Ground stratum	In the patches with a low diverse grass, forb and herb cover Aristida ramose, Elmyus scaber, Austrostipa scabra, Cheilanthes sieberi, Lomandra spp. and Dianella longifolia var. longifolia were common species.

This community has been subject to similar disturbance as the Ironbark, Black Cypress Pine Open Forest, however as the density of target timber species is generally lower (such as the Ironbarks), there appears to have been less logging activity. Recruitment of canopy species however was occurring. This community was of condition Class 2.

Sixty-three species of plant were recorded in the Tumbledown Red Gum, Dwyer's Red Gum Woodland (across 3 sites) of which 76% was native (refer to Attachment A).

Photograph 3-6 **Tumbledown Red Gum, Dwyer's Red Gum Woodland at the southern end of Hervey Range**

3.2.6 Red Ironbark, Red Stringybark Woodland

Red Ironbark, Red Stringybark Woodland occurs on rocks slopes associated with Hervey Range and has been described by Porteners (Wilson & Lindenmayer 1995) as occurring in Goobang National Park. This community is dominated by *Eucalyptus macrorhyncha* (Red Stringybark) in association with *Eucalyptus fibrosa* (Red Ironbark). The patch in the study area was however co-dominated by *Eucalyptus sideroxylon* (Mugga Ironbark) apposed to *Eucalyptus fibrosa* (Red Ironbark) as described by Porteners (1997). Other dominant species in this community are summarised in Table 3-7.

Table 3-7 Dominant species in the Red Ironbark, Red Stringybark Woodland

Strata	Dominant species and description
Canopy	The canopy in this community was dominated by *Eucalyptus macrorhyncha* (Red Stringybark), *Eucalyptus sideroxylon* (Mugga Ironbark) and associated of other *Eucalyptus goniocalyx*.
Understorey	The shrub stratum was relatively diverse given how sparse its cover was. Species included Grevillea floribunda, Pimelea linifolia, Acacia penninervis, Babingtonia cunninghamii, Allocasuarina verticillata, Hibbertia sp., Astroloma humifusum, Leptospermum trivalve and Persoonia curvifolia.
Ground stratum	The ground cover was the most diverse stratum in this community (63% of the native diversity) and consisted of a combination of grasses, herbs and small shrubs of the species as mention above. Other common groundcover species included *Cheilanthes sieberi, Lomandra* spp., *Bracteantha viscosa*, *Dianella longifolia* var. *longifolia*, *Laxmannia gracilis, Poranthera microphylla, Aristida ramosa* and *Microlaena stipoides*.

The study area includes only one patch of Red Ironbark, Red Stringybark Woodland on the western side of Hervey Range (Figure 3-1). This patch was dominated by regrowth in the age range of 15 years since last clearing, which has modified the structure and diversity of the community. The patch of this community in the study area was a low woodland (canopy cover to 20-30% and height range of 8-10 m, refer Photograph 3-7) with a low shrubby understorey. This community was of condition Class 1.

Despite the high level of disturbance, 44 species of plant were recorded in this community, of which 93% was native (refer to Attachment A). This community also included one ROTAP (Rate or Threatened Australian Plants) species: *Lomandra patens* (listed 3Ra).

Photograph 3-7 **Red Ironbark, Red Stringybark Woodland regrowth on the eastern edge of Hervey Range**

3.2.7 Cleared areas and paddocks

The remaining areas of the study area included cleared areas dominated by paddocks. These areas generally corresponded with arable soils on the low ranges, rounded hills and alluvial plains. These areas area likely to have been dominated historically by Box Gum, Fuzzy Box Woodlands and River Red Gum woodlands prior to clearing.

The paddocks in the study area are highly modified by long term grazing and/or routine cropping, pasture improvement practices (introduction of non-endemic feed or soil improvement species) and incursion of weeds. These activities have modified the natural soil profile and extinguished the natural seed bank resulting in a ground cover that is dominated by exotic species including *Hordeum leporinum* and *Bromus diandrus* in combination with numerous species of thistle, mustard weed (Brassicaceae), *Malva parviflora* and other grass weeds.

Amongst these cleared areas some scattered paddock trees remain that include canopy species representative of the communities described above. These trees may be habitat value to some fauna (as discussed below), however are no longer representative of a native vegetation community.

Photograph 3-8 Cleared areas and paddocks

3.3 Species of plant

A total of 250 species of plant, representing 66 families, were recorded within the study area of which 186 (74%) were native (refer to Attachment A). The number of species recorded in each community is summarised in terms of the in number of species of plant recorded in the study area and in each community (refer Table 3-8).

The diversity of native and exotic species of plant was highest in the ground cover. Within the ground cover, Poaceae (grasses) was the most diverse family (40 species including 25 natives), followed by Asteraceae (daises, 26 species including 15 natives). Fabaceae was the most diverse family of shrubs (22 species including both Mimosoideae and Faboideae) with included 14 *Acacia* (wattles). *Eucalyptus* species dominated the canopy stratum of all communities with a total of 13 species recorded in the study area.

No threatened species of plant listed under the *Threatened Species Conservation Act 1995* or *Environment Protection and Biodiversity Conservation Act 1999* were recorded in the study area. One ROTAP (Rate or Threatened Australian Plants) species was recorded however in the study area: *Lomandra patens* (listed 3Ra). This species occurred in the Ironbark, Black Cypress Pine Open Forest and Red Ironbark, Red Stringybark Woodland.

Table 3-8 Number of species of plant recorded in the study area

Community	Total Number of species	Number of native species (% of total)	Number of introduced species	Number of sample sites
Box Gum Woodland	136	89 (65)	47	21
Fuzzy Box Woodland	50	38 (76)	12	2
River Red Gum Woodland	66	29 (44)	37	3
Ironbark, Black Cypress Pine Open Forest	71	63 (89)	7	5
Tumbledown Red Gum, Dwyer's Red Gum Woodland	63	15 (23)	48	3
Red Ironbark, Red Stringybark Woodland	44	41 (93)	3	2
All communities combined	250	186 (74)	64	36

3.4 Fauna habitats

The size and configuration of the fauna habitats in the study area generally correlate with the broad vegetation communities described above. Table 3-3 details the five broad fauna habitat types identified in the study area and their association with each of the vegetation communities described in Section 3.2.

Table 3-9 Fauna habitats and their associated vegetation communities in the study area

Fauna habitat	Vegetation community
Open Forest	▪ Ironbark / Black Cyprus Pine Open Forest.
Woodland	▪ White Box – Yellow Box – Blakeys Red Gum Grassy Woodland. ▪ Fuzzy Box Woodland. ▪ Tumbledown Red Gum and Dwyer's Red Gum Woodland. ▪ Red Ironbark / Red Stringybark Woodland.
Open Woodland	▪ Scattered Paddock Trees (former Box Gum Woodland). ▪ Scattered Paddock Trees.
Riparian/riverine forest	▪ River Red Gum Woodland.
Cleared land/ grassland	▪ Al other areas within the study area.

Finer-scale habitat features in and near the study area were observed, including foraging resources, tree hollows, hollow logs including ephemeral drainage lines and dams. These habitats and species associations are discussed below and the location of each fauna habitat type is shown in Figure 3-2.

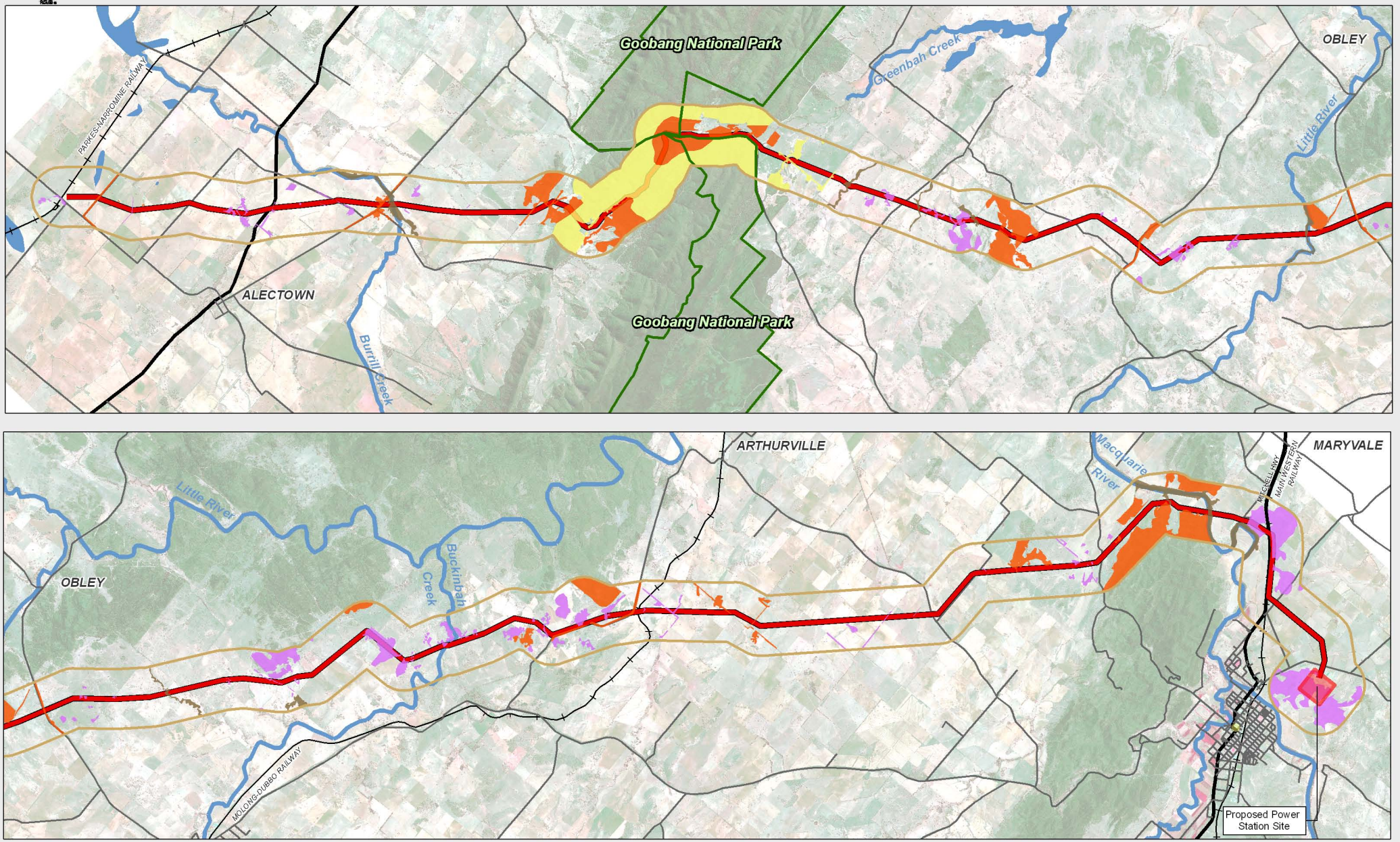


Figure 3-2 Fauna habitat types in the study area

Open forest

The open forest fauna habitat strongly correlated with the Ironbark / Black Cyprus Pine Open Forest vegetation community within the study area. This habitat was predominately confined to the southern half of the study area adjacent Goobang National Park (refer to Photograph 3-9) and covered a total area of 7.7 ha within the subject site.

Typically the structure of the open forest fauna habitat ranged from 10 to 30 m in height with foliage protection cover values of 30 to 70 % depending on the management regime. For example some areas of open forest adjacent Goobang National Park were typically tall (20 to 25 m) with an average foliage protection cover of 50%. In contrast other areas, particularly along access tracks were highly disturbed by historical vegetation clearing. These disturbed areas provided an over storey of 14 to 18 m with low foliage protection cover (30%).

These differences in fauna habitat quality were reflected in the type of fauna species observed. More disturbed areas had greater abundance of fallen timber, branches and leaf litter providing suitable habitat for ground dwelling mammals (i.e. Antechinus sp) and small reptiles including Striped Skink (*Ctenotus robustus)*, Stone Gecko (*Diplodactylus vittatus*) and Carnaby's Wall Skink (*Crytoblepharus carnabyi*).

In less disturbed areas dense stands of *Leptospermum trivalve* (a recolonising species after disturbance) provided mid strata cover up to 2 m for small ground dwelling mammals and macropods. Whilst larger trees up to 25 m provided tree hollow resources at low densities (approximately 1 to 2 tree hollows per hectare). These hollows were typically small and only provide suitable habitat for small open forest birds and species of microchiropteran bats.

Photograph 3-9 **Open forest fauna habitat located adjacent Goobang National Park, Hervey Range**

However, the high abundance of exfoliating bark present on Ironbark species also provided suitable roosting habitat for species of microchirpoteran bat.

Overall the fauna habitat condition of the open forest ranged from poor to good depending on the level of disturbance.

Woodland

The woodland fauna habitat encompassed four vegetation communities within the study area. These vegetation communities include:

- White Box – Yellow Box – Blakeys Red Gum Grassy Woodland.
- Tumbledown Red Gum and Dwyer's Red Gum Woodland.
- Red Stringybark Woodland.
- Fuzzy Box Woodland.

This habitat type covered a total area of 12.4 ha within the subject site. Typically this habitat had a moderate to dense over storey reaching up to 20 m providing foliage protection cover of 10 to 30%.

Hollow bearing trees were present at low densities of 3 trees per hectare throughout this habitat type. Tree hollows ranged from small to medium suitable for species of arboreal mammals and woodland birds including Kingfishers, Kookaburras, Rosellas and Parrots. Possum dreys in larger eucalyptus trees were also observed during fauna habitat assessments and spotlighting surveys within this fauna habitat.

Groundcover comprised largely of leaf litter (> 50% cover) with high levels of log debris (20% cover) and sparse vegetation cover (<20% foliage protection cover). The accumulation of leaf litter and fallen timber provided suitable habitat for species of reptile including Stone Gecko and Carnaby's Wall Skink. Similar to most of the habitat in the study area open forest fauna habitat was devoid of surface water and few drainage and creek lines were present.

Overall the fauna habitat condition of the open forest ranged from moderate to good.

Open woodland

This fauna habitat corresponded largely with Scattered Paddock Trees (former Box Gum Woodland) vegetation community and comprised approximately 18.3 ha within the subject site (refer Figure 3-2). These fauna habitats are beneficial in a highly fragmented landscape with isolated accumulations of trees providing stepping stones for the movement of fauna species between large fragments of habitat (Bennett 1990; Wilson & Lindenmayer 1995).

This habitat type exhibited a broad distribution and was variable in microhabitat (i.e. rocky slopes, small ephemeral drainage lines) and was typically dominated by Box Gum species.

The structure of most open woodland habitat ranged from 12 to 20 m in height with low foliage projection less than 10%. Hollow-bearing trees were present within mature stands providing small to medium sized hollows for a range of species including bats, possums, larger birds (Cockatoos, Parrots, Kingfishers and Kookaburras) at moderate densities of four trees per hectare. Many areas of open woodland however lacked hollow bearing trees including the site of the new proposed power station (refer Photograph 3-10).

Photograph 3-10 Woodland fauna habitat

Photograph 3-11 Proposed Power Station open woodland fauna habitat

The groundcover was comprised largely of introduced and native grasses (>60%). Some habitats contained larger areas of bare soil and was a reflection of the grazing intensity of livestock in the area. The habitat was generally devoid of surface water other than ephemeral soaks, drainage lines and farm dams.

The disturbance regime was largely influenced by the extent of grazing, clearing practices and weed infestation of each site. The overall fauna habitat condition of open woodland ranged from poor to moderate.

Riparian/riverine forest

Riparian/riverine forest occurred in the northern and southern sections of the alignment adjacent large water courses including Macquarie River and smaller creeks including Little River (west of Obley Road), Burril Creek (west of Goobang National Park) and various other drainage lines (refer Figure 3-2). This fauna habitat comprised a total of 3 ha within the subject site and comprised the River Red Gum Woodland vegetation community.

In the northern study area adjacent the Macquarie River this fauna habitat was dominated by a dense cover (40-60% foliage projection cover) of River Red Gum at a height of approximately 20 m and mean Diameter at Breast Height (DBH) greater than 150 cm (refer Photograph 3-12). Species of *Allocasuarina*, Blakely's Red Gum and large overhanging Black and Weeping Willows also bordered the riparian zone contributing to additional canopy cover.

Photograph 3-12 Macquarie River riparian/riverine fauna habitat

Tree hollows were abundant within the riparian zone at densities of approximately eight hollows per hectare. Hollows present included small trunk hollows and medium sized branch hollows suitable for species of woodland bird, possums, bats and larger birds including Cockatoos and Parrots. Large trunk hollows were present at densities of approximately two hollows per hectare and provide suitable habitat for Masked and Powerful Owls. A Powerful

Owl was recorded during a call playback event within the Macquarie River riparian fauna habitat.

Groundcover attributes consisted of large decaying logs and fallen trees consistent with a heavily disturbed site. There were extensive cleared areas due in part by clearing and grazing by livestock and much of the fallen timber had been derived from anthropogenic sources such as clearing and grazing.

In the southern study area adjacent Little River large River Red Gums (*Eucalyptus camaldulensis*) up to 20 m provide a thin riparian corridor between Goobang National Park in the south and Nangar Range in the north. Although some larger trees are spaced at up to 20 m in some areas this riparian habitat provides a suitable habitat for movement of arboreal mammals including the Koala, possums and small gliders all of which are known to occur within the locality.

Mid-storey vegetation is generally sparse comprising isolated species of shrubs and trees including Black and Weeping Willows up to 7 m. Large accumulations of fallen branches, trees and leaf litter up to 2 m at the base of trees provide refuge for ground dwelling species of mammal including Yellow-footed Antechinus (*Antechinus flavipes*) (caught during trapping events) and small species of reptile including Striped Skink and Rainbow Skink (*Carlia tetradactyla*).

Photograph 3-13 Riparian/riverine fauna habitat at Little River

Riverine/riparian habitat at Burrill creek (refer Photograph 3-14) was dominated by an over storey of Box Gum species providing 20 to 25% foliage protection cover and reaching heights of approximately 22 m. Hollow resources were limited with small trunk hollows at a density of 3 per hectare capable of providing refuge habitat for species of woodland birds. Groundcover attributes were characterised by native and introduced grasses up to 80 cm. This linear strip (50 to 60 m wide) of poor to moderate fauna habitat was surrounded exclusively by cleared agricultural lands and provided a corridor for movement of fauna species in the southern end of the study area.

The most significant feature of all riverine/riparian fauna habitats bisected by the proposed alignment are the stands of mature Eucalyptus trees that provide a habitat linkage with small and large fragments of fauna habitat across the landscape.

Photograph 3-14 Riparian/riverine fauna habitat at Burrill Creek

Cleared land/grassland

Cleared land/grassland (refer Photograph 3-15) occurs over most of the proposed gas pipeline route. This habitat encompassed two broad forms of agriculture; grazing lands including introduced grasses with intermittent tree cover not subject to vegetation mapping and cultivated lands with little native vegetation and isolated paddock trees.

The grazing land provided some habitat value for vertebrate fauna. Isolated paddock trees with hollows provided refuge habitat for species of microchiropteran bats, nesting and foraging resources for generalist species of bird including Eastern Rosella (*Platycercus eximius*), Galah (*Cacatua roseicapilla*) and Red-rumped parrot (*Psephotus haematonotus*), whilst native grasses provided additional foraging resources for species of macropod including Eastern Grey Kangaroo (*Macropus giganteus*), Swamp Wallaby (*Wallabia bicolor*) and Red-necked Wallaby (*Macropus rufogriseus*).

Generally this habitat was in poor condition over the entire length of the proposed pipeline route.

Photograph 3-15 Cleared land/grassland fauna habitat including introduced and native grasses with intermittent tree cover

3.4.1 Microhabitat features

Finer-scale habitat features in and near the study area were observed to include foraging resources, tree hollows, hollow logs and riparian habitats, including ephemeral drainage lines and dams. These habitats and species associations are discussed below.

Tree hollows

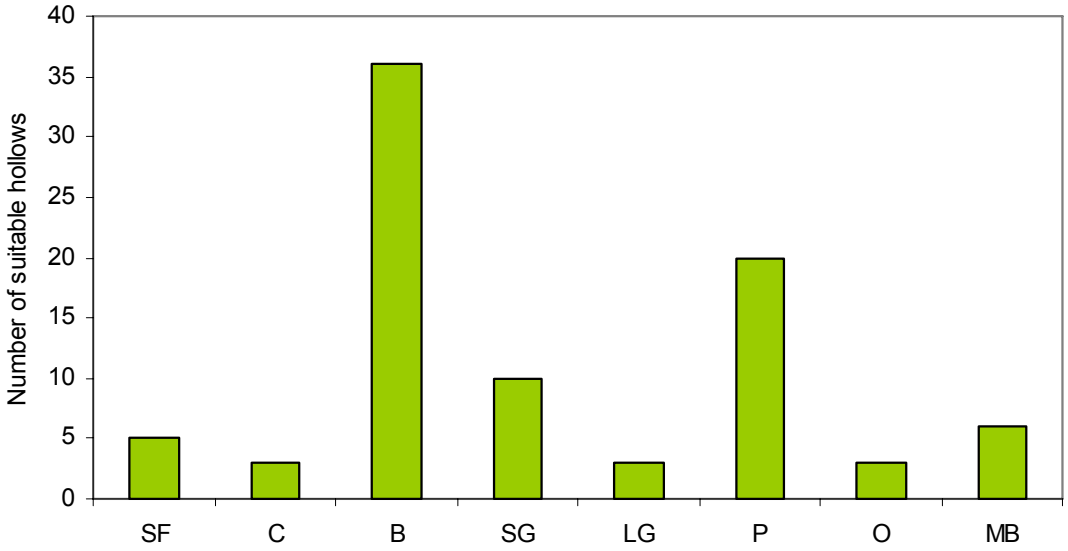
Tree hollows typically provide den and nesting habitat for a range of species of birds and arboreal mammal species, including the Sulphur-crested Cockatoo (*Cacatua galerita*), Sugar Glider, and forest-dwelling microchiropteran bats (NSW Scientific Committee 2002b). Locally recorded threatened species requiring tree-hollows for mating and nesting include the Glossy Black-cockatoo, Squirrel Glider and microchiropteran bats.

Whether or not tree hollows are used by animals, and which species use them, depends on a number of factors, including hollow characteristics (diameter, height, depth), the number of hollows in a tree, tree health, size, location and spacing (NSW National Parks and Wildlife Service 2002b).

Twenty-six hollow-bearing trees were identified along the entire length of the proposed gas pipeline route culminating in a total of 61 tree hollows. The greatest density of hollows were located within riparian/riverine fauna habitats providing small to large hollows at a density in some areas up to 6 hollows per hectare. Isolated paddock trees provided some small hollows within open woodland habitats at a density no greater than 3 hollows per hectare whilst open forest fauna habitats were similar, only providing low densities of small hollows.

Figure 3-3 details the suitability of the 61 tree hollows identified and provide a distinction in the suitability of tree hollows among different faunal groups. Many of the tree hollows identified are likely to provide hollows suitable for hollow dependent birds (i.e. Kookaburra, Kingfishers and Parrots) as well as Possums, small gliders and microchiropteran bats. Only three hollows are likely to provide suitable nesting sites for cockatoos and suitable habitat for large forest owls.

The low density of tree hollows observed along the route of the proposed pipeline is a reflection of the highly disturbed nature of the landscape and the low retention of senescing and mature trees within private lands.



Species are expressed as scansorial mammals (SF) (e.g. Antechinus, Phascogale), Cockatoos (C) (e.g. Galah, Corella, Yellow-tailed Black Cockatoo, Glossy Black-cockatoo), Hollow-dependent birds (B) (e.g. Parrots), Small gliders (SG) (e.g. Feather-tail Glider, Sugar Glider), Large Gliders (LG), Possums (P) (e.g. Ringtail Possum, Brushtail Possum) Owls (O) (e.g. Powerful Owl, Masked Owl) and Microchiropteran bats (MB).

Figure 3-3 Suitability of tree hollows from 26 habitat trees identified within the 30 m survey site along the proposed gas pipeline route and gas-fired power station site

Fallen timber, bark and leaf litter

Fallen branches bark and leaves were observed at the base of trees in the forested areas. These habitat attributes potentially provide refuge and nesting habitat for a range of terrestrial animals such as reptiles, amphibians and invertebrates. Generally, many invertebrates and amphibians rely on these moisture-retaining microhabitats as refuge during periods of drought. Similarly, many reptiles rely on ground litter and debris for shelter and foraging. Larger hollow logs provide potential dens and nesting habitat for small to medium sized mammals.

The greatest density of fallen timber, bark and leaf litter was located among the riparian/riverine fauna habitats. Large accumulations of dry timber up to 1 m are found at the base of trees adjacent large water courses including Little River and Macquarie River. This microhabitat provides suitable habitat for small reptiles and ground dwelling mammals including Yellow-footed Antechinus caught adjacent Little River.

3.4.2 Aquatic habitats

Wet depressions, creeks and drainage lines typically provide optimal habitat for a range of vertebrate (amphibians, reptiles and small ground-dwelling mammals) and invertebrate species. Throughout the study area a number of waterways, drainage lines, creeks and open water bodies are present. Specific waterways that intersect the proposed gas pipeline including fish habitat classification (Fairfull & Witheridge 2003) are detailed in Table 3-10.

Table 3-10 Aquatic habitats within the subject site including fish habitat classification (Fairfull & Witheridge 2003)

Waterway	Fish habitat classification (Fairfull & Witheridge 2003)
Macquarie River	**Major fish habitat**: Major permanently or intermittently flowing waterway (e.g. river or major creek). Potential habitat for threatened fish species.
Buckinbah Creek	**Moderate Fish Habitat**: Permanent creek with clearly defined bed and banks and semi-permanent to permanent waters in pools. Freshwater aquatic vegetation is present. This creek supports potential fish habitat.
Little River	**Moderate Fish Habitat:** Permanent creek with clearly defined bed and banks and semi-permanent to permanent waters in pools. Freshwater aquatic vegetation is present. This creek supports potential fish habitat.
Burrill Creek	**Unlikely Fish Habitat**: Named or unnamed waterway with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or freestanding water or pools after rain events.

Macquarie River is located in the northern half of the study area approximately 15 km to the west of the town of Wellington (refer Figure 1-1). Aquatic habitat associated with the Macquarie River is dense riparian vegetation and highly disturbed banks from livestock grazing. Water sedges and large overhanging Weeping Willows provide habitat for water birds including Australian Wood Duck (*Chenonetta jubata)* Grey Teal *(Anas gracilis),* Black Swan (*Cygnus atratus*) and Pacific Black Duck (*Anas superciliosa*).

Buckinbah Creek is located adjacent to the town of Yeoval in the centre of the pipeline route (refer Figure 1-1). Aquatic habitat associated with Buckinbah Creek is highly modified open grassland. Damp grasslands and water sedges associated with the creek provide habitat for water birds, including ducks, herons and egrets. Riparian edges have been highly disturbed by livestock using the creek, however large accumulations of rocks still remain providing isolated areas of good aquatic habitat for reptiles and frogs. Fauna species observed utilising this creek include Eastern Long-necked Tortoise (*Chelodina longicollis),* Broad-palmed Frog (*Litoria latopalmata)* and Peron's Tree Frog (*Litoria peronii*).

Little River is located adjacent to Obley road in the centre of the pipeline route (refer Figure 1-1). Aquatic habitat associated with this river includes high accumulations of fallen timber, branches and rocks along its banks proving suitable habitat for species of fauna including frogs and fish. The Giant Banjo Frog (*Limnodynastes interioris)* was recorded following rain.

Burrill Creek is located in the southern half of the study area approximately 25 km west of Goobang National Park. This ephemeral waterway was dry at the time of the current survey with heavy scouring along its banks caused by livestock and adjacent agriculture practices. No evidence of aquatic fauna including frogs was recorded during rainfall events.

3.5 Species of animal

A total of 145 species of animal was recorded in the study area during surveys carried out for this assessment; including eleven threatened species (refer Attachment C). The most abundant and diverse group was birds, followed by reptiles and mammals. Nine introduced species of animal were also recorded in the study area.

Birds

Native birds were the most diverse group of animals recorded in the proposal locality with 105 species recorded during the field surveys (refer Attachment C). The majority of the birds were common, open generalist species, or species common to grassy woodland/open forest environments.

The majority of species observed in the study area were diurnal species including:

- insectivores (active foragers), such as wrens, gerygones, thornbills, whistlers and honeyeaters
- insectivores (aerial feeders), such as bee-eaters and flycatchers
- nectar feeders, such as honeyeaters
- larger omnivores, such as butcherbirds, magpie, currawong and crows
- raptors, such as falcons and eagles.

Nine threatened species of bird listed under the *Threatened Species Conservation Act 1995* were recorded during the survey, including one Threatened species listed under the *Environment Protection and Biodiversity Conservation Act 1999*. Eighteen of the 104 species recorded are also considered Migratory under the *Environment Protection and Biodiversity Conservation Act 1999.*

The majority of these Threatened species included woodland birds such as Speckled Warbler (*Pyrrholaemus sagittatus*), Diamond Firetail (*Stagonopleura guttata*), Hooded Robin (*Melanodryas cucullata*), and Brown Treecreeper (*Climacteris picumnus*). These species are known to persist in open woodland habitats and were observed throughout the study area.

Grey-crowned Babbler (*Pomatostomus temporalis*) was recorded throughout the study area in areas of open Box-Gum Woodland, with a particularly preference for fragments of vegetation containing Cypress Pine. No stick nests were observed in trees within study area.

The Macquarie River provided suitable habitat for the Powerful Owl which was recorded during a call playback event in the area and the Blue-billed Duck (*Oxyura australis*) was seen opportunistically from the banks of the river. Both species are listed as Vulnerable under the *Threatened Species Conservation Act 1995*.

Mammals

Twenty species of mammal were recorded during the field surveys (refer Attachment C) including three threatened species, the Greater Long-eared Bat (*Nyctophilus timoriensis*) listed as Vulnerable under both the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999 and the* Little Pied Bat (*Chalinolobus picatus*) and Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) listed as Vulnerable under both the *Threatened Species Conservation Act 1995*. The Greater Long-eared Bat was caught over four consecutive nights in Box/Ironbark open forest adjacent Goobang National Park in the southern study area, whilst calls of the Little Pied Bat and Eastern Bent-wing Bat were recorded throughout the study area.

Thirteen of the mammal species recorded were microchiropteran bats, whilst the remaining seven species comprised small to large ground dwelling fauna such as rodents, marsupials and macropods. Four species of introduced mammal were recorded including both herbivorous and carnivorous species.

Reptiles

Sixteen species of reptile were recorded in the study area. None of these species are listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* or the *Threatened Species Conservation Act 1995.*

These species comprised eight skinks, two snakes, two geckos, one dragon lizard, one pygopod lizard, one goanna and one turtle. The majority of these species were recorded within large accumulations of fallen timber and branches in riparian/riverine habitats and on rocky outcrops in cleared lands and open forest/woodland habitats.

Amphibians

Four species of frog were recorded during the field surveys, of which none are listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* or the *Threatened Species Conservation Act 1995.* These species were all recorded adjacent to Little River, whilst only the Peron's Tree Frog was recorded calling adjacent to the Macquarie River and Buckinbah Creek within the study area.

3.6 Corridors and connectivity

Wildlife corridors can be defined as "retained and/or restored systems of (linear) habitat which, at a minimum enhance connectivity of wildlife populations and may help them overcome the main consequences of habitat fragmentation" (NSW Scientific Committee 2004). Corridors can assist ecological functioning at a variety of spatial and temporal scales, from daily foraging movements of individuals, to broad-scale genetic gradients across biogeographical regions.

Corridors serve a number of different functions in terms of biodiversity conservation including:

- Providing increased foraging area for wide-ranging species.
- Providing cover for movement between habitat patches, particularly for cover-dependent species and species with poor dispersal ability, and enhancing the movement of animals through sub-optimal habitats.
- Reducing genetic isolation.
- Facilitating access to a mix of habitats and successional stages to those species that require them for different activities (e.g. foraging or breeding).
- Providing refuge from disturbances such as fire.
- Providing habitat in itself.
- Linking wildlife populations and maintaining immigration and re-colonisation between otherwise isolated patches. This in turn may help reduce the risk of population extinction (NSW Scientific Committee 2004).

How species use a corridor network depends largely on the home and activity ranges of the species, their habitat requirements and the ecological characteristics of the corridor. For example, some large or mobile species may make direct movements through the corridor network, moving from one patch of habitat to another. These direct movements may be on the scale of a foraging expedition or a migration (Department of Environment and Climate Change 2007b). Other species may have movements by single individuals punctuated by pauses in the corridor, which can last anything from a small foraging or resting bout to weeks and even months. If the corridor contains sufficient resources to maintain a population, then continuity through the corridor may be through gene flow through the resident population (Department of the Environment and Water Resources 2007b, searched 25 October 2007).

Vegetation within the regions of the proposed gas pipeline route is highly fragmented with large expanses of cleared land surrounding. Although remanet vegetation in many patches is of sufficient size to maintain viable populations, in many cases there may only be limited connectivity among the patches given the extent of clearing and the distance to cores areas. Even small patches however may provide stepping stones within the wider landscapes.

Although none will be affected by the proposed pipeline construction, significant areas of wildlife corridors exist in the project locality. These wildlife corridors include Goobang National Park in the west, Nangar Range in the north and Catombal Range in the east (adjacent Macquarie River and Wellington) (refer Figure 1-1).

4. Threatened biodiversity and other significant matters

This chapter describes the threatened biodiversity occurring within the study area as well as other significant ecological features requiring consideration, such as those covered under the *Environment Protection and Biodiversity Conservation Act 1999*.

Potential impacts are described in Chapter 5.

4.1 Threatened ecological communities

Two Endangered ecological communities under the *Threatened Species Conservation Act 1995* and one Critically endangered ecological community listed under the *Environment Protection and Biodiversity Conservation Act 1999* were identified in the study area.

4.1.1 Ecological communities listed under the *Threatened Species Conservation Act 1995*

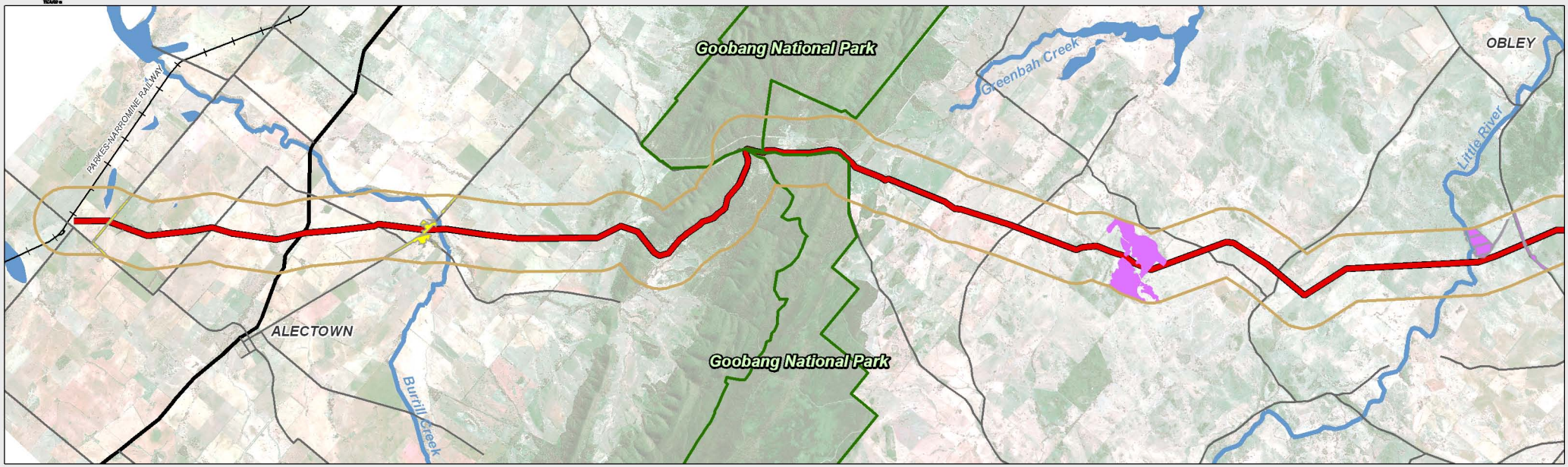
White Box, Yellow Box, Blakely's Red Gum Woodland

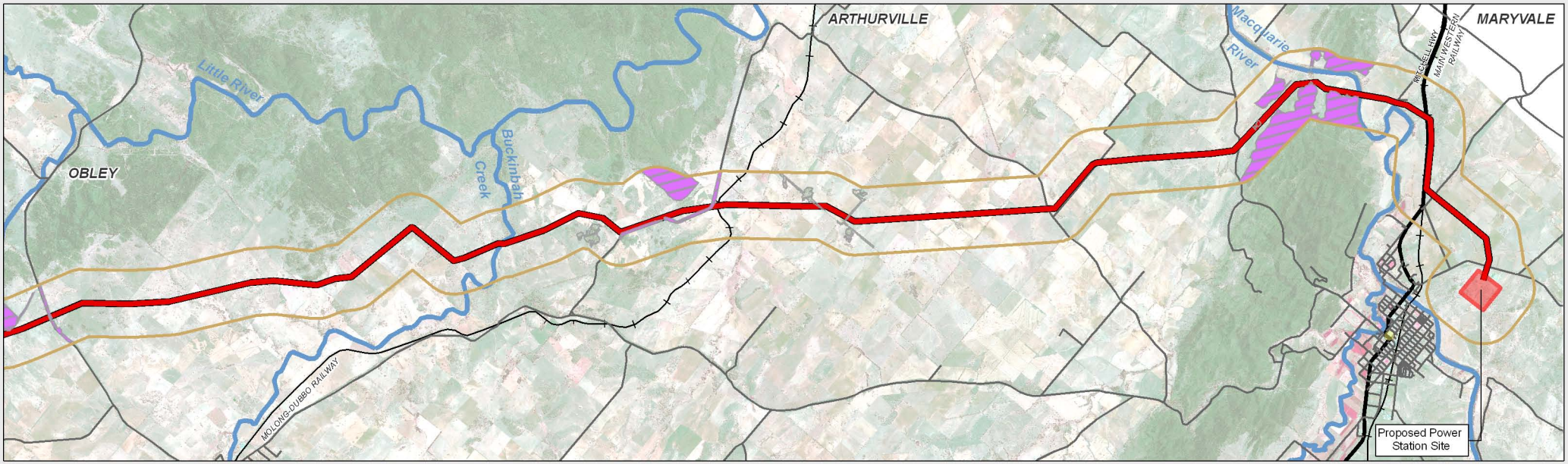
White Box, Yellow Box, Blakely's Red Gum Woodland is listed as an Endangered ecological community under the *Threatened Species Conservation Act 1995*. Under this listing, White Box, Yellow Box, Blakely's Red Gum Woodland is an open woodland community in which the dominant canopy species are one or more of the following: *Eucalyptus albens*, *E. melliodora* and/or *E. blakelyi*. A range of other *Eucalyptus* species may also occur in the community. Under the *Threatened Species Conservation Act 1995* definition of the community, the size or age of the community does not matter so long as it meets the features listed above.

The community occurs on relatively fertile soils on the tablelands and western slopes of NSW within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. Within these bioregions, White Box, Yellow Box, Blakely's Red Gum Woodland generally occurs between the 400 and 800 mm isohyets and from extending from the c. 170m altitude on the western slopes to c. 1200 m altitude on the northern tablelands (Department of Environment and Climate Change 2007b).

Five features have been identified to define whether a patch is consistent with the community determination under the *Threatened Species Conservation Act 1995* (refer Table 4-1).

Numerous patches of Box Gum Woodland dominated by the characteristic species of the Endangered ecological community (*E. albens, E. melliodora* and *E. blakelyi*) were identified on the low ranges, rounded hills and alluvial plains in the study area. These areas have been extensively cleared for agricultural land uses and not all patches possessed characteristic species (excluding the canopy species) or have potential for natural (assisted) regeneration.





Proposed gas pipeline / subject site

Study area

Major roads

Minor roads

Rail line

Major drainage

Water body

National parks

TSC Act Endangered ecological communities

Fuzzy Box Woodland

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland

EPBC Act Endangered ecological communities

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

0 2.5 5 Kms

Figure 4-1 Endangered ecological communities in the study area

The remaining patches of White Box, Yellow Box, Blakely's Red Gum Woodland that were consistent with the listed Endangered ecological community under the *Threatened Species Conservation Act 1995* were small linear strips within the road corridors, or several small isolated patches in paddocks that disperse into paddock trees (refer Figure 4-1). The small linear strips of this community within the road corridors were modified by fragmentation, edge effects and weed intrusion from adjoining paddocks. Within these patches however, the natural soil profile and native seed bank were generally intact; and the ground cover was dominated by a range of native grasses and herbs.

The White Box, Yellow Box, Blakely's Red Gum Woodland that occurred in paddocks have been highly modified by long term grazing and/or routine cropping, pasture improvement practices and incursion of weeds. These activities have modified the natural soil profile and extinguished the natural seed bank. The result were patches with a canopy of dominated by the characteristic *Eucalyptus* species, however no recruitment of these species is occurring. The ground cover in these patches is dominated by exotic species, usually dominated by *Hordeum leporinum* and *Bromus diandrus* in combination with numerous species of thistle, mustard weeds (Brassicaceae), *Malva parviflora* and other grass weeds. The remaining natives were generally only *Einadia nutans* and *Rumex brownii*. Under the identification criteria for White Box, Yellow Box, Blakely's Red Gum Woodland as listed under the *Threatened Species Conservation Act 1995*, these patches do not quality as representing the endangered ecological community.

Several other patches of Box Gum Woodland were identified in the 1km buffer around the study area including the edges of the Catombal and Nangar Ranges, however these patches will not traversed by the proposed pipeline route.

Fuzzy Box Woodland on alluvials of South West Slopes, Darling Riverine Plains & the Brigalow Belt South

Fuzzy Box Woodland is listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*. Under this listing, Fuzzy Box Woodland is tall woodland or open forest dominated by *E. conica* (Fuzzy Box) which may occur in association with one or more of the following other canopy species *E. blakelyi* (Blakely's Red Gum), *E. intertexta* (Gum Coolibah) , *E. melliodora* (Yellow Box), *E. microcarpa* (Grey Box), *E. populnea* subsp. *bimbil* (Bimble Box). Noticeably, some of these species are common with those listed in the White Box, Yellow Box, Blakely's Red Gum Woodland, however this community is distinguished by a dominance of *E. conica* which only occurs as a suppressed species in the White Box, Yellow Box, Blakely's Red Gum Woodland.

Fuzzy box woodland as listed under the *Threatened Species Conservation Act 1995* occurs on alluvial soils of the South West Slopes, Brigalow Belt South and Darling Riverine Plains Bioregions, mainly in the Dubbo-Narromine-Parkes-Forbes area (an region that includes the study area). *Eucalyptus. conica* is more widely distributed than this community on the western slopes of NSW and may occur in association with other eucalypt species to form other communities (Department of the Environment and Water Resources 2007b). Less than 5% of Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South bioregions is estimated to remain compared to pre-European times due to past clearing (Department of Environment and Climate Change 2007b).

Two patches of Fuzzy Box Woodland were identified in the study area in road corridors on the western side of Hervey Range (refer Figure 4-1). Both of these patches were dominated by an association of *E. conica* and *E. microcarpa.* One of the patches also includes *E. melliodora* and *E. polyanthemos* (Red Box). These patches are of condition class 2 with a relatively intact natural soil profile, seed bank and an understorey dominated by native species. Both of these patches qualify as Fuzzy box woodland as listed under the *Threatened Species Conservation Act 1995*.

It is likely that the original extent of this community would have been much greater that the current extent, particularly extending along the alluvial flats adjacent to the River Red Gum Woodlands (Department of the Environment and Water Resources 2007b, searched 25 October 2007) before merging into Box Gum Woodlands on the alluvial plains, low ranges and rounded hills.

4.1.2 Threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999*

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Grassy Woodland and Grasslands) is a Critically endangered ecological community listed under the *Environment Protection and Biodiversity Conservation Act 1999* and the only Threatened ecological community predicted to occur in the study locality (Department of the Environment and Water Resources 2007b, searched 25 October 2007).

The definition of this ecological community under differs slightly from White Box, Yellow Box, Blakely's Red Gum Woodland listed under the *Threatened Species Conservation Act 1995* and patches that qualify one Act are not automatically included under the other. The patches of Box Gum Woodland in small linear strips within the road corridors were modified by fragmentation, edge effects and weed intrusion from adjoining paddocks. Within these patches however, the natural soil profile and native seed bank were generally intact; and the ground cover was dominated by a range of native grasses and herbs. These patches were greater than 0.1 ha in size and had more than 12 native species in the understory including at least one important species. All patches of Box Gum Woodland within the road corridors therefore quality as the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (refer Figure 4-1).

The patches of Box Gum Woodland that occurred in paddocks have been highly modified by long term grazing and/or routine cropping, pasture improvement practices and incursion of weeds. These activities have modified the natural soil profile and extinguished the natural seed bank. The result were patches with a canopy of dominated by the characteristic *Eucalyptus* species, however no recruitment of these species is occurring. The ground cover in these patches is dominated by exotic species, usually dominated by *Hordeum leporinum* and *Bromus diandrus* in combination with numerous species of thistle, mustard weeds (Brassicaceae), *Malva parviflora* and other grass weeds and fewer than 12 native species. None of these patches quality as the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland as listed under the *Environment Protection and Biodiversity Conservation Act 1999.*

Under the *Environment Protection and Biodiversity Conservation Act 1999* definition of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, the patches of Fuzzy Box Woodland in the study area are also consistent with the community. These patches were co dominated, or likely to have formerly been, by *E. melliodora* and *E. blakelyi,* were over 0.1 ha in size, had over 12 native species in the understorey including one important species (refer Figure 4-1).

4.1.3 Endangered populations

One endangered population, listed under the *Threatened Species Conservation Act 1995*, occurs within the Lower and Upper Slopes Catchment Management Authority area:

- The Olive Perchlet (*Ambassis agassizii*) population in Western New South Wales.

This population has not been previously recorded within the study area and is restricted to the Murray Darling Basin (Department of the Environment and Water Resources 2007b). Therefore the proposal is unlikely to affect this endangered population.

4.1.4 Threatened species of plants

Five Threatened species of plant been previously recorded in the locality that are listed under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment and Heritage 2006b). An addition seven species were either predicted to occur in the locality by the EPBC Protected Matters Search Tool or within the Upper Slopes sub-region of the Central West Catchment Management Area (refer Attachment C and Table 4-2).

No Threatened species were identified in the study area. However, potential habitat was identified for three of the species recorded previously or predicted to occur (refer Table 4-1). An assessment of the likely significance of impacts on this species is considered in Chapter 8 and Attachment E.

4.1.5 Threatened species of animal

Forty-one threatened species of animal have been recorded previously, or have been predicted to occur, in the locality (refer Figure 4-2, Table 4-1 and Attachment D). Forty of these threatened species are listed under the *Threatened Species Conservation Act 1995* and 15 are listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

It is unlikely that all of the threatened species of animal are likely to occur within the study area (refer Attachment D). Despite the existence of records and the occurrence of suitable habitat, 19 of the 41 threatened species of animal are considered unlikely to occur within the study area for one of the following reasons:

- No habitat was recorded in the study area.
- The area is outside the normal range of the species and records are likely to be of vagrants or invalid.
- The species is considered locally extinct.

Full details of species requirements and reasons for not further considering their occurrence within the study area are provided in Attachment D.

Table 4-1 Threatened species previously recorded or predicted to occur in the locality

Scientific name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Likelihood of occurrence
Ammobium craspedioides	V	V	2V	Low
Austrostipa wakoolica	E1		2E	Low
Caladenia arenaria	E	E1	E	Low
Diuris tricolor	V	V	3K	Low
Goodenia macbarronii	V	V	3V	Low
Philotheca ericifolia	V	V	3R	Low
Prasophyllum petilum	E1	E	2E	Low
Rulingia procumbens	V	V	3V	Low
Swainsona recta	E1	E	3Ei	Moderate
Swainsona sericea	V			Moderate
Tylophora linearis	E1	E	3E	Moderate
Zieria obcordata	E1	E	3E	Low

1. V= Vulnerable, E1 = Endangered (Threatened Species Conservation Act 1995).

2. V = Vulnerable, E = Endangered (Environment Protection and Biodiversity Conservation Act 1999).

3. ROTAP (Rare or Threatened Australian Plants, Briggs and Leigh 1996) is a conservation rating for Australian plants. Codes are:

1	Species only known from one collection
2	Species with a geographic range of less than 100km in Australia
3	Species with a geographic range of more than 100km in Australia
X	Species presumed extinct; no new collections for at least 50 years
E	Endangered species at risk of disappearing from the wild state if present land use and other causal factors continue to operate
V	Vulnerable species at risk of long-term disappearance through continued depletion.
R	Rare, but not currently considered to be endangered.
K	Poorly known species that are suspected to be threatened.
C	Known to be represented within a conserved area.
a	At least 1,000 plants are known to occur within a conservation reserve(s).
i	Less than 1,000 plants are known to occur within a conservation reserve(s).
-	The reserved population size is unknown.

Table 4-2 Threatened species recorded or predicted to occur in the project locality

Group	TSC Act1	EPBC Act2	Total threatened
Frogs	0	0	0
Birds	22	4	22
Mammals	13	6	13
Reptiles	2	1	2
Fish	3	4	4
TOTAL	**40**	**15**	**41**

Notes:

1. TSC Act = *Threatened Species Conservation Act 1995*

2. EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

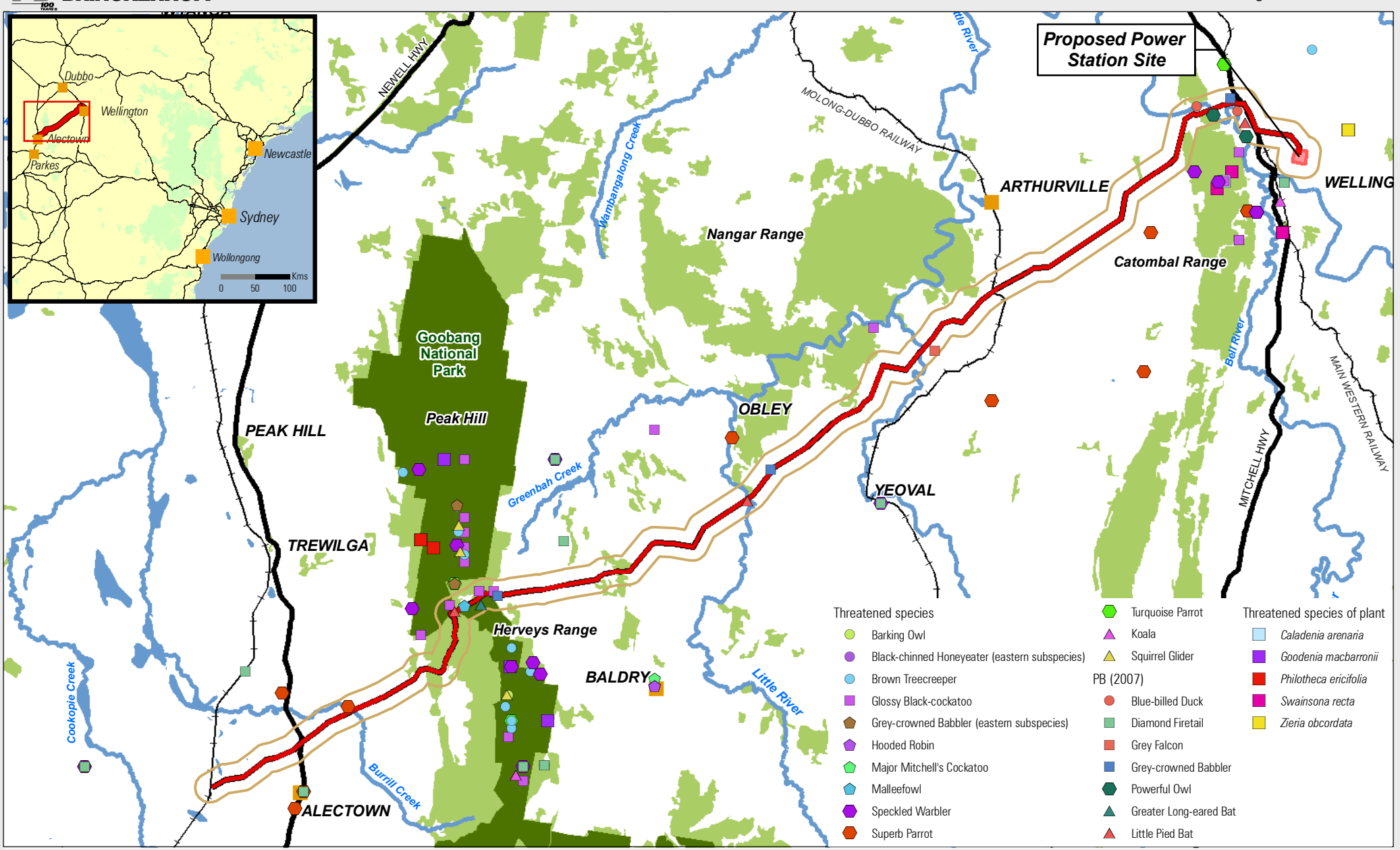


Figure 4-2 Threatened species in the locality

Based on the habitat present in the study area, 22 species of animal are likely to occur. These include:

- Brown Treecreeper (*Climacteris picumnus victoriae*) - recorded
- Hooded Robin (*Melanodryas cucullate*) - recorded
- Black-chinned Honeyeater (*Melithreptus gularis gularis*)
- Gilbert's Whistler (*Pachycephala inornata*)
- Grey-crowned Babbler (*Pomatostomus temporalis*) - recorded
- Speckled Warbler (*Pyrrholaemus sagittatus*) - recorded
- Diamond Firetail (*Stagonopleura guttata*) - recorded
- Regent honeyeater (*Xanthomyza Phrygia*)
- Glossy Black-cockatoo (*Calyptorhynchus lathami*)
- Turquoise Parrot (*Neophema pulchella*)
- Superb Parrot (*Polytelis swainsonii*) - recorded
- Bush-stone Curlew (*Burhinus grallarius*)
- Powerful Owl (*Ninox strenua*) - recorded
- Masked Owl (*Tyto novaehollandiae*)
- Barking Owl (*Ninox connivens*)
- Grey Falcon (*Falco hypoleucos*) - recorded
- Greater Long-eared Bat (*Nyctophilus timoriensis*) - recorded
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Little Pied Bat (*Chalinolobus picatus*) - recorded
- Squirrel Glider (*Petaurus norfolcensis*)
- Koala (*Phascolarctos cinereus*)
- Trout Cod *(Maccullochella macquariensis).*

Significance assessments, as required under the *Environmental Planning and Assessment Act 1979* and/or the *Environment Protection and Biodiversity Conservation Act 1999* have been completed for these species (Attachment E).

4.1.6 Critical habitat

Critical habitat is listed under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999.* Both the State (Department of Environment and Climate Change) and Federal (Department of the Environment and Water Resources) Directors-General maintain a register of this habitat. Critical habitat is the whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is critical to the survival of the species, population or ecological community.

No listed critical habitat occurs within the study area and none is likely to be affected by the proposal.

4.2 Matters of National Environmental Significance

Matters of National Environmental Significance are listed and protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Act identifies seven matters of national environmental significance:

- World Heritage properties.
- National heritage places.
- Wetlands of international importance (Ramsar wetlands).
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- Nuclear actions (including uranium mining).

Matters of National Environmental Significance relating to biodiversity are discussed below in relation to the proposed project.

4.2.1 World heritage properties

World heritage properties include sites of both cultural and/or environmental heritage that are either:

- an Australian property on the World Heritage List kept under the World Heritage Convention, or
- a property declared to be a World Heritage property by the Commonwealth Environment Minister.

No records of world heritage properties listed under the *Environment Protection and Biodiversity Conservation Act 1999* were identified from the Protected Matters Search Tool in the study locality.

4.2.2 Wetlands of international importance (Ramsar wetlands)

No Ramsar Wetlands listed and protected under the *Environment protection and Biodiversity Conservation Act 1999* occur in the study locality.

4.2.3 Threatened species and ecological communities

Ten Threatened species of plant, 15 threatened species of animal and one threatened ecological community listed the *Environment Protection and Biodiversity Conservation Act 1999* were identified or predicted to occur in the study area (see Attachment C and D). Table 4-4 summaries the Threatened species and ecological identified, or likely to occur, in the study area that are matters of National Environmental Significance.

Table 4-3 Summary of Threatened ecological communities, populations and species listed that are Matters of National Environmental Significance

Name	EPBC Status[1]	Recorded or predicted to occur
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	Recorded
Tylophora linearis	E	Predicted
Swainsona recta	E	Predicted
Regent honeyeater (*Xanthomyza Phrygia*)	EM	Predicted
Superb Parrot (*Polytelis swainsonii*)	V	Recorded
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V	Recorded
Trout Cod (*Maccullochella macquariensis*)	E	Predicted

1. V = Vulnerable, E = Endangered, CE = Critically Endangered (*Environment Protection and Biodiversity Conservation Act 1999*).

4.2.4 Migratory species

Migratory species are those protected under international agreements to which Australia is a signatory. These include the *Japan Australia Migratory Bird Agreement* (JAMBA), the *China Australia Migratory Bird Agreement* (CAMBA) and the *Bonn Convention on the Conservation of Migratory Species of Wild Animals*. Migratory species are considered to comprise 'matters of national environmental significance' and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

Nineteen species of bird recorded within the study area are recognised under the migratory provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (refer Attachment B). A further 8 species are predicted to occur in the wider project locality (refer Attachment D).

While migratory species of bird may potentially use the study area (refer Attachment D), this would not be classed as an 'important habitat' as defined under the *EPBC Act Policy Statement 1.1 Principal Significant Impact Guidelines* (CSIRO 2001), in that the study area does not contain:

- Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species.
- Habitat used by a migratory species that is at the limit of the species range.
- Habitat within an area where the species is declining.

As such, impacts of the proposal on migratory species are not considered further for these species.

4.2.5 Commonwealth marine areas

The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters. Generally, the Commonwealth marine area stretches from three miles to two hundred nautical miles from the coast. The proposal is not located close to nor is likely to affect any Commonwealth marine area.

5. Potential impacts on biodiversity

The proposed gas pipeline would result in a range of direct impacts on existing biodiversity within the potential construction corridor and potential indirect impacts on biodiversity in the surrounding landscape. These impacts include:

- clearing of native vegetation and disturbance of habitats
- habitat fragmentation and barrier effects
- edge effects
- direct mortality to plants and less mobile animals
- invasion and establishment of pest species
- weeds
- noise
- increase CO_2 and global warming
- cumulative impacts.

These impacts have the potential to affect the Threatened biodiversity identified as occurring, or likely to occur, in the study area.

This chapter describes the potential impacts of the proposal on the biological environment. Management measures to avoid, remedy and mitigate these potential impacts are discussed in Chapter 6.

5.1 Clearing of native vegetation and disturbance of habitat

Clearing of native vegetation would be the major direct impact of the project on biodiversity in the study area. It is known to affect threatened species of flora and fauna and is recognised as a key threatening process under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999,* under the following final determination titles:

- Clearing of native vegetation (Threatened Species Conservation Act 1995).
- Land clearance (Environment Protection and Biodiversity Conservation Act 1999).

Clearing of native vegetation has avoided as far as possible through the route selection and design process. Nonetheless, total avoidance of vegetation clearing was not possible and 41.4 ha of woodland vegetation and associated fauna habitat will be cleared as a result of the proposal. The loss of vegetation and associated habitats represents approximately 1% of the available woodland vegetation identified within the study area (refer Table 5-1). Of the vegetation that will be cleared as a result of the proposal, 44% will be scattered paddock trees which no longer represent a native vegetation community.

Table 5-1 Potential loss of vegetation

Vegetation community	Extent within Footprint (ha)	Extent within study area (ha)	Percent clearing within study area
Fuzzy Box Woodland	0.5	49.2	1%
Ironbark / Black Cyprus Pine Woodland	7.7	1220.4	1%
Red Stringybark Woodland	2.3	46.2	5%
River Red Gum Woodland	3.1	283.0	1%
Scattered paddock trees including some areas of former Gum Woodland)	18.2	1023.6	2%
Tumbledown Red Gum and Dwyers Red Gum Woodland	6.4	470.1	1%
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland	3.3	949.3	0%
Other vegetation (plantings)	0.0	9.0	0%
Total vegetation	**41.4**	**4050.9**	**1%**

The most significant loss of fauna habitat types will occur within open forest and open woodland fauna habitats (refer Table 5-2).

Table 5-2 Potential loss of fauna habitat

Fauna habitat type	Extent within Footprint (ha)	Extent within study area (ha)	Percent clearing within study area
Open forest	7.7	1220.4	1%
Woodland	12.4	1514.9	1%
Open woodland	18.3	1032.7	2%
Riparian/riverine forest	3	282.9	1%
Total	**41.4**	**4050.9**	**1%**

5.1.1 Removal of key fauna habitat elements

Clearing of native vegetation would result in the removal of fauna habitat elements including direct and indirect feeding resources, dead trees (fallen and standing), tree hollows (often limited to small hollows only suitable for woodland birds), bushrock, dead wood (fallen) and leaf litter layer. Fauna use these habitat elements for shelter, to hide from predators, find food, avoid extreme weather conditions and for breeding.

The removal of certain fauna habitat elements is recognised as a key threatening process under the *Threatened Species Conservation Act 1995* under the following final determination or preliminary listing titles:

- Bushrock removal.
- Removal of dead wood and dead trees.
- Loss of hollow-bearing trees.

These fauna habitat elements are limited resources, especially in modified landscapes, and are generally slow to develop following disturbance. Many threatened species of animal are dependent on one or more of these habitat elements to complete their life cycle (e.g. tree hollows for breeding).

The area to be cleared as a result of the proposed power station consists of open woodland fauna habitat. This habitat type is characterised by little to no understorey with limited microhabitat features including fallen logs, bushrock and hollow bearing trees.

The area to be cleared for the proposed gas pipeline includes areas of riparian/riverine and open forest fauna habitat. These habitat types provide large accumulations of dry timber up to 1 m (adjacent Goobang National park and large water courses including Little River and Macquarie River) and moderate densities of hollow bearing trees (3 to 5 hollows per hectare).

Provided appropriate mitigation measures are followed during construction it is likely important microhabitat elements will be retained within the study area.

5.2 Habitat fragmentation and barrier effects

Habitat fragmentation is the division of a single area of habitat into two or more smaller areas, with the occurrence of a new habitat type in the area between the fragments. This new dividing habitat type is often artificial and inhospitable to the species remaining within the fragments (Department of Environment and Heritage 2005). Although the newly created habitat is generally used by some species, those species are usually generalists and are often considered aggressive (Department of Environment and Heritage 2005), further decreasing population levels of the species remaining in the fragments. In addition to the loss of total habitat area, the process of fragmentation can impact on species within the newly created fragments in a number of ways, including barrier effects, genetic isolation and edge effects. The degree to which these potential impacts affect the flora and fauna within the newly created fragments depends on a number of variables, including distance between the fragments, local environmental conditions, the species present and mitigation measures. Some of the potential impacts are summarised below:

- **Barrier effects:** Barrier effects occur where particular species are either unable or unwilling to move between suitable areas of fragmented habitat. This could result in either a complete halt to movement or reduced level of movement between fragments.
- **Genetic Isolation:** Genetic isolation occurs where individuals form a population within one fragment are unable to interbreed with individuals from populations in adjoining fragments. Genetic isolation can lead to inbreeding and genetic drift problems for populations isolated within a fragment.
- **Edge effects:** Edge effects are where a zone of changed environmental conditions (i.e. altered light levels, wind speed and/or temperatures) occurs along the edges of habitat fragments (refer Section 5.2).

Cleared areas present a barrier to the movement of some species such as woodland dependant birds (Bennett & Radford 2004; Radford & Bennett 2007). Much of the study area traverses landscapes that are already highly fragmented as a result of past land uses. The species that occur in these habitats are generally species that are tolerant to habitat fragmentation and are unlikely to be further disturbed by further habitat fragmentation resulting from the project.

The potential for habitat fragmentation is higher where the project bisecting large patches of native vegetation. This has been avoided where possible through the route selection and design process. Nonetheless, the project will traverse a large patch of Open Forest and Woodland habitat along Hervey Range. At this location the proposal will following exiting forests tracks and trails to minimise potential form fragmentation. In addition, once rehabilitation (following construction) the 30 m corridor is unlikely to form a permanent barrier to woodland dependant species.

5.3 Edge effects

Edge effects are zones of changed environmental conditions (i.e. altered light levels, wind speed and/or temperature) occurring along the edges of habitat fragments. These new environmental conditions can promote the growth of different vegetation types (including weeds) and allow invasion by pest animals specialising in edge habitats. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators. Edge effects have mainly been recorded adjacent to roads and at distances greater than 1,000 m from a road surface (Busby & Pearman 1988). However, Bali (NSW Scientific Committee 2000), in a comparison of edge effects in a variety of different habitat types, estimated that on average, edge effects generally occur up to 50 m away from the road edge.

Habitats within the study area consist primarily of landscapes that are already highly fragmented as a result of past land uses including agriculture practices and forestry practices. The small patches of Box Gum and Fuzzy Box Woodland in the road corridors and paddocks, and the linear strips of River Red Gum Woodland along the creeks and rivers, are all already subject to edge effects. Addition clearing across these habitats is will not result in any areas being introduced to new edge effects.

Within the Open Forest and Woodland habitats along Harvey Range, the route alignment follows existing cleared areas, tracks and unsealed road. Although there will be some vegetation clearing and habitat loss in this area, it is unlikely to result in the exposure of new areas to edge effects.

5.4 Direct mortality to plants and less mobile animals

Clearing of native vegetation results in direct mortality of plants and less mobile animals in the areas being cleared, including potentially threatened species. This would directly impact any threatened species occurring in the areas cleared (Refer to Section 4 for threatened species of plant and animal with suitable habitat within the study area).

Fauna injury or death has the greatest potential to occur during the construction phase when vegetation and habitats are being cleared. While some mobile species, such as birds, may be able to move away from the path of clearing, other species that are less mobile, or those that are nocturnal and restricted to tree hollows may find it difficult to move rapidly to adjoining areas of suitable habitat.

There may also a chance of animals entering the pipeline trench during construction and being trapped. This would particularly be the case for ground-dwelling fauna including reptiles and small mammals.

5.5 Invasion and establishment of pest species

Thirteen of the key threatening processes under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999* relate to invasion and establishment, predation by, competition from, and change in habitat resulting from feral animal species. Two of these key threatening processes relate to the following feral animal species identified within the study area:

- Predation by the European Red Fox *Vulpes vulpes* (Linnaeus, 1758).
- Predation by the Feral Cat, *Felis catus* (Linnaeus, 1758).

These pest species are likely to already be established within the study area and most likely already have an effect on native fauna populations in the locality. However, clearing of the fauna habitats in the study area has the potential to result in the redistribution of European Red Fox and cats into the remaining areas of faunal habitat in the study area.

These species are all relatively mobile and are likely to flee vegetation and habitats being cleared during construction. This has the potential to increase their abundance and distribute individuals to surrounding fragments that may not have initially been affected.

5.6 Weeds

Sixty-eight non-endemic and exotic species of plant (weed) were recorded in the study area (Attachment A) of which six are declared plants as listed under the *Noxious Weeds Act 1993.*

Scientific name	Common name	Noxious weed class[1]
Lycium ferocissimum	African boxthorn	4
Xanthium spp.	Bathurst/Noogoora/Californian/ cockle burrs	4
Heliotropium amplexicaule	Blue heliotrope	4
Opuntia spp. (except O. ficus-indica)	Prickly pear	4
Ailanthus altissima	Tree-of-heaven	4
Salix spp.	Willows	5

Noxious weed classes: 4 = The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority, 5 = The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with.

The construction of the gas pipeline and power station has the potential to disperse weeds into areas of remnant vegetation where weed species do not occur currently. The most likely causes of weed dispersal associated with the proposal would include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery. This may, in turn, reduce the condition of vegetation communities and habitat quality for Threatened species. The majority of the vegetation within the study area however contains weeds and the overall extent of habitat modification is not likely to increase significantly existing weeds populations.

5.7 Disturbance to aquatic habitats

Without careful management, run-off from the construction corridor during the construction and operation phases of the proposed gas pipeline has the potential to modify water quality, and as such, adversely affect aquatic flora and fauna in the surrounding aquatic habitats, including threatened and migratory aquatic species.

Surface run-off from the corridor during construction has the potential to carry increased sediment loads, in addition to other contamination from accidental spillage/leakage of road construction materials, fuels, lubricants and hydraulic oils from construction equipment.

Barriers to fish passage can occur temporarily (i.e. during construction) and/or over the long-term where inappropriate structures are used. In addition to the potential effects associated with the alteration of natural hydrology from the construction of waterway crossings, other impacts, including decreased light levels and debris blockage, have the potential to affect fish passage (Fairfull & Witheridge 2003).

Currently there are no barriers to fish passage within each of the waterways intersected by the proposed gas pipeline and this will continue following construction provided appropriate mitigation measures are followed.

5.8 Noise and dust

During construction of the pipeline and power station there will be increased noise in the local area for a short period of time. This may cause disturbance for fauna in the area, although given the proximity of the pipeline to existing roads, it is expected that the impact of this would be minor. Access for maintenance vehicles may cause intermittent disturbance, however, the impacts are likely to be minor.

5.9 Increased CO_2 and global warming

Current scientific evidence indicates that modification of the environment by humans can result in climate change, including the production of carbon emissions into the atmosphere, which changes climate at a faster rate than has previously occurred naturally (NSW Scientific Committee 2000). Human-induced climate change can impact on the habitats of a range of species, including threatened species (CSIRO 2001).

Atmospheric climate controls how the spatial distribution of most species, populations and communities is determined and has been a major driving force for evolution, resulting in biodiversity. Human-induced climate change by the emission of greenhouse gases (including carbon dioxide) is known to impact on Threatened species of flora and fauna. It is also recognised as a Key Threatening Process under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999,* under the following final determination titles:

- ‘human-caused climate change’ (Threatened Species Conservation Act 1995)
- ‘loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases’ *(Environment Protection and Biodiversity Conservation Act 1999).*

The response of organisms to future climate change (however caused) is likely to differ from that in the past because it would occur in a highly modified landscape in which the distribution of natural communities is highly modified. This may limit the ability of organisms to survive climate change through dispersal (Contant & Wiggins 1991; Council on Environmental Quality 1978). Species at risk include those with long generations, poor mobility, narrow ranges, specific host relationships and isolated and specialised species (NSW National Parks and Wildlife Service 2003). Pest species may, however, be advantaged by climate change. Fire regimes may change and affect species composition and the structure of ecological communities (Department of Environment and Conservation 2005b).

Modelling of the distribution of species under realistic climate change scenarios suggests that many species (including Threatened ones) would be adversely affected unless populations are able to move across the landscape (Department of the Environment and Heritage 2006b). Changes in essential microhabitat conditions in areas that are fragmented from suitable habitats and/or are at the limit of a species' distribution could result in localised extinctions, affecting the recovery of Threatened species. Conservation reserves, including national parks and nature reserves that contain significant refuges for Threatened species, have not been designed specifically to accommodate climate change, and the present biodiversity values of the protected area system may not all survive under different climatic conditions (NSW Department of Natural Resources 2005).

Australia has the highest per capita emissions of greenhouse gases in the developed world. Electricity consumption, due to the burning of coal and other fossil fuels, is the most significant source of greenhouse emissions in Australia. Although the pipeline itself would not produce greenhouse gases, it would supply gas to the new proposed power station.

5.10 Cumulative impacts

The potential biodiversity impacts of the proposed upgrade have been considered as a consequence of the construction and operation of the proposed upgrade within the existing environment. The incremental effect of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the proposed upgrade in a strategic context. This is necessary so that the impacts associated with the proposed upgrade and other activities within the region are examined collectively.

The proposed gas pipeline route is located in a highly developed landscape dominated by agricultural activity in which the remaining areas of remnant vegetation and associated habitat are fragmented and isolated. The gas pipeline falls in some areas within the footprint of an existing electricity easement, access tracks and cleared areas for agriculture. Due to its location in a highly developed landscape, the gas pipeline is one of many developments and pressures on biodiversity in the local area.

The significance of the biodiversity impacts of the current proposals are likely to be increased by biodiversity impacts from the surrounding projects and agricultural activity.

5.11 Key threatening processes

Threatening processes are those that threaten, or have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities.

A process can be listed as a key threatening process if it could:

- Cause a native species or ecological community to become eligible for inclusion in a threatened list (other than the conservation dependent category).
- Cause an already listed threatened species or threatened ecological community to become more endangered.
- Adversely affect two or more listed threatened species or threatened ecological communities.

Key threatening processes are listed under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*.

At present there are 32 key threatening processes listed, and one pending finalisation, under the *Threatened Species Conservation Act 1995*, and 17 listed under the *Environment Protection and Biodiversity Conservation Act 1999.*

Table 5-3 Key threatening processes

Key threatening process[1]	TSC Act[2]	EPBC Act[3]	Associated with proposed development
Alteration of habitat following subsidence due to longwall mining.	●		no
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.	●		no
Anthropogenic climate change.	●	●	no
Bushrock removal (as described in the final determination of the Scientific Committee to list the threatening process).	●		no
Clearing of native vegetation (as defined and described in the final determination of the Scientific Committee to list the key threatening process) / land clearance.	●	●	**Yes**
Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (L.).	●	●	no
Competition and habitat degradation by feral goats, *Capra hircus* Linnaeus 1758.	●	●	no
Competition from feral honeybees *Apis mellifera* L.	●		no
Death or injury to marine species following capture in shark control programs on ocean beaches.	●		no
Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments.	●	●	no
Herbivore and environmental degradation caused by feral deer.	●		no
High frequency fire resulting in the disruption of life cycle processes in plants and animal and loss of vegetation structure and composition.	●		no
Importation of Red Imported Fire Ants *Solenopsis invicta* Buren 1972.	●	●	no

Key threatening process[1]	TSC Act[2]	EPBC Act[3]	Associated with proposed development
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis.	●	●	no
Infection of native plants by *Phytophthora cinnamomi.*	●	●	no
Introduction of the Large Earth Bumblebee, *Bombus terrestris.*	●		no
Invasion and establishment of exotic vines and scramblers.	●		no
Invasion and establishment of the Cane Toad, *Bufo marinus.*	●	●	no
Invasion of native plant communities by Bitou bush and Boneseed (*Chrysanthemoides monilifera*).	●		no
Invasion of native plant communities by exotic perennial grasses.	●		no
Invasion of the Yellow Crazy Ant *Anoplolepis gracilipes* (Fr. Smith) into NSW.	●	●	no
Invasion, establishment and spread of Lantana (*Lantana camara).*	●		no
Loss and/or degradation of sites used for hill-topping by butterflies.	●		no
Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish) (as described in the final determination of the Scientific Committee to list the threatening process).	●		no
Predation by the European Red Fox *Vulpes vulpes* (Linnaeus, 1758).	●	●	no
Predation by the Feral Cat, *Felis catus* (Linnaeus, 1758).	●	●	no
Predation from the Ship Rat *Rattus rattus* on Lord Howe Island (or other offshore islands of less than 1000 km^2 for listing under the *Environment Protection and Biodiversity Conservation Act 1999*).	●	●	no
Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa*, Linnaeus 1758.	●	●	no
Psittacine Circoviral (beak and feather) disease affecting endangered psittacine species and populations.	●	●	no
Removal of dead wood and dead trees.	●		**Yes**
Loss of hollow-bearing trees.	●		**Yes**
Invasion and establishment of Scotch broom (*Cytisus scoparius*) (preliminary listing under the Threatened Species Conservation Act 1995)	●		no

Notes: Key threatening process names based on the listing under the *Threatened Species Conservation Act 1995*. Names may differ slightly from those listed under the *Environment Protection and Biodiversity Conservation Act 1999*. 1 - TSC Act = *Threatened Species Conservation Act 1995.* 2 - EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999.*

The proposal will involve three Key Threatening Processes - Clearing of native vegetation, removal of dead wood and trees and loss of hollow bearing trees.

6. Impact amelioration

A general principle of environmental management is to, in order of preference;

- Avoid environmental impacts.
- Minimise impacts.
- Mitigate the impacts.
- As a last resort once the above options have been investigated, compensate for the residual impacts.

Major land uses within the locality of the proposed power station site and gas pipeline include grazing of native and modified pastures, native forests and nature conservation. During the current survey 4051 ha of native vegetation was identified within a 1 km radius of the proposal. Of this native vegetation it was predicted only 41 ha of native vegetation and fauna habitat (culminating in only 1% of native vegetation within 1 km of the proposal) will be directly affected by the proposal. Given the highly fragmented landscape in conjunction with an isolated construction footprint (30 m) impacts of the project on local flora and fauna have been avoided and minimised through the route selection process.

In order to further minimise and mitigate impacts on the ecological values of the site, the mitigation measures in Table 6-1 are proposed to be implemented.

Table 6-1 Proposed mitigation measures

Mitigation measure
Prior to construction
▪ During the detailed design phase the pipeline route would be confirmed following assessment by geotechnical specialists, and consultation with biodiversity specialists, landowners and relevant authorities. Any variations to the route alignment would be carefully determined to avoid significant habitat features, such as large mature trees or habitat for threatened species where possible. Should previously unsurveyed areas be traversed by the pipeline, biodiversity specialists would provide on-site assessment, if necessary.
Construction
▪ Suitable fencing or colour tape or 'parawebbing' would be used to delineate the maximum width of work area permitted in sensitive areas. This would be implemented prior to any work commencing on-site. If any tape is disturbed, it would be immediately replaced along the appropriate alignment. Construction work outside this area would constitute a non-conformance with the contract terms.
▪ Except for trenching and at the proposed gas-fired power station, vegetation clearing would involve only the removal of above-ground plant parts, with root systems and the soil profile left undisturbed.
▪ Any dead logs within the development footprint would be moved to an adjacent area that is outside the construction footprint, thus minimising the loss of habitat and returned to the disturbed site following construction.
▪ Directional drilling launch and receiving pad areas would be carefully planned in order to avoid removal of mature trees. If this is not possible, the number of trees to be affected would be minimised. It is envisaged, however, that any directional drilling would take place from within cleared areas.

Mitigation measure

- For any habitat trees to be removed, clearing protocols would be put in place. These protocols would include:

  1. All habitat trees in the area to be cleared should be identified (by survey) and marked.

  2. Marked habitat trees and corridors of retained trees linking marked habitat trees with the nearest uncleared (secure) habitat areas should be left standing after initial vegetation clearing for a period of at least 24 hours (to encourage animals to disperse into adjacent uncleared habitat).

  3. After the 24 hour waiting period, standing habitat trees and corridors may be felled, commencing with the most distant trees from secure habitat.

  4. Clearing should be undertaken in the spring to autumn period to facilitate survival of displaced animals.

  5. If habitat trees are in short supply artificial nest sites (nest boxes) should be installed in adjacent (secure) habitat before clearing.

  6. All contractors should have the contact numbers of wildlife rescue groups should animals be injured during clearing.

- Clearance of paddock trees at the proposed power station site would be minimised as far as possible within the construction car park and laydown area.
- Areas not necessary for the operation of the pipeline would be rehabilitated in a progressive manner as construction proceeds. This would include:
  - planting of a range of locally occurring and sourced native shrubs, trees and groundcover plants (Discussion would be held with Department of the Environment and Conservation regarding the choice of species, particularly in areas where the revegetation would be adjacent to existing patches of native vegetation, including Endangered Ecological Communities.)
  - inclusion of logs, dead trees and stumps in the landscaping works
  - inclusion of foraging species, such as *Allocasuarina* for Glossy Black-cockatoos
  - incorporation of existing natural vegetation where possible
  - maintenance of plantings through a revegetation plan included in the Construction Environmental Management Plan.
- Soil that may contain seeds of exotic species would be stockpiled away from drainage lines, and vegetated areas and weed-free soil stockpiles. Weed infested stockpiles would be covered to eliminate the spread of the soil and seed during rainfall and high wind events.
- Where possible, branches overhanging the easement that are in the way of construction activities would be tied back for the duration of the construction rather than being cut.
- No materials, spoil or machinery would be stored or parked within the drip-line of any trees.
- Topsoil removed during trenching would be stockpiled nearby within the easement and replaced once the pipe has been laid. Care should be taken not to transfer topsoil between areas.
- Vehicles and other equipment (including boots) would be thoroughly cleaned of soil, seeds and plant material before entering or leaving the site. This would help to prevent the spread of weed species or pathogens within the site or into the surrounding bushland.
- The amount of open trenching would be generally limited to 100 metres per crew at any one time.
- Trenches would be backfilled so as to cover as much open trench as practicable by the end of each day's work. If this is not possible, the ends of the open trenches would be graded to allow escape for any animals that may venture into the trench.
- Excavated material would not be placed within 20 metres of any drainage line.
- When accessing construction sites, contractors would use only designated access track.

- Directional drilling will be used to drill and install the gas pipeline across waterways and environmentally sensitive areas. Launch and retrieval sites at either end of the directional drill will be located in cleared areas to reduce vegetation disturbance and clearing outside the construction footprint (30 m).

Mitigation measure
▪ Trenching and directional drilling will only occur in dry weather adjacent to waterways.
Management and operations
▪ A flora and fauna management sub plan should be prepared for the operation of the pipeline and power station. This plan would be prepared in conjunction with the flora and fauna management plan for construction of the pipeline. Completion of the flora and fauna management plan would be finalised prior to the commencement of construction. This would include: ▸ ongoing monitoring of the impacts ▸ rehabilitation ▸ undertaking ongoing management of weed invasion in the easement to ensure weeds do not spread.

6.1 Offsets of residual impacts

Many of the potential impacts of the proposed upgrade have either been avoided or minimised through design decisions or can be adequately mitigated or managed. The proposal will, however, include the removal of 41.4 ha of woodland and open forest vegetation communities including the removal of habitat for a variety of native species including secondary habitat for threatened species of plant and animal.

To address the residual impacts of the proposed upgrade, NRM power would implement an offset strategy that would contribute to the long-term conservation of biodiversity.

An offset is one or more appropriate actions that are put in place to counterbalance specific impacts on biodiversity. Appropriate actions are long-term management activities to improve biodiversity conservation. These can include legal protection of land to ensure security as well as direct management actions (Department of Environment and Conservation 2006).

6.1.1 Principles and guidelines for offsets

There is no comprehensive government policy for offsets in NSW, although the Department of Environment and Climate Change has issued principles by which it will negotiate offsets that are not covered by an existing offset program (e.g. under the Native Vegetation Act 2003 and NSW Department of Environment and Conservation 2007). These principles are:

- Impacts must be avoided first through prevention and mitigation measures. Offsets are then used to address residual impacts.
- All regulatory requirements must be met.
- Offsets must never reward ongoing poor performance.
- Offsets should complement other government programs.
- Offsets must be underpinned by sound ecological principles.
- Offsets should aim to result in a net improvement in biodiversity over time.
- Offsets must be enduring — they must offset the impact of the development for at least the period that the impact occurs.
- Offsets should be agreed prior to the impact occurring.
- Offsets must be quantifiable — the impacts and benefits must be reliably estimated.

- Offsets must be targeted — they must offset impacts on a like-for-like or better basis.
- Offsets must be located appropriately — they must offset the impact in the same region.
- Offsets must be supplementary — they must be beyond existing requirements and not already be funded under another scheme.
- Offsets and their actions must be enforceable — through development consent conditions, licence conditions, conservation agreements or a contract (NSW Department of Environment and Conservation 2007).
- Consultation with the Department of Environment and Climate Change will be carried out to discuss offsets relating to residual impacts for the proposed gas pipeline and power station. It is however likely that the offsets will include rehabilitation of lands surrounding the power station site.

7. Assessment of significance of impacts

Projects assessed under Part 3A of the *Environmental Planning and Assessment Act 1979* consider the significance of impacts on biodiversity following on the heads of consideration detailed in the draft *Guidelines for Threatened Species Assessment* , including assessment of the significance of the impacts relative to the conservation importance of the habitat, individuals and populations likely to be affected.

Threatened biodiversity listed under the *Environment Protection and Biodiversity Conservation Act 1999* are required to be assessed following the *Principal Significant Impact Guidelines*.

A number of threatened ecological communities, species of plant and species of animal have been recorded along the proposed gas pipeline route, or were considered likely to occur, that may be directly or indirectly affected by the proposal. Significance assessments for these communities and species are included in Attachment E. Given the small scale of impacts of the proposal relative to the availability of similar habitat in local and regional area the significance assessments indicate that the proposal is unlikely to have a significant impact on any endangered ecological communities, or threatened species of plant or animals (as summarised in Table 7-1).

Table 7-1 Summary of threatened biodiversity for which significance assessments were undertaken and their likelihood of being significantly affected by the proposal

Name	TSC Act[1]	EPBC Act[2]	Likely to be significantly affected	Reason for the outcome
Threatened Ecological Communities				
White Box, Yellow Box, Blakely's red Gum Woodland	E	EC[3]	No	Impacts are small across the extent of the proposal and restricted to several small, modified and isolated patches.
White Box, Yellow Box, Blakely's red Gum Woodland and derived Grassland	E	EC	No	Impacts are small across the extent of the proposal and restricted to several small, modified and isolated patches.
Fuzzy Box Woodland	E	EC[3]	No	Impacts are small across the extent of the proposal and restricted to several small, modified and isolated patches.
Threatened Flora				
Tylophora linearis	E	E	No	Impacts are small across the extent of the proposal and restricted to several small, modified and isolated patches.
Swainsona recta	E	E	No	Impacts are small across the extent of the proposal and restricted to several small, modified and isolated patches.
Swainsona sericea	V	-	No	Impacts are small across the extent of the proposal and restricted to several small, modified and isolated patches.

Name	TSC Act[1]	EPBC Act[2]	Likely to be significantly affected	Reason for the outcome
Threatened Fauna				
Native birds				
Brown Treecreeper (*Climacteris picumnus victoriae*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Hooded Robin (*Melanodryas cucullate*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Black-chinned Honeyeater (*Melithreptus gularis gularis*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Gilbert's Whistler (*Pachycephala inornata*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Grey Crowned Babbler (*Pomatostomus temporalis*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Speckled Warbler (*Pyrrholaemus sagittatus*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Diamond Firetail (*Stagonopleura guttata*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Turquoise Parrot (*Neophema pulchella*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Regent Honeyeater (*Xanthomyza Phrygia*)	E1	EM	No	Loss of foraging habitat is not considered significant considering availability in wider locality.
Superb Parrot (*Polytelis swainsonii*)	V	V	No	Loss of foraging habitat is not considered significant considering availability in wider locality.
Bush-stone Curlew (*Burhinus grallarius*)	E1		No	Loss of suitable habitat is not considered significant considering availability in wider locality.
Glossy Black-cockatoo (*Calyptorhynchus lathami*)	V		No	Study area only provides marginal habitat for this species with no nesting habitat and only limited foraging habitat available.
Powerful Owl (*Ninox strenua*)	V		No	Loss of foraging habitat is not considered significant considering availability in wider locality.
Masked Owl (*Tyto novaehollandiae*)	V		No	Loss of foraging habitat is not considered significant considering availability in wider locality.
Barking Owl (*Ninox connivens*)	V		No	Loss of foraging habitat is not considered significant considering availability in wider locality.
Grey Falcon (*Falco hypoleucos*)	V		No	Loss of foraging habitat is not considered significant considering availability in wider locality.

Name	TSC Act[1]	EPBC Act[2]	Likely to be significantly affected	Reason for the outcome
Native mammals				
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V	V	No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Little Pied Bat (*Chalinolobus picatus*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Squirrel Glider (*Petaurus norfolcensis*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Koala (*Phascolarctos cinereus*)	V		No	Greater habitat resources available adjacent study area and important habitat resources not removed.
Fish				
Trout Cod (*Maccullochella macquariensis*)	E	E	No	Appropriate mitigation measures will reduce impact on aquatic habitats in the study area.

1. V= Vulnerable, E1 = Endangered (*Threatened Species Conservation Act 1995*)

2. V = Vulnerable, E = Endangered, CE = Critically Endangered (*Environment Protection and Biodiversity Conservation Act 1999*).

3. The equivalent *Environment Protection and Biodiversity Conservation Act 1999* listing for White Box, Yellow Box, Blakely's red Gum Woodland and Fuzzy Box Woodland only applies to those patches that qualify as White Box, Yellow Box, Blakely's red Gum Woodland and derived Grassland under the EPBC definition.

8. Summary and Conclusions

The proposed pipeline route crosses areas of native vegetation that contain a high diversity of species and vegetation communities, some of which are considered Threatened. However the general habitat and vegetation in the local area is already highly fragmented and disturbed due to past land uses including agriculture. The project would remove approximately 41.4 ha of vegetation, which represents 1% of the native vegetation within 1 km of the subject site.

The vegetation to be removed contains significant habitat features, such as hollow-bearing trees (however present at low densities throughout the study area), important water resources (i.e. Macquarie River) and in some areas, vegetation contributing to large continuous corridors in a highly fragmented landscape. These habitat features are, however, also widely available in the surrounding landscape.

The potential for significant impacts on vegetation and fauna habitats has been largely avoided through the route selection process for the pipeline. With appropriate mitigation measures as outlined in this document, it is unlikely that the project would have a significant impact on Threatened biodiversity, as listed under either the *Threatened Species Conservation Act 1995* or the *Environment Protection and Biodiversity Conservation Act 1999*.

8.1 Summary of assessment

Under the draft Guidelines for Threatened Species Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979*, the following thresholds need to be addressed:

Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.

The term 'maintain or improve' is defined in the draft Guidelines for threatened Species Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979*, as: 'no net impact on threatened species or native vegetation' (Department of Environment and Conservation 2005a). The proposed pipeline and power station would result in the loss of up to approximately 41.4 ha of vegetation and associated habitat, including endangered ecological communities. The potential for significant impacts on vegetation and fauna habitats has been largely avoided through the route selection process for the pipeline. Management measures would be outlined in the Flora and Fauna Management Sub-plan for the project, which would form part of the Construction Environmental Management Plan. Measures would include those outlined in Chapter 6 of this report. These measures would allow for continuance of biodiversity values for the subject site.

Given that the proposed gas pipeline would result in clearing of native vegetation, including Endangered Ecological Communities and habitat for Threatened species, it would be necessary to develop offset strategies to which would contribute to the maintenance and improvement of biodiversity values.

Whether or not the proposal is likely to reduce the long-term viability of a local population of a species, population or ecological community.

The proposed pipeline and power station is unlikely to reduce the long-term viability of the species, populations and communities found, or considered likely to occur, in the locality. The potential for significant impacts on vegetation and fauna habitats has been largely avoided through the route selection process for the pipeline, the availability of similar habitat in local and regional areas and through the implementation of mitigation measures proposed in this report. Although the proposed pipeline and power station is considered unlikely to have a significant impact on any threatened biodiversity, there are some impacts that cannot be adequately mitigated. As such, an offset package would be developed, which would contribute to the maintenance and improvement of biodiversity values.

Whether or not the proposal is likely to accelerate the extinction of a species, population or ecological community or place it at risk of extinction.

The proposed upgrade would remove up to 41.4 ha of vegetation ranging from poor to good habitat quality within the local area, including endangered ecological communities and habitat for threatened species. However, through the implementation of mitigation measures and offsets, it is unlikely that the proposed upgrade would accelerate the extinction of a species, population or community. This is demonstrated by the conclusions of the assessment of significance in that the project is unlikely to have a significant impact on threatened biodiversity.

Whether or not the proposal will adversely affect critical habitat.

Critical habitat is listed under both the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999* and both the State and Federal Directors-General maintain a register of this habitat (Department of Environment and Conservation 2007; Department of the Environment and Water Resources 2007c).

Under the *Threatened Species Conservation Act 1995* , critical habitat is the whole, or any part or parts, of an area, or areas, of land comprising the habitat of an endangered species, an endangered population or an endangered ecological community that is critical to the survival of the species, population or ecological community (Department of Environment and Conservation 2004). Under the *Environment Protection and Biodiversity Conservation Act 1999*, 'habitat critical to the survival of a species or ecological community' refers to areas that are necessary for one or more of the following:

- Activities such as foraging, breeding, roosting, or dispersal.
- Long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community such as pollinators).
- Maintaining genetic diversity and long-term evolutionary development.
- Reintroduction of populations or recovery of a species or ecological community (Department of the Environment and Heritage 2005).

As such, habitat under both Acts may be, but is not limited to, habitat identified in a recovery plan for a species or ecological community as habitat critical for that species or ecological community, and/or habitat listed in the Registers of Critical Habitat.

The study area does not include areas of critical habitat listed for any threatened species or ecological communities listed under the *Threatened Species Conservation Act 1995* and/or *Environment Protection and Biodiversity Conservation Act 1999*, nor is the study area considered to comprise or contain habitat critical to any of the threatened species or ecological communities identified or considered likely to occur in the study area.

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Attachment A

Species of plant recorded in the study area

Species of plant recorded in the study area

Attachment A provides a summary of the vegetation surveys done for the proposal. Table A-1 provides a summary of the species recorded with the detection frequency in each vegetation community. Table A-2 provides the raw results of the 36 random meander / transect surveys. Table A-3 provides a summary of the vegetation habitat assessment used to describe the communities.

Table A-1 Species of plant recorded within each vegetation in the study area

Family	Scientific name	Native	Frequency profile of each species in each vegetation community [1, 2]					
			BGW	FBW	RRGW	IBCOF	TRDRW	RIRSW
Acanthaceae	*Brunoniella australis*	Y	-	0.50	-	-	-	-
	Rostellularia adscendens	Y	-	0.50	-	-	-	-
Adiantaceae	*Cheilanthes distans*	Y	0.05	-	-	-	0.33	-
	Cheilanthes sieberi	Y	0.29	-	0.33	0.60	1.00	1.00
Anacardiaceae	*Schinus areira*	N	0.05	-	-	-	-	-
Anthericaceae	*Arthropodium milleflorum*	Y	0.19	-	-	0.40	0.33	-
	Laxmannia gracilis	Y	-	-	-	-	-	1.00
	Tricoryne elatior	Y	-	-	-	0.20	-	-
Apiaceae	*Actinotus gibbonsii*	Y	-	-	-	0.20	0.33	1.00
	Conium maculatum	N	-	-	0.33	-	-	-
	Daucus glochidiatus	Y	0.05	-	-	0.60	0.67	-
	Foeniculum vulgare	N	0.05	-	-	-	-	-
	Hydrocotyle laxifolia	Y	0.05	-	-	0.40	0.33	0.50
	Xanthosia tridentata	Y	-	-	-	0.20	-	-
Apocynaceae	*Parsonsia eucalyptophylla*	Y	-	-	-	-	-	-
Asteraceae	*Arctotheca calendula*	N	0.10	-	-	-	0.33	-
	Bracteantha viscosa	Y	0.10	-	-	-	0.33	1.00
	Calocephalus citreus	Y	0.05	-	-	-	-	-
	Calotis cuneifolia	Y	0.29	0.50	-	-	0.33	0.50
	Calotis sp.	Y	0.14	-	-	-	-	-
	Carduus tenuiflorus	N	0.24	-	0.67	-	0.33	-
	Cassinia compacta	Y	-	-	-	0.20	-	-
	Cassinia sp.	Y	-	-	-	0.20	-	-
	Carthamus lanatus	N	0.24	-	0.67	-	0.33	-
	Centaurea solstitialis	N	0.05	-	0.33	-	-	-
	Chrysocephalum apiculatum	Y	0.05	-	0.33	-	-	0.50
	Cirsium vulgare	N	0.05	-	0.67	-	-	-
	Chrysocephalum semipapposum	Y	-	-	-	0.20	-	-
	Conyza sp.	N	-	-	0.33	-	-	-
	Helipterum demissum	Y	-	-	-	-	-	0.50
	Hypochaeris radicata	N	0.14	-	0.67	0.20	0.33	-
	Lactuca serriola	N	0.05	-	1.00	-	-	-
	Lagenifera gracilis	Y	0.10	-	-	-	-	-
	Ozothamnus diosmifolius	Y	-	-	-	-	0.33	-
	Rhodanthe pygmaea	Y	-	-	-	-	-	0.50
	Senecio quadridentatus	Y	0.05	-	-	-	-	-
	Silybum marianum	N	0.48	-	1.00	-	-	-
	Solenogyne dominii	Y	-	-	-	-	-	-
	Sonchus oleraceus	N	0.19	-	1.00	-	0.33	-

Family	Scientific name	Native	Frequency profile of each species in each vegetation community [1, 2]					
			BGW	FBW	RRGW	IBCOF	TRDRW	RIRSW
	Tragopogon porrifolius	N	-	-	-	-	-	-
	Vittadinia cuneata	Y	0.14	0.50	-	0.20	0.33	-
Boraginaceae	*Echium plantagineum*	N	0.71	0.50	1.00	-	0.33	-
	Heliotropium amplexicaule	N	0.10	-	-	-	-	-
Brassicaceae	*Capsella bursa-pastoris*	N	0.38	-	0.33	-	-	-
	Hirschfeldia incana	N	0.19	-	0.67	-	-	-
	Sisymbrium irio	Y	0.10	-	-	-	-	-
	Sisymbrium officinale	N	0.10	-	0.33	-	-	-
	Sisymbrium orientale	N	0.14	0.50	0.33	-	-	-
Cactaceae	*Opuntia aurantiaca*	N	0.05	-	-	-	-	-
Campanulaceae	*Wahlenbergia communis*	Y	0.05	-	-	-	-	-
	Wahlenbergia gracilis	Y	-	-	-	-	0.33	-
	Wahlenbergia luteola	Y	0.05	-	-	-	-	-
	Wahlenbergia multicaulis	Y	0.10	-	-	0.20	-	-
	Wahlenbergia sp.	Y	0.14	-	0.33	-	0.33	-
	Wahlenbergia stricta ssp. *alterna*	Y	-	-	-	-	-	-
	Wahlenbergia stricta ssp. *stricta*	Y	-	-	-	0.20	-	0.50
Caryophyllaceae	*Cerastium glomeratum*	N	-	-	0.33	-	-	-
	Petrorhagia nanteuilii	N	0.05	-	-	0.20	0.33	-
Casuarinaceae	*Allocasuarina verticillata*	Y	-	-	-	0.20	-	0.50
	Allocasuarina luehmannii	Y	0.10	-	-	0.20	-	-
	Allocasuarina stricta	Y	-	-	-	-	0.33	-
	Casuarina cunninghamiana	Y	-	-	0.33	-	-	-
Chenopodiaceae	*Atriplex pseudocampanulata*	Y	-	1.00	-	-	-	-
	Atriplex sp.	Y	-	-	-	-	-	-
	Chenopodium album	N	-	-	-	-	-	-
	Einadia nutans	Y	0.52	0.50	0.67	-	-	-
	Enchylaena tomentosa	Y	0.05	-	-	-	-	-
	Maireana enchylaenoides	Y	0.19	1.00	-	-	-	-
	Maireana microphylla	Y	0.05	-	0.33	-	-	-
	Sclerolaena muricata	Y	-	0.50	-	-	-	-
	Sclerolaena sp.	Y	-	1.00	-	-	-	-
Convolvulaceae	*Convolvulus erubescens*	Y	0.10	-	-	-	-	-
	Dichondra repens	Y	0.10	1.00	0.33	0.20	0.33	-
	Evolvulus alsinoides	Y	0.05	-	-	-	-	-
Cupressaceae	*Callitris endlicheri*	Y	0.05	0.50	-	0.80	0.33	-
	Callitris glaucophylla	Y	0.38	0.50	-	-	0.33	-
Cyperaceae	*Carex appressa*	Y	0.05	-	0.67	-	-	-
	Cyperus tenellus	Y	-	-	0.33	0.20	-	-
	Gahnia aspera	Y	-	-	-	0.40	0.33	-
	Lepidosperma laterale	Y	-	-	-	0.20	-	-
Dilleniaceae	*Hibbertia empetrifolia*	Y	-	-	-	0.80	-	-
	Hibbertia obtusifolia	Y	-	-	-	0.60	-	1.00
	Hibbertia sp.	Y	-	-	-	-	-	0.50
Epacridaceae	*Acrotriche rigida*	Y	-	-	-	0.80	-	-

Family	Scientific name	Native	Frequency profile of each species in each vegetation community [1, 2]					
			BGW	FBW	RRGW	IBCOF	TRDRW	RIRSW
	Astroloma humifusum	Y	-	-	-	-	-	0.50
	Brachyloma daphnoides var. glabrum	Y	-	-	-	-	0.33	1.00
	Melichrus sp.	Y	0.05	-	-	0.20	-	-
Euphorbiaceae	*Euphorbia drummondii*	Y	-	-	-	0.20	0.33	-
	Poranthera microphylla	Y	-	-	-	0.20	0.33	1.00
Fabaceae (Caesalpinioideae)	*Senna* form taxon *'artemisioides'*	Y	0.14	1.00	-	-	-	-
	Senna barclayana	Y	0.10	-	0.33	-	-	-
Fabaceae (Faboideae)	*Desmodium varians*	Y	0.33	-	-	0.20	0.33	-
	Glycine tabacina	Y	0.19	-	0.33	-	0.33	-
	Medicago sp.	N	0.19	-	-	-	-	-
	Melilotus indica	N	0.05	-	-	-	-	-
	Trifolium arvense	N	0.19	-	0.67	-	-	-
	Trifolium sp.	N	0.52	1.00	-	0.20	0.33	-
	Swainsona galegifolia	Y	-	-	-	0.20	-	0.50
	Vicia sp.	N	-	-	0.33	-	-	-
Fabaceae (Mimosoideae)	*Acacia buxifolia* ssp. *buxifolia*	Y	0.05	-	-	-	-	-
	Acacia deanei	Y	0.10	-	-	-	-	-
	Acacia deanei ssp. *paucijuga*	Y	-	0.50	-	-	-	-
	Acacia decora	Y	0.14	-	-	-	-	-
	Acacia decurrens	Y	-	-	-	-	-	-
	Acacia doratoxylon	Y	0.10	-	0.33	0.20	0.33	-
	Acacia homalophylla	Y	0.10	-	-	-	-	-
	Acacia implexa	Y	-	-	-	-	-	-
	Acacia karroo	N	0.05	-	-	-	-	-
	Acacia mollifolia	Y	-	-	-	1.00	0.67	-
	Acacia paradoxa	Y	-	-	-	0.40	0.33	-
	Acacia penninervis	Y	0.05	-	-	-	-	0.50
	Acacia rubida	Y	0.05	-	-	-	-	-
	Acacia spectabilis	Y	0.05	-	-	-	-	-
Fumariaceae	*Fumaria* sp.	Y	-	-	-	-	-	-
Geraniaceae	*Erodium crinitum*	Y	-	-	-	0.20	-	-
	Geranium solanderi	Y	0.10	-	-	-	-	-
	Pelargonium sp.	Y	-	-	0.33	-	-	-
Goodeniaceae	*Brunonia australis*	Y	-	-	-	-	0.33	-
	Goodenia cycloptera	Y	-	-	-	-	-	-
	Goodenia glabra	Y	0.05	-	-	-	-	-
	Goodenia hederacea	Y	0.10	1.00	-	-	0.33	0.50
	Goodenia hederacea ssp. *hederacea*	Y	-	-	-	0.60	-	0.50
	Goodenia pinnatifida	Y	0.05	-	-	-	-	-
	Goodenia rotundifolia	Y	-	-	-	-	-	-
Haloragaceae	*Gonocarpus aspera*	Y	-	-	-	-	0.33	-
	Haloragis aspera	Y	-	-	-	-	0.33	-
Hypoxidaceae	*Hypoxis* sp.	Y	0.05	-	-	-	-	-

Family	Scientific name	Native	Frequency profile of each species in each vegetation community [1, 2]					
			BGW	FBW	RRGW	IBCOF	TRDRW	RIRSW
Iridaceae	*Romulea rosea*	N	-	-	-	-	0.33	-
Juncaceae	*Juncus* sp.	Y	0.05	-	0.67	0.20	-	-
Lamiaceae	*Marrubium vulgare*	N	0.43	0.50	0.67	-	-	-
	Salvia verbenaca	N	0.14	0.50	-	-	-	-
Lauraceae	*Cassytha glabella*	Y	-	-	-	0.20	-	0.50
Lomandraceae	*Lomandra bracteata*	Y	0.29	1.00	-	0.20	0.67	-
	Lomandra confertifolia ssp. *rubiginosa*	Y	0.05	0.50	-	-	-	-
	Lomandra filiformis ssp. *filiformis*	Y	-	-	-	0.40	-	0.50
	Lomandra longifolia	Y	-	-	0.33	-	-	0.50
	Lomandra multiflora	Y	0.19	0.50	-	0.60	0.33	1.00
	Lomandra patens	Y	-	-	-	0.40	-	0.50
Loranthaceae	*Amyema miquelii*	Y	-	-	-	0.20	-	-
Malvaceae	*Malva parviflora*	N	0.38	-	-	-	-	-
	Sida corrugata	Y	0.29	1.00	0.33	-	-	-
	Sida cunninghamii	Y	0.05	-	-	-	-	-
	Sida subspicata	Y	0.14	0.50	-	-	-	-
Meliaceae	*Melia azedarach var. australasica*	Y	-	-	0.33	-	-	-
Myoporaceae	*Eremophila debilis*	Y	0.19	1.00	0.33	-	-	-
Myrtaceae	*Babingtonia cunninghamii*	Y	0.05	-	-	-	-	0.50
	Calytrix tetragona	Y	-	-	-	0.20	-	1.00
	Eucalyptus albens	Y	0.81	-	-	0.20	-	-
	Eucalyptus blakelyi	Y	0.24	-	-	-	-	-
	Eucalyptus camaldulensis	Y	-	-	1.00	-	-	-
	Eucalyptus conica	Y	0.05	0.50	0.33	-	-	-
	Eucalyptus dealbata	Y	0.05	-	-	0.40	0.67	-
	Eucalyptus dwyeri	Y	-	-	-	-	0.33	-
	Eucalyptus fibrosa	Y	-	-	-	0.60	0.33	-
	Eucalyptus goniocalyx	Y	-	-	-	-	-	1.00
	Eucalyptus macrorhyncha	Y	-	-	-	0.20	0.67	1.00
	Eucalyptus melliodora	Y	0.57	0.50	0.33	0.40	-	-
	Eucalyptus microcarpa	Y	0.14	-	-	0.40	-	-
	Eucalyptus polyanthemos	Y	-	0.50	-	-	-	-
	Eucalyptus sideroxylon	Y	-	-	-	0.80	0.33	1.00
	Leptospermum trivalve	Y	-	-	-	0.20	0.67	0.50
Onagraceae	*Oenothera mollissima*	N	-	-	-	-	-	-
Oxalidaceae	*Oxalis corniculata*	N	0.38	0.50	0.33	-	1.00	0.50
Papaveraceae	*Argemone ochroleuca* ssp. *ochroleuca*	N	0.05	-	-	-	-	-
	Papaver somniferum ssp. *setigerum*	N	-	-	0.33	-	-	-
Phormiaceae	*Dianella longifolia* var. *longifolia*	Y	0.05	0.50	-	0.40	0.33	1.00
	Stypandra glauca	Y	-	-	-	-	-	-
Plantaginaceae	*Plantago debilis*	Y	0.05	-	-	-	-	-
	Plantago lanceolata	N	0.05	0.50	-	-	-	-
Poaceae	*Aira cupaniana*	N	0.05	-	-	0.40	1.00	0.50
	Aristida behriana	Y	0.14	0.50	-	-	-	-

Family	Scientific name	Native	Frequency profile of each species in each vegetation community [1, 2]					
			BGW	FBW	RRGW	IBCOF	TRDRW	RIRSW
	Aristida ramosa	Y	0.10	-	0.33	0.40	0.67	1.00
	Austrodanthonia auriculata	Y	0.05	-	-	-	-	-
	Austrodanthonia bipartita	Y	0.05	-	-	-	-	-
	Austrodanthonia caespitosa	Y	0.24	-	-	0.20	-	0.50
	Austrodanthonia penicillata	Y	0.14	-	-	0.20	-	-
	Austrodanthonia pilosa	Y	0.10	0.50	-	-	-	-
	Austrodanthonia setacea	Y	0.05	0.50	-	-	-	-
	Austrodanthonia sp.	Y	0.14	0.50	-	0.60	0.33	0.50
	Austrodanthonia tenuior	Y	0.05	-	-	-	-	-
	Austrostipa bigeniculata	Y	0.14	-	-	-	-	-
	Austrostipa ramosissima	Y	-	-	0.33	-	-	-
	Austrostipa scabra	Y	0.57	0.50	-	0.60	0.33	-
	Avena fatua	N	0.14	0.50	0.67	-	-	-
	Bothriochloa macra	Y	-	-	-	-	0.33	-
	Briza minor	N	-	-	0.33	0.20	0.67	-
	Bromus alopecuros	N	0.52	-	1.00	-	-	-
	Bromus brevis	N	0.05	-	0.67	-	-	-
	Bromus diandrus	N	0.33	1.00	1.00	-	0.33	-
	Bromus rubens	N	0.19	-	-	-	-	-
	Chloris divaricata var. *divaricata*	Y	0.05	1.00	-	0.20	-	-
	Chloris truncata	Y	0.05	-	-	-	-	-
	Cynodon dactylon	Y	-	-	0.67	-	-	-
	Echinopogon caespitosus	Y	-	-	-	-	-	0.50
	Elymus scaber	Y	0.38	0.50	-	0.20	0.33	-
	Enneapogon sp.	Y	0.05	-	-	-	-	-
	Eragrostis curvula	N	0.05	-	-	-	-	-
	Eragrostis microcarpa	Y	0.05	-	-	-	-	-
	Hordeum distichon	N	-	-	-	-	-	-
	Hordeum leporinum	N	0.57	1.00	1.00	-	-	-
	Lachnagrostis filiformis	Y	-	-	-	-	0.33	-
	Lolium rigidum	N	0.76	1.00	1.00	-	0.33	-
	Microlaena stipoides	Y	-	-	-	0.20	-	1.00
	Phalaris aquatica	N	-	-	-	-	-	-
	Phalaris sp.	N	0.05	-	0.33	-	-	-
	Phragmites australis	Y	-	-	0.67	-	-	-
	Poa sp.	Y	-	-	-	-	-	-
	Polypogon monspeliensis	N	0.05	-	0.33	-	-	-
	Vulpia ciliata	N	0.43	0.50	0.33	0.40	0.33	1.00
Polygonaceae	*Polygonum aviculare*	N	0.14	-	-	-	-	-
	Rumex brownii	Y	0.38	-	0.67	0.40	-	-
	Rumex crispus	N	0.05	-	-	-	-	-
Proteaceae	*Grevillea floribunda*	Y	-	-	-	-	-	1.00
	Grevillea robusta	Y	-	-	-	-	-	-
	Persoonia curvifolia	Y	-	-	-	-	-	0.50
Ranunculaceae	*Ranunculus sceleratus*	N	-	-	-	-	-	-

Family	Scientific name	Native	Frequency profile of each species in each vegetation community [1, 2]					
			BGW	FBW	RRGW	IBCOF	TRDRW	RIRSW
Rosaceae	*Acaena echinata*	Y	0.05	-	-	-	-	-
	Rosa rubiginosa	N	-	-	0.33	-	-	-
Rubiaceae	*Asperula conferta*	Y	-	-	-	-	-	-
	Galium aparine	N	0.05	-	-	0.20	-	-
	Opercularia hispida	Y	-	-	-	0.40	-	0.50
Rutaceae	*Geijera parviflora*	Y	-	0.50	-	-	-	-
Salicaceae	*Salix babylonica*	N	-	-	0.67	-	-	-
	Salix nigra	N	-	-	0.33	-	-	-
Santalaceae	*Exocarpos cupressiformis*	Y	-	-	-	-	0.33	-
	Santalum acuminatum	Y	-	0.50	-	-	-	-
	Santalum lanceolatum	Y	-	-	-	-	-	-
Sapindaceae	*Dodonaea boroniifolia*	Y	0.05	-	-	-	-	-
	Dodonaea truncatiales	Y	0.05	-	-	-	-	-
	Dodonaea viscosa	Y	-	0.50	-	-	-	-
	Dodonaea viscosa ssp. *angustifolia*	Y	-	0.50	-	-	-	-
	Dodonaea viscosa ssp. *spatulata*	Y	-	0.50	-	0.20	-	-
Scrophulariaceae	*Orobanche minor*	N	0.05	-	-	-	-	-
	Verbascum thapsus	N	-	-	-	-	-	-
	Veronica plebeia	Y	-	-	-	-	0.33	-
Simaroubaceae	*Ailanthus altissima*	N	-	-	0.33	-	-	-
Solanaceae	*Lycium ferocissimum*	N	0.05	-	-	-	-	-
	Nicotiana glauca	N	-	-	-	-	-	-
	Solanum cinereum	Y	0.10	-	-	-	-	-
	Solanum nigrum	N	-	-	0.33	-	-	-
Stackhousiaceae	*Stackhousia viminea*	Y	0.10	-	-	0.20	-	-
Sterculiaceae	*Brachychiton populneus* ssp. *populneus*	Y	0.24	0.50	0.67	-	0.67	-
Thymelaeaceae	*Pimelea linifolia*	Y	-	-	-	-	-	1.00
Typhaceae	*Typha domingensis*	Y	-	-	-	-	-	-
	Typha orientalis	Y	-	-	0.33	-	-	-
Urticaceae	*Urtica incisa*	Y	0.05	-	0.33	-	-	-
Verbenaceae	*Verbena bonariensis*	N	-	-	0.67	-	-	-
Violaceae	*Hybanthus monopetalus*	Y	-	-	-	-	0.33	-
Xanthorrhoeaceae	*Xanthorrhoea* sp.	Y	-	-	-	0.20	-	-
Zamiaceae	*Macrozamia communis*	Y	-	-	-	0.20	-	-

1. Frequency profile is a determined based on a count of the number of times each species was recorded divided by the number of sample plots for each community. A score of 1 indicated the species was recorded at every site in a community: a score of 0 indicated the species was not recorded at any sites within the community.

2. Vegetation community codes: BGW = Box Gum Woodland (White Box, Yellow Box, Blakely's Red Gum Woodland). FBW = Fuzzy Box Woodland. RRGW = River Red Gum Woodland. IBCOF = Ironbark, Black Cyprus Open Forest. TRDRW = Tumbledown Redgum, Dywers Red Gum Woodland. Red Ironbark, Red Strigybark Woodland = RIRSW.

Table A-2 Species of plant recorded within each vegetation sample site

Family name	Scientific name [1]	Vegetation survey site ID																																		
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
Acanthaceae	*Brunoniella australis* TSC																																		•		
	Rostellularia adscendens TSC																																		•		
Adiantaceae	*Cheilanthes distans* EPBC					•										•																					
	Cheilanthes sieberi TSC		•							•			•			•							•	•	•	•			•	•	•	•	•	•			•
Anacardiaceae	*Schinus areira* *								•																												
Anthericaceae	*Arthropodium milleflorum*		•	•		•										•							•		•	•											
	Laxmannia gracilis EPBC																														•						•
	Tricoryne elatior EPBC																								•												
Apiaceae	*Actinotus paddisonii* ROTAP 3K																											•		•	•						•
	Conium maculatum *	•																																			
	Daucus glochidiatus EPBC					•										•										•	•		•	•							
	Foeniculum vulgare *																				•																
	Hydrocotyle laxifolia																						•		•	•				•							•
	Xanthosia tridentata																												•								
Apocynaceae	*Parsonsia eucalyptophylla* TSC																																				
Asteraceae	*Arctotheca calendula* *					•										•																	•				
	Bracteantha viscosa TSC		•									•																		•	•						•
	Calocephalus citreus EPBC																				•																
	Calotis cuneifolia EPBC		•	•		•			•										•		•									•	•				•		
	Calotis sp.					•	•																											•			
	Carduus tenuiflorus *	•											•		•	•			•				•									•		•			
	Cassinia compacta																												•								
	Cassinia sp.																										•										
	Carthamus lanatus *								•						•	•			•		•	•	•									•					
	Centaurea solstitialis *	•							•																												
	Chrysocephalum apiculatum EPBC, TSC	•				•																									•						
	Cirsium vulgare *																				•	•										•					
	Chrysocephalum semipapposum EPBC																								•												
	Conyza sp. *																															•					

Family name	Scientific name [1]	Vegetation survey site ID																																		
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
	Helipterum demissum																														•						
	Hypochaeris radicata *																					•	•			•				•		•	•	•			
	Lactuca serriola *	•																			•	•										•					
	Lagenifera gracilis																				•		•														
	Ozothamnus diosmifolius																							•													
	Rhodanthe pygmaea																														•						
	Senecio quadridentatus								•																												
	Silybum marianum *	•					•	•		•	•		•	•	•		•	•			•	•										•					
	Solenogyne dominii [EPBC]																																				
	Sonchus oleraceus *	•				•	•									•					•	•										•		•			
	Tragopogon porrifolius *																																				
	Vittadinia cuneata			•					•									•											•	•					•		
Boraginaceae	*Echium plantagineum* *	•	•	•	•		•	•		•		•	•	•	•	•	•	•	•			•	•									•		•	•		
	Heliotropium amplexicaule *		•							•																											
Brassicaceae	*Capsella bursa-pastoris* *									•		•		•	•				•	•	•											•		•			
	Hirschfeldia incana *	•							•		•	•	•									•															
	Sisymbrium irio										•	•																									
	Sisymbrium officinale *	•									•									•																
	Sisymbrium orientale *			•														•	•													•				•	
Cactaceae	*Opuntia aurantiaca* *		•																																		
Campanulaceae	*Wahlenbergia communis* [TSC]																				•																
	Wahlenbergia gracilis															•																					
	Wahlenbergia luteola																				•																
	Wahlenbergia multicaulis								•																•									•			
	Wahlenbergia sp.		•				•																•							•		•					
	Wahlenbergia stricta ssp. alterna																																				
	Wahlenbergia stricta ssp. stricta																												•		•						
Caryophyllaceae	*Cerastium glomeratum* *																															•					
	Petrorhagia nanteuilii *															•										•							•				
Casuarinaceae	*Allocasuarina verticillata* [TSC]																											•			•						
	Allocasuarina luehmannii			•																					•								•				
	Allocasuarina stricta															•																					

Family name	Scientific name [1]	Vegetation survey site ID																																		
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
	Casuarina cunninghamiana	•																																		
Chenopodiaceae	*Atriplex pseudocampanulata*																																		•	•
	Atriplex sp.																																			
	Chenopodium album *																																			
	Einadia nutans	•	•	•		•			•				•	•				•	•		•		•								•		•		•	
	Enchylaena tomentosa			•																																
	Maireana enchylaenoides								•									•	•	•															•	•	
	Maireana microphylla																				•											•					
	Sclerolaena muricata																																		•		
	Sclerolaena sp.																																		•	•	
Convolvulaceae	*Convolvulus erubescens*												•								•																
	Dichondra repens								•							•									•						•		•	•	•		
	Evolvulus alsinoides								•																												
Cupressaceae	*Callitris endlicheri* [TSC]																									•	•	•	•	•			•		•	
	Callitris glaucophylla [TSC]		•	•		•	•		•	•			•			•					•														•	
Cyperaceae	*Carex appressa*																					•										•	•				
	Cyperus tenellus																					•					•										
	Gahnia aspera																									•		•		•							
	Lepidosperma laterale																											•									
Dilleniaceae	*Hibbertia empetrifolia*																								•	•	•		•								
	Hibbertia obtusifolia [EPBC, TSC]																								•	•			•		•						•
	Hibbertia sp.																														•						
Epacridaceae	*Acrotriche rigida*																									•	•	•	•								
	Astroloma humifusum																														•						
	Brachyloma daphnoides var. glabrum [TSC]																													•	•						•
	Melichrus sp. [EPBC]																						•				•										
Euphorbiaceae	*Euphorbia drummondii*															•									•												
	Poranthera microphylla [EPBC]																											•		•	•						•
Fabaceae (Caesalpinioideae)	*Senna* form taxon *'artemisioides'*								•									•	•																•	•	
	Senna barclayana		•								•																					•					
Fabaceae (Faboideae)	*Desmodium varians* [EPBC]												•	•	•			•	•	•					•					•			•			
	Glycine tabacina [EPBC, TSC]					•	•		•	•						•																•					

Family name	Scientific name [1]	Vegetation survey site ID																																		
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
	Medicago sp. *									•	•	•						•																			
	Melilotus indica *																				•																
	Trifolium arvense *		•			•																•										•	•	•			
	Trifolium sp. *			•			•	•	•	•			•	•	•	•				•	•				•									•	•	•	
	Swainsona galegifolia [TSC]																								•												•
	Vicia sp. *																					•															
Fabaceae (Mimosoideae)	*Acacia buxifolia ssp. buxifolia* [TSC]																																	•			
	Acacia deanei		•																•																		
	Acacia deanei ssp. paucijuga																																		•		
	Acacia decora [EPBC]								•														•											•			
	Acacia decurrens																																				
	Acacia doratoxylon					•										•									•							•	•				
	Acacia homalophylla								•												•																
	Acacia implexa [TSC]																																				
	Acacia karroo *									•																											
	Acacia mollifolia																							•	•	•	•	•	•	•							
	Acacia paradoxa [TSC]																							•	•	•											
	Acacia penninervis																																	•			•
	Acacia rubida																						•														
	Acacia spectabilis																																•				
Fumariaceae	*Fumaria sp.*																																				
Geraniaceae	*Erodium crinitum*																								•												
	Geranium solanderi [TSC]												•		•																						
	Pelargonium sp.																															•					
Goodeniaceae	*Brunonia australis* [EPBC]																													•							
	Goodenia cycloptera																																				
	Goodenia glabra		•																																		
	Goodenia hederacea [EPBC]								•							•					•														•	•	•
	Goodenia hederacea ssp. hederacea [EPBC]																									•		•	•		•						
	Goodenia pinnatifida																						•														
	Goodenia rotundifolia																																				
Haloragaceae	*Gonocarpus aspera*															•																					

Family name	Scientific name [1]	Vegetation survey site ID																																	
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
	Haloragis aspera																							•													
Hypoxidaceae	*Hypoxis sp.*																						•														
Iridaceae	*Romulea rosea* *															•																					
Juncaceae	*Juncus sp.*																					•				•						•		•			
Lamiaceae	*Marrubium vulgare* *	•	•	•				•		•			•				•	•	•		•											•			•		
	Salvia verbenaca *												•					•			•														•		
Lauraceae	*Cassytha glabella*																												•		•						
Lomandraceae	*Lomandra bracteata*					•				•						•		•	•		•				•					•				•	•	•	
	Lomandra confertifolia ssp. rubiginosa																				•															•	
	Lomandra filiformis ssp. filiformis [TSC]																											•	•								•
	Lomandra longifolia																															•					•
	Lomandra multiflora								•				•	•							•						•	•	•	•	•				•		•
	Lomandra patens																											•	•		•						
Loranthaceae	*Amyema miquelii*																								•												
Malvaceae	*Malva parviflora* *		•		•					•	•	•					•	•		•																
	Sida corrugata [EPBC, TSC]			•											•			•		•	•		•									•			•	•	
	Sida cunninghamii			•																																	
	Sida subspicata		•	•		•																													•		
Meliaceae	*Melia azedarach var. australasica*																															•					
Myoporaceae	*Eremophila debilis*			•		•			•										•													•			•	•	
Myrtaceae	*Babingtonia cunninghamii*																														•		•				
	Calytrix tetragona																											•			•						•
	Eucalyptus albens [TSC]			•	•		•	•	•	•	•	•	•		•		•	•	•	•	•		•			•								•			
	Eucalyptus blakelyi [TSC]		•			•													•		•		•										•				
	Eucalyptus camaldulensis	•																				•										•					
	Eucalyptus conica [TSC]																					•	•													•	
	Eucalyptus dealbata																							•		•	•			•				•			
	Eucalyptus dwyeri																							•													
	Eucalyptus fibrosa																							•		•		•	•								
	Eucalyptus goniocalyx [TSC]																														•						•
	Eucalyptus macrorhyncha															•										•				•	•						•
	Eucalyptus melliodora [TSC]		•	•		•			•	•			•	•	•				•		•		•	•	•	•	•				•	•		•		

Family name	Scientific name [1]	Vegetation survey site ID																																		
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
	Eucalyptus microcarpa [TSC]													•						•						•			•				•				
	Eucalyptus polyanthemos																																		•		
	Eucalyptus sideroxylon																								•	•	•		•	•	•						•
	Leptospermum trivalve																							•				•		•	•						
Onagraceae	*Oenothera mollissima* *																																				
Oxalidaceae	*Oxalis corniculata* *		•	•		•			•					•		•					•		•	•						•		•		•	•		•
Papaveraceae	*Argemone ochroleuca ssp. ochroleuca* *														•																						
	Papaver somniferum ssp. setigerum *																															•					
Phormiaceae	*Dianella longifolia var. longifolia* [EPBC, TSC]																				•						•	•		•	•				•		•
	Stypandra glauca [EPBC]																																				
Plantaginaceae	*Plantago debilis*								•																												
	Plantago lanceolata *																				•														•		
Poaceae	*Aira cupaniana* *															•							•	•	•	•				•							•
	Aristida behriana [TSC]		•	•														•																	•		
	Aristida ramosa [TSC]															•		•						•	•	•					•	•	•				•
	Austrodanthonia auriculata [TSC]		•																																		
	Austrodanthonia bipartita [TSC]																				•																
	Austrodanthonia caespitosa		•	•								•						•		•									•		•					
	Austrodanthonia penicillata			•																	•					•								•			
	Austrodanthonia pilosa			•											•																				•		
	Austrodanthonia setacea																				•														•		
	Austrodanthonia sp.								•							•			•				•		•	•	•									•	•
	Austrodanthonia tenuior		•																																		
	Austrostipa bigeniculata								•									•			•																
	Austrostipa ramosissima																															•					
	Austrostipa scabra [TSC]		•	•		•				•		•	•			•		•	•		•		•		•		•		•				•	•	•	
	Avena fatua *																	•			•	•										•		•	•		
	Bothriochloa macra [TSC]															•																					
	Briza minor *															•						•			•					•							
	Bromus alopecuros *	•				•	•			•			•	•	•					•	•	•	•									•	•	•			
	Bromus brevis *																				•	•										•					
	Bromus diandrus *	•						•				•	•	•		•			•		•	•	•									•			•	•	

Family name	Scientific name [1]	Vegetation survey site ID																																		
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
	Bromus rubens *				•		•		•	•																											
	Chloris divaricata var. divaricata																	•							•										•	•	
	Chloris truncata [TSC]																				•																
	Cynodon dactylon	•																														•					
	Echinopogon caespitosus [TSC]																														•						
	Elymus scaber [TSC]		•						•				•		•	•			•		•				•								•	•	•		
	Enneapogon sp.																				•																
	Eragrostis curvula *																				•																
	Eragrostis microcarpa		•																																		
	Hordeum distichon *																																				
	Hordeum leporinum *	•				•				•	•	•	•	•	•		•	•	•	•		•										•		•	•	•	
	Lachnagrostis filiformis																													•							
	Lolium rigidum *	•	•	•		•			•	•		•		•	•	•	•	•	•	•	•	•	•									•	•	•	•	•	
	Microlaena stipoides																											•			•						•
	Phalaris aquatica *																																				
	Phalaris sp. *																				•	•															
	Phragmites australis	•																				•															
	Poa sp. [TSC]																																				
	Polypogon monspeliensis *																			•		•															
	Vulpia ciliata *		•			•							•	•	•	•				•			•		•				•		•	•	•	•		•	•
Polygonaceae	*Polygonum aviculare* *											•	•								•																
	Rumex brownii [TSC]				•					•			•	•	•					•		•	•		•	•						•		•			
	Rumex crispus *																				•																
Proteaceae	*Grevillea floribunda*																														•						•
	Grevillea robusta																																				
	Persoonia curvifolia																														•						
Ranunculaceae	*Ranunculus sceleratus* *																																				
Rosaceae	*Acaena echinata*																				•																
	Rosa rubiginosa *																					•															
Rubiaceae	*Asperula conferta* [EPBC, TSC]																																				
	Galium aparine *												•																•								
	Opercularia hispida																										•		•								•

Family name	Scientific name [1]	Vegetation survey site ID																																	
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
Rutaceae	*Geijera parviflora* [TSC]																																		•		
Salicaceae	*Salix babylonica* *	•																				•															
	Salix nigra *																					•															
Santalaceae	*Exocarpos cupressiformis* [EPBC,]																													•							
	Santalum acuminatum																																		•		
	Santalum lanceolatum																																				
Sapindaceae	*Dodonaea boroniifolia*																																	•			
	Dodonaea truncatiales								•																												
	Dodonaea viscosa [TSC]																																		•		
	Dodonaea viscosa ssp. angustifolia																																		•		
	Dodonaea viscosa ssp. spatulata [TSC]																												•						•		
Scrophulariaceae	*Orobanche minor* *																						•														
	Verbascum thapsus *																																				
	Veronica plebeia																													•							
Simaroubaceae	*Ailanthus altissima* *	•																																			
Solanaceae	*Lycium ferocissimum* *			•																																	
	Nicotiana glauca *																																				
	Solanum cinereum																	•																•			
	Solanum nigrum *																															•					
Stackhousiaceae	*Stackhousia viminea* [TSC]		•																				•		•												
Sterculiaceae	*Brachychiton populneus ssp. populneus* [EPBC]				•	•		•	•							•						•		•							•		•	•			
Thymelaeaceae	*Pimelea linifolia*																														•						•
Typhaceae	*Typha domingensis*																																				
	Typha orientalis	•																																			
Urticaceae	*Urtica incisa*													•								•															
Verbenaceae	*Verbena bonariensis* *	•																														•					
Violaceae	*Hybanthus monopetalus*															•																					
Xanthorrhoeaceae	*Xanthorrhoea sp.*																											•									
Zamiaceae	*Macrozamia communis*																											•									
Total Number of spp.	**250**	24	30	25	6	25	11	7	32	21	9	14	25	17	19	36	7	25	22	16	50	31	31	13	32	26	16	19	25	29						

Family name	Scientific name [1]	Vegetation survey site ID																																		
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036
Number of natives	**182**								7	21	18	3	17	5	2	24	8	3	5	12	7	8	22	1	15	13	7	28	9	20	11	28	23	16	19	23	25
% of species native	**73**								29	70	72	50	68	45	29	75	38	33	36	48	41	42	61	14	60	59	44	56	29	65	85	88	88	100	100	92	86
Number of weeds	**68**								17	9	7	3	8	6	5	8	13	6	9	13	10	11	14	6	10	9	9	22	22	11	2	4	3	0	0	2	4
Number of EPBC Important spp.	**23**								1	1	2	0	5	1	0	4	1	0	0	1	1	2	4	0	2	2	2	5	0	3	0	4	3	3	3	3	7
Number of Box Gum species as per TSC Act determination	**45**								1	10	6	3	7	3	2	6	7	1	3	8	3	6	8	1	5	4	4	11	3	9	4	10	8	4	4	7	6

Notes: * non-endemic and exotic species

EPBC = 'Important' White Box, Yellow Box, Blakely's Red Gum Woodland species as identified in the EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands (Department of the Environment and Heritage 2006).

TSC = characteristic White Box, Yellow Box, Blakely's Red Gum Woodland species identified by the NSW Threatened Species and Conservation Act 1995 determination for the Endangered Ecological Community listing

Table A-3 Species of plant recorded within each vegetation sample site

Community		Number of species					% cover of in under-storey weeds	Large trees (present / absent)	Canopy cover (%)	Recruitment	Ground cover (%)				
		total	native	% native	weeds	% weeds					vegetation	organic litter	fallen timber	rocks	bare soil
Box Gum Woodland 21 sites	mean	21	12	51	9	49	67	76	13	38	26	43	5	9	18
	min	6	1	14	3	25	10	0	3	0	3	10	0	0	0
	max	50	28	75	22	86	99	100	25	100	80	85	20	60	70
Fuzzy Box Woodland 3 sites	mean	32	24	74	8	26	65	100	28	100	39	49	2	0	10
	min	21	15	71	6	23	40	100	25	100	18	28	2	0	10
	max	43	33	77	10	29	90	100	30	100	60	70	2	0	10
River Red Gum 3 sites	mean	34	13	35	21	65	65	100	13	67	79	8	3	3	6
	min	24	7	29	17	53	40	100	10	0	75	5	2	0	2
	max	47	22	47	25	71	90	100	20	100	83	10	5	10	10
Ironbark / Black Cyprus Pine Woodland 5 sites	mean	24	22	94	2	6	13	100	30	80	24	54	9	3	11
	min	16	16	88	0	0	0	100	10	0	5	8	2	0	0
	max	32	28	100	4	13	50	100	50	100	80	75	15	5	40
Tumbledown red Gum and Dyers Red Gum Woodland 3 sites	mean	26	19	77	7	23	8	67	33	100	22	24	6	17	32
	min	13	11	61	2	14	5	0	25	100	5	3	2	0	5
	max	36	25	86	14	39	10	100	50	100	40	60	10	40	80
Red Stringybark Woodland 2 sites	mean	31	29	93	2	7	8	0	25	100	28	60	8	0	5
	min	28	25	89	1	3	5	0	20	100	25	55	5	0	0
	max	34	33	97	3	11	10	0	30	100	30	65	10	0	10

Attachment A references

Department of the Environment and Heritage (2006) EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands. In. (Department of the Environment and Heritage)

Attachment B

Species of animal recorded in the study area

Attachment B Animals recorded in the study area

This appendix details the animals recorded during current field surveys of the study area.

Table B-1 Species of animal recorded in the study area

Common name	Scientific name	Wellington to Obley Road	Obley Road to Alectown west Gas Station	TSC Act[1]	EPBC Act[2]
Frogs					
Broad-palmed Frog	*Litoria latopalmata*		•		
Peron's Tree Frog	*Litoria peronii*	•	•		
Giant Banjo Frog	*Limnodynastes interioris*		•		
Desert Tree Frog	*Litoria rubella*		•		
Native Birds					
Spotted Harrier	*Circus assimilis*	•			M
Wedge-tailed Eagle	*Aquila audax*	•	•		M
Whistling Kite	*Haliastur sphenurus*	•			M
Azure Kingfisher	*Alcedo azurea*	•			
Australian Wood Duck	*Chenonetta jubata*	•	•		M
Black Swan	*Cygnus atratus*	•			M
Blue-billed Duck	*Oxyura australis*	•		V	M
Grey Teal	*Anas gracilis*	•	•		M
Pacific Black Duck	*Anas superciliosa*	•	•		M
Darter	*Anhinga melanogaster*	•	•		
White-faced Heron	*Egretta novaehollandiae*	•	•		
Australian Magpie	*Gymnorhina tibicen*	•	•		
Dusky Woodswallow	*Artamus cyanopterus*	•			
Grey Butcherbird	*Cracticus torquatus*	•			
Pied Butcherbird	*Cracticus nigrogularis*	•	•		
Pied Currawong	*Strepera graculina*	•			
White-breasted Woodswallow	*Artamus leucorhynchus*	•	•		
Cockatiel	*Nymphicus hollandicus*	•	•		
Galah	*Cacatua roseicapilla*	•	•		
Little Corella	*Cacatua sanguinea*	•			
Long-billed Corella	*Cacatua tenuirostris*	•			
Sulphur-crested Cockatoo	*Cacatua galerita*	•	•		
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	•	•		
White-winged Triller	*Lalage sueurii*	•			

Common name	Scientific name	Wellington to Obley Road	Obley Road to Alectown west Gas Station	TSC Act[1]	EPBC Act[2]
Emu	*Dromaius novaehollandiae*	•	•		
Black-fronted Dotterel	*Elseyornis melanops*	•	•		M
Masked Lapwing	*Vanellus miles*	•	•		M
Brown Treecreeper	*Climacteris picumnus*	•	•	V	
White-throated Treecreeper	*Cormobates leucophaeus*	•	•		
Common Bronzewing	*Phaps chalcoptera*	•	•		
Crested Pigeon	*Ocyphaps lophotes*	•	•		
Peaceful Dove	*Geopelia striata*	•	•		
Dollarbird	*Eurystomus orientalis*	•	•		
Apostlebird	*Struthidea cinerea*	•	•		
White-winged Chough	*Corcorax melanorhamphos*	•	•		
Australian Raven	*Corvus coronoides*	•	•		
Little Raven	*Corvus mellori*		•		
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	•	•		
Pallid Cuckoo	*Cuculus pallidus*	•			
Mistletoebird	*Dicaeum hirundinaceum*	•			
Grey Fantail	*Rhipidura fuliginosa*	•	•		
Magpie-lark	*Grallina cyanoleuca*	•	•		
Rufous Fantail	*Rhipidura rufifrons*	•	•		M
Willie Wagtail	*Rhipidura leucophrys*	•	•		
Australian Hobby	*Falco longipennis*	•			M
Brown Falcon	*Falco berigora*	•			M
Grey Falcon	*Falco hypoleucos*		•	V	
Nankeen Kestrel	*Falco cenchroides*	•	•		M
Laughing Kookaburra	*Dacelo novaeguineae*	•	•		
Sacred Kingfisher	*Todiramphus sanctus*	•			
Fairy Martin	*Hirundo ariel*	•			
Tree Martin	*Hirundo nigricans*	•			
Welcome Swallow	*Hirundo neoxena*	•	•		
Superb Fairy-wren	*Malurus cyaneus*	•	•		
Blue-faced Honeyeater	*Entomyzon cyanotis*	•	•		
Brown Honeyeater	*Lichmera indistincta*	•			
Brown-headed Honeyeater	*Melithreptus brevirostris*	•			
Crimson Chat	*Epthianura tricolor*	•			

Common name	Scientific name	Wellington to Obley Road	Obley Road to Alectown west Gas Station	TSC Act[1]	EPBC Act[2]
Little Friarbird	*Philemon citreogularis*	•	•		
Noisy Friarbird	*Philemon corniculatus*	•	•		
Noisy Miner	*Manorina melanocephala*	•	•		
Red Wattlebird	*Anthochaera carunculata*	•	•		
Striped Honeyeater	*Plectorhyncha lanceolata*	•	•		
White-eared Honeyeater	*Lichenostomus leucotis*	•	•		
White-plumed Honeyeater	*Lichenostomus penicillatus*	•	•		
Yellow-faced Honeyeater	*Lichenostomus chrysops*	•	•		
Yellow-tufted Honeyeater	*Lichenostomus melanops*		•		M
Rainbow Bee-eater	*Merops ornatus*	•	•		M
Richard's Pipit	*Anthus novaeseelandiae*	•	•		
Brown Songlark	*Cinclorhamphus cruralis*	•			M
Clamorous Reed-Warbler	*Acrocephalus stentoreus*	•			M
Crested Shrike-tit	*Falcunculus frontatus*	•			M
Grey Shrike-thrush	*Colluricincla harmonica*	•	•		
Rufous Whistler	*Pachycephala rufiventris*	•	•		
Brown Thornbill	*Acanthiza pusilla*	•			
Buff-rumped Thornbill	*Acanthiza reguloides*		•		
Speckled Warbler	*Pyrrholaemus sagittatus*	•	•	V	
Spotted Pardalote	*Pardalotus punctatus*	•	•		
Striated Pardalote	*Pardalotus striatus*		•		
Western Gerygone	*Gerygone fusca*	•	•		
White-throated Gerygone	*Gerygone olivacea*	•	•		
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		•		
Diamond Firetail	*Stagonopleura guttata*		•	V	
Red-browed Finch	*Neochmia temporalis*	•	•		
Eastern Yellow Robin	*Eopsaltria australis*	•	•		
Hooded Robin	*Melanodryas cucullata*	•	•	V	
Jacky Winter	*Microeca fascinans*	•	•		
Red-capped Robin	*Petroica goodenovii*		•		
Little Pied Cormorant	*Phalacrocorax melanoleucos*	•	•		

Common name	Scientific name	Wellington to Obley Road	Obley Road to Alectown west Gas Station	TSC Act[1]	EPBC Act[2]
Pied Cormorant	*Phalacrocorax varius*	•	•		
Tawny Frogmouth	*Podargus strigoides*	•	•		
Australasian Grebe	*Tachybaptus novaehollandiae*		•		
Grey-crowned Babbler	*Pomatostomus temporalis*	•	•	V	
White-browed Babbler	*Pomatostomus superciliosus*		•		
Australian King-Parrot	*Alisterus scapularis*	•	•		
Blue Bonnet	*Northiella haematogaster*	•			
Crimson Rosella	*Platycercus elegans*	•			
Eastern Rosella	*Platycercus eximius*	•	•		
Red-rumped Parrot	*Psephotus haematonotus*	•	•		
Superb Parrot	*Polytelis swainsonii*	•		V	V
Dusky Moorhen	*Gallinula tenebrosa*	•			
Powerful Owl	*Ninox strenua*	•		V	
Southern Boobook	*Ninox novaeseelandiae*	•			
Australian White Ibis	*Threskiornis molucca*	•	•		
Straw-necked Ibis	*Threskiornis spinicollis*	•	•		
Barn Owl	*Tyto alba*	•			
Introduced Birds					
European Goldfinch	*Carduelis carduelis*	•	•		
Common Blackbird	*Turdus merula*	•	•	M	
House Sparrow	*Passer domesticus*	•	•		
Common Myna	*Acridotheres tristis*	•	•		
Common Starling	*Sturnus vulgaris*	•	•		
Native Mammals					
Yellow-footed Antechinus	*Antechinus flavipes*		•		
Eastern Grey Kangaroo	*Macropus giganteus*	•	•		
Red-necked Wallaby	*Macropus rufogriseus*	•			
Swamp Wallaby	*Wallabia bicolor*	•	•		
Little Mastiff-bat	*Mormopterus planiceps*	•			
Common Ringtail Possum	*Pseudocheirus peregrinus*	•	•		
Common Brushtail Possum	*Trichosurus vulpecula*	•	•		
Chocolate Wattled Bat	*Chalinolobus morio*		•		
Gould's Wattled Bat	*Chalinolobus gouldii*	•	•		

Common name	Scientific name	Wellington to Obley Road	Obley Road to Alectown west Gas Station	TSC Act[1]	EPBC Act[2]
Little Pied Bat	*Chalinolobus picatus*	•	•	V	
Gould's Long-eared Bat	*Nyctophilus gouldi*		•		
Greater Long-eared Bat	*Nyctophilus timoriensis*		•	V	V
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	•	•		
Little Forest Bat	*Vespadelus vulturnus*	•	•		
Inland Broadnosed Bat	*Scotorepans balstoni*	•	•		
Little Broad-nosed bat	*Scotorepans greyii*	•	•		
Greater Broad-nosed Bat	*Scotorepans ruepellii*	•	•		
Inland Freetail Bat	*Mormopterus sp 3*	•	•		
Southern freetail Bat	*Mormopterus sp 4*	•	•		
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	•	•	V	
Introduced Mammals					
Goat (feral)	*Capra hircus*		•		
Fox	*Vulpes vulpes*	•	•		
Cat (feral)	*Felis catus*	•	•		
Rabbit	*Oryctolagus cuniculus*	•	•		
Reptiles					
Bearded Dragon	*Pogona barbata*	•	•		
Eastern Long-necked Tortoise	*Chelodina longicollis*		•		
Eastern Brown Snake	*Pseudonaja textilis*	•	•		
King Brown Snake	*Pseudechis australis*		•		
Stone Gecko	*Diplodactylus vittatus*		•		
Carnaby's Wall Skink	*Cryptoblepharus carnabyi*		•		
Eastern Blue-tongued Lizard	*Tiliqua scincoides*	•	•		
Grey's Skink	*Menetia greyii*	•			
Shingleback	*Trachydosaurus rugosus*	•	•		
Striped Skink	*Ctenotus robustus*	•	•		
White's Skink	*Egernia whitii*	•	•		
Lace Monitor	*Varanus varius*	•			
	Lerista punctatovittata	•			
	Gehyra variegata	•			
Rainbow Skink	*Carlia tetradactyla*	•			
	Ctenotus ingrami	•			

1 V= Vulnerable (*Threatened Species Conservation Act* 1995)

2. E= Endangered, M= Migratory, V= Vulnerable (*Environment Protection and Biodiversity Conservation Act 1999*)

Attachment C

Threatened species of plant

Attachment C: Threatened plants in the local area

This appendix details the Threatened species of plant that have either been recorded in the local area based on records from the Department of Conservation and Climate Change *Atlas of NSW Wildlife* (Department of Environment and Climate Change 2007a, data acquired on the 13 November 2007). Threatened species that have predicted habitat within the study area were also considered based on records from the Department of the Environment and Water Resources *EPBC Protected Matters Search Tool* (Accad, Neldner *et al.* 2006; Department of the Environment and Water Resources 2007, data acquired on the 25 October 2007) and Department of Conservation and Climate Change combined geographic and habitat search (Department of Environment and Climate Change 2007c) for the Upper Slopes subregion of the Central West Catchment Management Authority area.

Table C-1 Threatened species of plant recorded or predicted to occur in the locality

Family Name	Scientific name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Records within locality	Likelihood of occurrence
Asclepiadaceae	*Tylophora linearis*	E1	E	3E	Grows in dry scrub in the Barraba, Mendooran, Temora and West Wyalong districts, in the NWS, Central Western Slopes botanical subdivisions (Royal Botanic Gardens 2005). Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa*, *E. sideroxylon*, *E. albens*, *Callitris endlicheri*, *C. glaucophylla* and *Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides*, *A. lineata*, *Myoporum species* and *Casuarina species* (Department of Environment and Conservation 2005).	Predicted habitat only (EPBC)	**Moderate** The study area is located within the known range of the species and the woodlands and forests traversed by the pipeline in the Hervey Ranges are dominated by species with which the species is known to occur – specifically in association with the Ironbark, Black Cypress Pine Open Forest, Tumbledown Red Gum, Dwyer's Red Gum Woodland and Red Ironbark, Red Stringybark Woodland. No records of the species were identified within the study area, including Goobang National Park which has targeted broad flora surveys (Porteners 1997).

Family Name	Scientific name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Records within locality	Likelihood of occurrence
Asteraceae	*Ammobium craspedioides*	V	V	2V	Found from near Crookwell on the Southern Tablelands to near Wagga Wagga on the South Western Slopes. Most populations are in the Yass region. Found in dry forest, Box-Gum Woodland and secondary grassland derived from clearing of these communities. Grows in association with a large range of eucalypts (*Eucalyptus blakelyi*, *E. bridgesiana, E. dives, E. goniocalyx, E. macrorhyncha, E. mannifera, E. melliodora, E. polyanthemos, E. rubida*). Apparently unaffected by light grazing, as populations persist in some grazed sites (Department of Environment and Conservation 2005).	Predicted habitat only (TSC)	**Low** The study area is not within the known range of the species.
Fabaceae (Faboideae)	*Swainsona recta*	E1	E	3Ei	Found in grassland and open woodland dominated by *E. blakelyi*, *E. melliodora*, *E. rubida* and *E. goniocalyx*., often on stony hillsides (Department of Environment and Climate Change 2007c; Royal Botanic Gardens 2004). Essential habitat for the species is forb rich grassy groundlayer (Department of Environment and Climate Change 2007c)	5	**Moderate** No Swainsona recta were recorded in the subject site. The known records of the species in the locality are located in Catombal Range that is avoided by the proposal route. However areas of species rich White Box, Yellow Box, Blakely's Red Gum grassy woodlands and Fuzzy Box Woodland have been considered as potential habitat for this species.
	Swainsona sericea	V			Grows in grassland and eucalypt woodland (Royal Botanic Gardens 2004). Found in Natural Temperate Grassland and Snow Gum *Eucalyptus pauciflora* Woodland on the Monaro; Box-Gum Woodland in the Southern Tablelands and South West Slopes; in association with *Callitris* spp. (Royal Botanic Gardens 2007); and a range of habitat in Victoria including Semi-arid Sand Dune Hummock Pine Woodland and heavy, cracking clays on gilgai puffs (Department of Sustainability and Environment 2000).	Predicted habitat only (TSC)	**Moderate** The study area is within the known range of the species and the study area traverses several patches of Grassy Woodlands. The species is however, only likely to occur within the patches with native dominated groundcovers. Suitable habitat is specifically associated with the areas of White Box, Yellow Box, Blakely's Wood Gum Woodland and Fuzzy Box Woodland that are of suitable quality to quality as endangered ecological communities.

Family Name	Scientific name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Records within locality	Likelihood of occurrence
Goodeniaceae	*Goodenia macbarronii*	V	V	3V	Occurs south from Guyra and Inverell districts where it grows in damp sandy soils (Royal Botanic Gardens 2004). It grows in damp sandy soils in seepages. The species is usually found in shaded, seasonally damp sites in clay-loam, sandy-loam and sandy soils. Habitats in NSW include a recently graded roadside drain adjacent to *Eucalyptus crebr*a and *Callitris glaucophylla* woodland, dry eucalypt forest with low shrubby undergrowth in sandy soil, damp sandy patches in bushland areas, along roadsides, near water in a shallow excavation which has exposed the clay subsoil, on the banks of a sandy creek and in *Eucalyptus blakelyi* and *Angophora floribunda* woodland. Sites often have some form of recent disturbance, such as depressions made by grading and excavation along roadsides. Other sites include grazed paddocks and clearings with a large proportion of weed and exotic species, and cleared open grazing land which was formerly eucalypt woodland (Department of Environment and Conservation 2005).	3	**Low** No suitable habitat of sandy soils were identified in the study area.
Orchidaceae	*Caladenia arenaria*	E	E1	E	Grows in sclerophyll forest and on sandhills, usually under Callitris; south from Mudgee district. *Caladenia arenaria* is currently only known to occur in the Riverina between Urana and Narranderra.	1	**Low** No sand hill habitats are located within the study area and although a previous record exists, the study area is beyond the current known extent of the species. The record from within the study area dates to 1980.

Family Name	Scientific name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Records within locality	Likelihood of occurrence
	Diuris tricolor	V	V	3K	Grows in sclerophyll forest among grass, often with Callitris (Royal Botanic Gardens 2005), or in grassy Callitris woodland (Bishop 2000; Royal Botanic Gardens 2007). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in *E. poplunea* community in western NSW. Soils include gritty orange-brown loam on granite, shallow red loamy sand on stony porphyry, skeletal lateritic soil and alluvial grey silty loam. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats (Royal Botanic Gardens 2007). Usually recorded as common and locally frequent in populations.	Predicted habitat only (EPBC)	**Low**. Potential to occur over a large range and in various communities and soils types. However, usually occurs in recorded as common and locally frequent in populations (Department of Environment and Climate Change 2007c) which are likely to have been recorded previously. Unlikely to occur in the highly modified cropped sites. Suitable habitat would be associated with the sites that have been grazed, however not routinely cropped, where a range of native species persist in the ground cover such as the woodlands in the Hervey Ranges: and the Box Gum and Fuzzy Box Woodlands in road reserves.
	Prasophyllum petilum	E1	E	2E	Known from two sites in the NSW Southern Tabellands at Boorowa and Captains Flat. Also at Hall in the Australian Capital Territory. Grows in open sites within Natural Temperate Grassland at the Boorowa site. Also grows in grassy woodland in association with River Tussock *Poa labillardieri, E. aggregata* and *Leptospermum* spp. at Captains Flat and within the grassy groundlayer of Box-Gum Woodland at Hall. Highly susceptible to grazing (Department of Environment and Climate Change 2007c).	Predicted habitat only (TSC)	**Low**. The study area is not within the known range of the species.

Family Name	Scientific name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Records within locality	Likelihood of occurrence
Poaceae	*Austrostipa wakoolica*	E1		2E	Grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils; habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine forest on low sandy range; and a low, rocky rise. Associated species include *Callitris glaucophylla, E. microcarpa, E. populnea, A. drummondii, Austrodanthonia spp.* and *Einadia nutans* (Department of Environment and Conservation 2005). The population appears to be centred between Parks, West Wylong, Tullibigeal and Tulliamore with some addition records to the south (Department of Environment and Climate Change 2007b)	Predicted habitat only (EPBC)	**Low**. The known extent of the populations does not extend into the study area, however suitable habitat associated occurs in the Hervey Ranges and Box Gum and Fuzzy Box Woodlands in road reserves where a moderate diversity of native species occur in the ground cover. Unlikely to occur in heavily grazed or routinely grazed paddocks.
Rutaceae	*Philotheca ericifolia*	V	V	3R	Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies, in the upper Hunter Valley and Pilliga to Peak Hill district (Royal Botanic Gardens 2004). It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include *Melaleuca uncinata*, *Eucalyptus crebra*, *E. rossii*, *E. punctata*, *Corymbia trachyphloia*, *Acacia triptera*, *A. burrowii, Beyeria viscosa, Philotheca australis, Leucopogon muticus* and *Calytrix tetragona*. Noted as being a moisture-loving plant, with plants common on the sides of a particular spur of the Hervey Ranges where soakage from the high background provides sufficient moisture for the plants (Department of Environment and Conservation 2005).	4	**Low**. The proposed route is traverses Hervey Range through a saddle between two north south orientated spurs and the spur that *Philotheca ericifolia* is known to occur is located to the north of the alignment. No areas of equivalent habitat are traversed by the proposal.

Family Name	Scientific name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Records within locality	Likelihood of occurrence
Rutaceae	*Zieria obcordata*	E1	E	3E	Occurs near Wellington and Bathurst where it grows on rocky hillsides in eucalypt woodland or shrubland dominated by species of Acacia (Harden, 2002). Extremely sensitive to grazing and browsing disturbances by domestic stock and native herbivores (Department of Environment and Climate Change 2007c).	4	**Low**. Known records of the species are located to the east of the study area all habitats traversed at the eastern end of the proposal are heavily grazed or cropped and support low diversity of native species.
Sterculiaceae	*Rulingia procumbens*	V	V	3V	Rarely found species that occurs in sandy sites mainly confined to the Dubbo - Mendooran - Gilgandra region, also in Pilliga and Nymagee areas (Royal Botanic Gardens 2004).	Predicted habitat only (EPBC)	**Low**. The known range of the species occurs ceases approximately 100km north of the study area.

1) V= Vulnerable, E1 = Endangered (*Threatened Species Conservation Act 1995*)

2) V = Vulnerable, E = Endangered (*Environment Protection and Biodiversity Conservation Act 1999*)

3) ROTAP (Rare or Threatened Australian Plants, Briggs and Leigh 1996) is a conservation rating for Australian plants. Codes are:

1	Species only known from one collection
2	Species with a geographic range of less than 100km in Australia
3	Species with a geographic range of more than 100km in Australia
X	Species presumed extinct; no new collections for at least 50 years
E	Endangered species at risk of disappearing from the wild state if present land use and other causal factors continue to operate
V	Vulnerable species at risk of long-term disappearance through continued depletion.
R	Rare, but not currently considered to be endangered.
K	Poorly known species that are suspected to be threatened.
C	Known to be represented within a conserved area.
a	At least 1,000 plants are known to occur within a conservation reserve(s).
i	Less than 1,000 plants are known to occur within a conservation reserve(s).
-	The reserved population size is unknown.

Appendix C references

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Attachment D

Threatened species of animal within the locality

Attachment D: Threatened animal in the local area

This appendix details the Threatened species of animal that have either been recorded in the local area based on records from the Department of Conservation and Climate Change *Atlas of NSW Wildlife* (Department of Environment and Climate Change 2007a, data acquired on the 13 November 2007). Threatened species that have predicted habitat within the study area were also considered based on records from the Department of the Environment and Water Resources *EPBC Protected Matters Search Tool* (Department of the Environment and Water Resources 2007, data acquired on the 25 October 2007) and Department of Conservation and Climate Change combined geographic and habitat search (Department of Environment and Climate Change 2007b) for the Upper Slopes subregion of the Central West Catchment Management Authority area.

Table D-1 Threatened species of animal previously recorded or predicted to occur in the study area

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
Birds					
Bush Stone-curlew *Burhinus grallarius*	E1		Require sparsely grassed, lightly timbered, open forest of woodland. In southern Australia they often occur where there is a well structured litter layer and fallen timber debris. Feed on a range of invertebrates and small vertebrates, as well as seeds and shoots (NSW National Parks and Wildlife Service 1999a, 2003a).	Predicted habitat only (TSC)	Yes. Suitable habitat for this species exists within the study area.
Major Mitchell's Cockatoo *Cacatua leadbeateri*	V		Generally found in western New South Wales in the Murray Basin. Occurs in arid and semi-arid zone woodlands dominated by Mulga, mallee, box eucalypts and callitris pine where it feeds on seeds, roots and fruit. The main requirement of this species is trees with suitable nesting hollows and fresh surface water (Garnett & Crowley 2000).	1	No. Considered to be only a sporadic visitor.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	V		Occurs in eucalypt woodland and forest with *Casuarina/Allocasuarina* spp. Characteristically inhabits forests on sites with low soil nutrient status, reflecting the distribution of key *Allocasuarina* species. The drier forest types with intact and less rugged landscapes are preferred by the species. Nests in tree hollows (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 1999b).	21	Yes. Suitable foraging resources including Casuarina feed trees were recorded along the edges of the Macquarie River and as isolated paddock trees within the study area.
Brown Treecreeper *Climacteris picumnus*	V		Occurs in eucalypt woodland and adjoining vegetation. Feeds on ants, beetles and larvae on trees and from fallen timber and leaf litter. Usually nests in hollows (Garnett & Crowley 2000).	19	Yes. This species was recorded in woodland habitat within the study area.

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
Grey Falcon *Falco hypoleucos*	V	M	Generally centred on inland drainage systems where the average rainfall is less than 500 millimetres. It is found in timbered lowland plains that are crossed by tree-lined water courses. Nests in the old nests of other birds, particularly raptors (Garnett & Crowley 2000).	Predicted habitat only (TSC)	Yes. This species was recorded in cleared agricultural lands in the study area.
Malleefowl *Leipoa ocellata*	E1	VM	Ground-dwelling bird found in mallee woodland and other dry scrub in the semi-arid zone of inland Australia. Restricted to semi-arid rangelands and small habitat remnants in the dry land cropping zone of the southwest and centre of NSW. Prefers well drained, light sandy or loamy soils. Habitat usually contains dense but discontinuous canopy which provides abundant leaf litter and dense, varied shrub and herb layers containing food plants, particularly acacia, cassia, bassiaea, beyeria and some open ground for ease of movement (NSW National Parks and Wildlife Service 1999c).	1	No. This species including nesting areas were not recorded during the current survey. The last known record of this species within Goobang National Park was in 1949.
Hooded Robin *Melanodryas cucullata*	V		Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrub land. This is one of a suite of species that has declined in woodland areas in south-eastern Australia (Garnett & Crowley 2000; Traill & Duncan 2000).	4	Yes. Suitable foraging habitat occurs with open forest and woodlands within the study area.
Black-chinned Honeyeater *Melithreptus gularis gularis*	V		Found in dry eucalypt woodland particularly those containing ironbark and box. Occurs within areas of annual rainfall between 400-700 mm. Feed on insects, nectar and lerps (Garnett & Crowley 2000).	1	Yes. Suitable foraging habitat occurs with open forest and woodlands within the study area.
Turquoise Parrot *Neophema pulchella*	V		Occurs in the foothills of the great dividing range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey. Nests in hollows in trees, stumps or even fence posts. It feeds on seeds of both native and introduced grass and herb species (Garnett & Crowley 2000).	4	Yes. Suitable foraging habitat occurs with open forest and woodlands within the study area.
Barking Owl *Ninox connivens*	V		Occurs in dry sclerophyll woodland. In the south west it is often associated with riparian vegetation while in the south east it generally occurs on forest edges. It nests in large hollows in live eucalypts, often near open country. It feeds on insects in the non-breeding season and on birds and mammals in the breeding season (Garnett & Crowley 2000).	1	Yes. Suitable nesting and foraging habitat occurs with open forest /woodlands and riparian/riverine vegetation within the study area.

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
Blue-billed Duck *Oxyura australis*	V	M	Relatively sparse throughout species range. Regularly found breeding in south-east Queensland, north-east South Australia and throughout New South Wales. Found on temperate, fresh to saline, terrestrial wetlands, and occupies artifical wetlands. Prefers deep permanent open water, within or near dense vegetation. Nest in rushes, sedge, Lignum *Muehlenbeckia cunnighamii* and paperbark Melaleuca (Garnett & Crowley 2000).	Predicted habitat only (EPBC)	Yes. This species was recorded within the Macquarie River adjacent to the study area during the current survey.
Gilbert's Whistler *Pachycephala inornata*	V		The Gilbert's Whistler occurs in ranges, plains and foothills in arid and semi-arid timbered habitats. In NSW it occurs mostly in mallee shrubland, but also in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests. Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including acacias, hakeas, sennas and grevilleas. In woodland habitats, the understorey comprises dense patches of shrubs (Department of Environment and Conservation 2005).	Predicted habitat only (TSC)	Yes. Suitable habitat for this species occurs within box-ironbark woodland within the study area.
Osprey *Pandion haliaetus*	V	M	Generally a coastal species, occurring in estuaries, bays, inlets, islands and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Sometimes ascends larger rivers to far inland. Builds nests high in tree, on pylon or on ground on islands. Feeds on fish (Pizzey & Knight 1997).	Predicted habitat only (TSC)	No suitable habitat for this species was recorded.
Superb Parrot *Polytelis swainsonii*	V	V	Mainly found in the Riverina where they nest in loose colonies in riparian woodland on River Red Gum. On the inland slopes, Superb Parrots both forage and feed within box woodland, mostly nesting in dead trees (Garnett & Crowley 2000).	11	Yes. Suitable habitat for this species occurs within box woodland and riparian vegetation adjacent Macquarie River within the study area.
Grey-crowned Babbler *Pomatostomus temporalis*	V		Found throughout western slopes and plains, southern and central tablelands and occurring in Northern Rivers area, mid-north coast and the Hunter Valley of NSW. Lives in open forest and woodland, acacia shrub land and adjoining farmland. Large stick dome nest with spout-like entrance (Pizzey & Knight 1997).	4	Yes. This species was recorded during the current surveys.
Speckled Warbler *Pyrrholaemus sagittatus*	V		Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett & Crowley 2000).	17	Yes. This species was recorded during the current surveys.

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
Painted Snipe *Rostratula benghalensis*	E1	VM	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as *Eucalyptus camaldulensis* (River Red Gum), *E. populnea* (Poplar Box) or shrubs such as *Muehlenbeckia florulenta* (Lignum) or *Sarcocornia quinqueflora* (Samphire). Feeds at the water's edge and on mudlflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett & Crowley 2000).	Predicted habitat only (EPBC)	No suitable habitat for this species was recorded.
Diamond Firetail *Stagonopleura guttata*	V		Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feed on seeds, mostly of grasses (Garnett & Crowley 2000).	10	Yes. This species was recorded during the current surveys.
Freckled Duck *Stictonetta naevosa*	V	M	In most years this species appear to be nomadic between ephemeral inland wetlands. In dry years they congregate on permanent wetlands while in wet years they breed prolifically and disperse widely, generally towards the coast. In inland eastern Australia, they generally occur in brackish to hyposaline wetlands that are densely vegetated with Lignum (*Muehlenbeckia cunninghamii*) within which they build their nests (Garnett & Crowley 2000).	Predicted habitat only (TSC)	No. This species was last recorded within the Macquarie River in 1996, and was not recorded during the current survey.
Powerful Owl *(Ninox strenua*)	V		A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, casuarina or callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands (Garnett & Crowley 2000).	Predicted habitat (EPBC).	Yes. This species was recorded in Riparian habitat along Macquarie River.
Masked Owl *Tyto novaehollandiae*	V		Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known to occasionally roost and nest in caves (Garnett & Crowley 2000).	Predicted habitat only (TSC and EPBC)	Yes. Marginal foraging resources are present in the study area. Riparian/riverine vegetation may provide suitable nesting resources.

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
Regent Honeyeater *Xanthomyza phrygia*	E1	EM	Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with *Casuarina cunninghamiana* and *Amyema cambagei* are important for feeding and breeding. Important food trees include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box) , *E. melliodora* (Yellow Box) and *E. leucoxylon* (Yellow Gum) (Garnett & Crowley 2000).	Predicted habitat only (TSC)	Yes. Foraging habitats were available for this species
Fork-tailed Swift *Apus pacificus*		M	Breeds from central Siberia eastwards through Asia, and is migratory, wintering south to Australia. Individuals never settle voluntarily on the ground and spend most of their lives in the air, living on the insects they catch in their beaks (Higgins 1999).	Predicted habitat only (EPBC)	Habitat within the local area would not be considered 'important habitat' as defined under the EPBC Act.
Great Egret *Ardea alba*		M	Great Egrets occur throughout most of the world. They are common throughout Australia, with the exception of the most arid areas. Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups. In Australia, the breeding season of the Great Egret is normally October to December in the south and March to May in the north. This species breeds in colonies, and often in association with cormorants, ibises and other egrets. (Australian Museum 2003).	Predicted habitat only (EPBC)	Habitat within the local area would not be considered 'important habitat' as defined under the EPBC Act.
Cattle Egret *Ardea ibis*		M	Subsepecies *A. i. coromanda* is found across the Indian subcontinent and Asia as far north as Korea and Japan, and in South-east Asia, Papua New Guinea and Australia (McKilligan 2005).	Predicted habitat only (EPBC)	Habitat within the local area would not be considered 'important habitat' as defined under the EPBC Act.
Latham's Snipe *Gallinago hardwickii*		M	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed (Garnett & Crowley 2000).	Predicted habitat only (EPBC)	Habitat within the local area would not be considered 'important habitat' as defined under the EPBC Act.
White-bellied Sea-Eagle *Haliaeetus leucogaster*		M	Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs (Pizzey & Knight 1997).	Predicted habitat only (EPBC)	Habitat within the local area would not be considered 'important habitat' as defined under the EPBC Act.

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
White-throated Needletail *Hirundapus caudacutus*		M	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey & Knight 1997).	Predicted habitat only (EPBC)	Habitat within the local area would not be considered 'important habitat' as defined under the EPBC Act.
Rainbow Bee-eater *Merops ornatus*		M	Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings (Higgins 1999).	Predicted habitat only (EPBC)	Yes. This species was recorded during the current survey within the woodland and open paddock habitats within the study area Habitat within the local area would not be considered 'important habitat' as defined under the EPBC Act.
Mammals					
Eastern Pygmy-possum *Cercartetus nanus*	V		Found in a range of habitats from rainforest through sclerophyll forest to tree heath. It feeds largely on the nectar and pollen of banksias, eucalypts and bottlebrushes and sometimes soft fruits. It nests in very small tree holes, between the wood and bark of a tree, abandoned birds nests and shredded bark in the fork of trees (Turner & Ward 1995).	Predicted habitat only (TSC)	No. This species has not been previously recorded within the project locality.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 1998).	Predicted habitat only (TSC and EPBC)	Yes. Potential foraging habitat is available for this species. However no suitable breeding sites were observed within the study area.
Little Pied Bat *Chalinolobus picatus*	V		The species roosts in trees, caves, and abandoned mines and houses. Roost sites in caves are unusually warm and dry but they can tolerate roost temperatures of more than 40 degrees Celsius. The Little Pied Bat has been recorded in dry open forest, open woodland, Mulga woodlands, chenopod shrub lands, Callitris forest and mallee (Churchill 1998).	Predicted habitat only (TSC)	Yes. Potential foraging habitat is available for this species.

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
Spotted-tailed Quoll *Dasyurus maculatus*	V	E	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold (NSW National Parks and Wildlife Service 1999d). Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heath land, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods (NSW National Parks and Wildlife Service 1999e, 1999d).	Predicted habitat only (TSC and EPBC)	No. Much of the remnant vegetation in study area is too fragmented and distant from large patches of suitable habitat. There have been no records of this species within Goobang National Park. Therefore it is unlikely this species will use on site habitats on occasion.
Eastern Bent-wing Bat *Miniopterus schreibersii*	V	C	Usually found in well timbered valleys where it forages on small insects above the canopy. Roosts in caves, old mines, stormwater channels and sometimes buildings and often return to a particular nursery cave each year (Churchill 1998).	Predicted habitat only (TSC)	Yes. This species was recorded using an Anabat II Bat detector during the current survey. However no suitable breeding sites including caves/old mines were observed within the study area.
Large-footed Myotis *Myotis adversus*	V		Colonies occur in caves, mines, tunnels, under bridges and buildings. Colonies always occur close to bodies of water where this species feeds on aquatic insects (Churchill 1998).	Predicted habitat only (TSC)	Yes. Potential foraging habitat is available for this species. However no suitable breeding sites were observed within the study area.
Eastern Long-eared Bat *Nyctophilus bifax*	V	V	Occurs in a range of tropical habitats from rainforest to dry sclerophyll woodland and is often found in riparian vegetation. It catches prey in the air and also takes insects from foliage and the ground or other hard surfaces. It roosts in tree hollows and in the roofs of buildings (Strahan 1995).	Predicted habitat only (TSC)	No. Records of this species are confined to north-east New South Wales. This species has not been previously recorded within the project locality.
Greater Long-eared Bat *Nyctophilus timoriensis*	V	V	Roosts in tree hollows and under loose bark in arid and semi-arid Australia (Strahan 1995) and forages in the understorey of woodlands and open savannah and swamps (Churchill 1998).	Predicted habitat only (TSC)	Yes. This species was recorded during the current survey.
Squirrel Glider *Petaurus norfolcensis*	V		Found in dry sclerophyll forest and woodland but not found in dense coastal ranges. Nests in hollows and feeds on gum of acacias, eucalypt sap and invertebrates (NSW National Parks and Wildlife Service 1999f).	3	Yes. This species has been recorded within Goobang National Park and is likely to use on-site habitats on occasion.

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
Brush-tailed Rock-wallaby *Petrogale penicillata*	E1	V	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It has a preference for rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or "colonies" each usually separated by hundreds of metres (NSW National Parks and Wildlife Service 2003b).	Predicted habitat only (TSC and EPBC)	No suitable habitat for this species is present.
Koala *Phascolarctos cinereus*	V		Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Forest Red Gum *Eucalyptus tereticornis*, Grey Gum *E. punctata*, and Monkey Gum *E. cypellocarpa* and Ribbon Gum *E. viminalis*. In coastal areas, Tallowwood *E. microcorys* and Swamp Mahogany *E. robusta* are important food species, while in inland areas White Box *E. albens*, Bimble Box *E. populnea* and River Red Gum *E. camaldulensis* are favoured (NSW National Parks and Wildlife Service 1999g, 2003c).	2	Yes. Suitable eucalyptus feed trees were recorded adjacent Little creek.
Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*	V		Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be a migratory species (Churchill 1998).	Predicted habitat only (TSC)	Yes. Suitable foraging and breeding habitat is available for this species
Inland Forest Bat *Vespadelus baverstocki*	V		This species roosts in tree hollows and abandoned buildings. The single young is carried by its mother until its weight affects her flight, and is then left in the roost at night. Roosts in tree hollows and abandoned buildings. It has been recorded from a variety of woodland formations, including mallee, mulga and River Red Gum. Colony size ranges from a few individuals to more than fifty. Females congregate to raise young. These bats fly rapidly and cover an extensive foraging area (Churchill 1998).	Predicted habitat only (TSC)	No. Records of this species are confined to inland New South Wales (west of the study area). This species has not been previously recorded within the project locality.
Reptiles					
Pink-tailed Worm Lizard *Aprasia parapulchella*	V	V	Open areas with predominantly native grass understorey and rock outcrops scattered, partially buried rocks. Burrowing species usually found under rocks on well-drained soil and in any nests, occasionally with several individuals found under the same rock (Swan et al. 2004). Found under weathered granite rocks on a grazed, grassy riverside slope (Cogger 2000).	Predicted habitat only (TSC and EPBC)	No suitable habitat in the study area.

Common Name (Latin Name)	TSC Act[1]/ FM Act[2]	EPBC Act[3]	Habitat	Records within locality	Likelihood of occurrence
Little Whip Snake *Suta flagellum*	V		Secretive nocturnal snake found mostly in eucalypt woodland and associated grasslands, especially on stony hills, where it shelters under rocks and logs on soil in well-drained areas. Often in groups. Found in south-east NSW (Cogger 2000).	Predicted habitat only (TSC)	No suitable habitat in the study area.
Fish					
Trout Cod (*Maccullochella macquariensis*)	E	E	The trout cod is endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central New South Wales. This species is often found close to cover and in relatively fast currents, especially in fairly deep water close to the bank, and often congregate around snags (Department of Environment and Climate Change 2007b)	Predicted habitat only (TSC and EPBC)	Yes. Suitable habitat for this species occurs in the Macquarie River in the study area.
Murray Cod (*Maccullochella peelii peelii*)		V	It occurs naturally in the waterways of the Murray–Darling Basin in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs. The upper reaches of the Murray and Murrumbidgee Rivers are considered too cold to contain suitable habitat (Department of Environment and Climate Change 2007b).	Predicted habitat only (EPBC)	No suitable habitat in the study area.
Macquarie Perch (*Macquaria australasica*)	V	E	Macquarie perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven catchments. Macquarie perch are found in both river and lake habitats; especially the upper reaches of rivers and their tributaries (Department of Environment and Climate Change 2007b).	Predicted habitat only (TSC and EPBC)	No suitable habitat in the study area.
Silver Perch (*Bidyanus bidyanus*)	V		Silver perch were once widespread and abundant throughout most of the Murray-Darling river system. The most abundant remaining natural population occurs in the central Murray River downstream of Yarrawonga Weir as well as several of its anabranches and tributaries (including the Edward River, an anabranch of the Murray which flows through Deniliquin, and the Murrumbidgee River) (Department of Environment and Climate Change 2007b).	Predicted habitat only (TSC)	No suitable habitat in the study area.

Notes:

1. P= Protected, V= Vulnerable, E1 = Endangered, (*Threatened Species Conservation Act 1995*)

2. E = Endangered (*Fisheries Management Act 1994*)

2. V = Vulnerable, E = Endangered, M = Migratory, C = Conservation Dependent (*Environment Protection and Biodiversity Conservation Act 1999*)

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Significance assessments

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E1. Significance assessments

For threatened biodiversity listed under the *Threatened Species Conservation Act 1995*, this Attachment details the heads of consideration for Threatened species assessment as suggested in the draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005b). The guidelines present methods to consider the impacts on biodiversity of projects assessed under Part 3A of *the Environmental Planning and Assessment Act 1979,* including presenting heads of consideration for determining the significance of impacts.

For threatened biodiversity listed under the *Environment Protection and Biodiversity Conservation Act 1999* significance assessment have been completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of the Environment and Heritage 2006a).

Threatened biodiversity listed under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* have been assessed using both assessment guidelines separately.

Table E-1 provides a summary of the threatened biodiversity for which significance were completed. The following groups of species were assessed as groups because of their similarity of habitats, habits and potential impacts:

- woodland birds
- forest owls
- microchiropteran bats

Table E-1 Summary of threatened biodiversity for which significance assessments were done

Name	TSC Act[1]/ FM Act[2]	EPBC Act[3]
Threatened Ecological Communities		
White Box, Yellow Box, Blakely's Red Gum Woodland	E	
Fuzzy Box Woodland on alluvials of South West Slopes, Darling Riverine Plains & the Brigalow Belt South	E	
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		CE
Threatened plants to be inserted		
Tylophora linearis	E	E
Swainsona recta	E	E
Swainsona sericea	V	
Threatened animals		
Birds		
Brown Treecreeper (*Climacteris picumnus victoriae*)	V	
Hooded Robin (*Melanodryas cucullata*)	V	
Black-chinned Honeyeater (*Melithreptus gularis gularis*)	V	

Name	TSC Act[1]/ FM Act[2]	EPBC Act[3]
Gilbert's Whistler (*Pachycephala inornata*)	V	
Grey Crowned Babbler (*Pomatostomus temporalis*)	V	
Speckled Warbler (*Pyrrholaemus sagittatus*)	V	
Diamond Firetail (*Stagonopleura guttata*)	V	
Turquoise Parrot (*Neophema pulchella*)	V	
Regent Honeyeater (*Xanthomyza Phrygia*)	E1	EM
Superb Parrot (*Polytelis swainsonii*)	V	V
Bush-stone Curlew (*Burhinus grallarius*)	E1	
Glossy Black-cockatoo (*Calyptorhynchus lathami*)	V	
Powerful Owl (*Ninox strenua*)	V	
Masked Owl (*Tyto novaehollandiae*)	V	
Barking Owl (*Ninox connivens*)	V	
Grey Falcon (*Falco hypoleucos*)	V	
Blue-billed Duck (*Oxyura australis*)	V	
Mammals		
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V	V
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V	
Little Pied Bat (*Chalinolobus picatus*)	V	
Squirrel Glider (*Petaurus norfolcensis*)	V	
Koala (*Phascolarctos cinereus*)	V	
Fish		
Trout Cod (*Maccullochella macquariensis*)	E	E

Notes: 1. V= Vulnerable, E1 and E = Endangered, (*Threatened Species Conservation Act 1995*)

2. E = Endangered (*Fisheries Management Act 1994*)

3. V = Vulnerable, E = Endangered, M = Migratory, CE = Critically Endangered (*Environment Protection and Biodiversity Conservation Act 1999*)

E2. Box Gum Woodland

Box Gum Woodland is a common name given a range of vegetation communities dominated by various combination of Box Gums such as *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box), *E. microcarpa* (Grey Gum), *E. conica* (Fuzzy Box), *E. goniocalyx* (Long-leaved Box), *E. populnea* (Bimble Box) and *E. polyanthemos* (Red Box). Within these woodlands a different species may dominant and the transition from one community to another may be unclear. Non-Box Gum species may also co-dominate in association with these species.

Box-Gum Woodland occur in the tablelands and Western Slopes on a range of moderate to highly fertile soils of NSW from South East Queensland through NSW and into Victorian which have been extensively cleared for agricultural land uses (Department of the Environment and Heritage 2006b). As a result, Box Gum Woodlands have been listed as Threatened ecological communities under both the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*.

Within the study area, two broad Box Gum Woodland Types were delineated that correspond with Threatened ecological communities: those dominated by *Eucalyptus albens* and/or *E. melliodora* and those dominated by *E. conica* and co-dominated *E. melliodora.* Patches dominated by *Eucalyptus albens, E. melliodora* and/or *E. blakelyi* (Blakely's Red Gum) have been assessed under the following listings:

- White Box, Yellow Box, Blakely's Red Gum Woodland under the *Threatened Species Conservation Act 1995*
- White Box, Yellow Box, Blakely's Red Gum Woodland and Derived Grassland under the *Environment Protection and Biodiversity Conservation Act 1999* .

Patches dominated by *E. conica* and co-dominated *E. melliodora* have been assessed under the following listings:

- Fuzzy Box Woodland on alluvials of South West Slopes, Darling Riverine Plains & the Brigalow Belt South under the *Threatened Species Conservation Act 1995*
- White Box, Yellow Box, Blakely's Red Gum Woodland and Derived Grassland under the *Environment Protection and Biodiversity Conservation Act 1999*.

E2.1 White Box, Yellow Box, Blakely's Red Gum Woodland (as listed under the *Threatened Species Conservation Act 1995*)

White Box, Yellow Box, Blakely's Red Gum Woodland (Box Gum Woodland) is listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*. Under this listing, White Box, Yellow Box, Blakely's Red Gum Woodland is an open woodland community in which the most obvious species are one or more of the following: *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and/or *E. blakelyi* (Blakely's Red Gum). A range of other *Eucalyptus* species may also occur in the community.

Numerous patches of Box Gum Woodland dominated by the characteristic species of the endangered ecological community (*E. albens, E. melliodora* and *E. blakelyi*) were identified on the low ranges, rounded hills and alluvial plains in the study area. However, most of the patches in paddocks are highly modified by long term grazing and/or routine cropping, pasture improvement practices and incursion of weeds. As a result, natural regeneration in

these patches is unlikely and they do not qualify as the Endangered ecological community definition under the *Threatened Species Conservation Act 1995* (see Box Gum Woodland identification key in section 2.3.4of main report).

The patches of Box Gum Woodland in thin linear strips within the road corridors were modified by fragmentation, edge effects and weed intrusion from adjoining paddocks. Some of these patches, and two larger patches of Box Gum Woodland in paddocks between Hervey Range and Obley, possessed a natural soil profile and native seed bank, and the ground cover was dominated by a range of native grasses and herbs. These patches therefore quality as the White Box, Yellow Box, Blakely's Red Gum Woodland endangered ecological community as listed under the *Threatened Species Conservation Act 1995* (refer to Figure 4-1).

Several other patches of Box Gum Woodland were identified in the 1km buffer around the study area including the edges of the Catombal and Nangar Ranges, however these patches will not be traversed by the proposed pipeline.

E2.1.1 Significance Assessment - Environmental Planning and Assessment Act 1979

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

Not applicable to the assessment of endangered ecological communities.

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

The proposal traverses three patches of White Box, Yellow Box, Blakely's Red Gum Woodland within the study area,and is in close proximity to a fourth. These are located at (from west to east):

- large paddock patch south of Hervey Road between Hervey range and Obley Road
- adjacent to Little River (in close proximity only)
- within the road corridor in Obley Road
- within an unnamed road corridor to the west of the Molong Dubbo Railway line crossing point.

At each of the four patches where the pipeline traverses White Box, Yellow Box, Blakely's Red Gum Woodland, an alignment has been chosen to avoid the core or the patch and minimise the number of trees affected.

Construction of the pipeline however will require clearing of a 30 m corridor through these patches of Box Gum Woodland. At the large paddock patch south of Hervey Road, the route alignment has been selected to avoid the centre of the patch and predominantly cuts through a narrow point in the patch. Adjacent to Little River the alignment avoids the core of the patch and traverses along its edge amongst impacting only scattered paddock trees that do not correspond with the definition of the community. Finally, at the two road crossing points, the alignment is positioned perpendicular to the road to minimise the extent of the community impacted.

The total area that will be cleared within this community is 1.7 ha spread over three of the four patches identified along the subject site (while within the study area, the patch adjacent to Little River is not within the proposed subject site). This represents approximately 0.2 % of the predicted 949.3 ha of potential White Box, Yellow Box, Blakely's Red Gum Woodland identified within 1km of the pipeline (the predicted extent is likely to include patches of box gum woodland that do not qualify as the endangered ecological community).

These areas will be rehabilitated following construction of the pipeline,, however planting of large trees characteristic of the community above the pipeline will be unsuitable for safety reasons.

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

Not applicable to the assessment of endangered ecological communities.

How is the proposal likely to affect current disturbance regimes?

Remnants of this community within the study area have been highly modified by extensive clearing for agricultural land uses, grazing, fragmentation, isolation, edge effects and weed intrusion. In addition, these impacts have modified natural disturbance regimes in the regions such as the effects of wildfire.

Construction of the pipeline however will require clearing of 30m corridor through three patches of Box Gum Woodland, which will have a direct impact, and be a cause of disturbance, to the community.

The patches of Box Gum Woodland in the study area are generally small, or linear patches that are already largely exposed to edge effects. Based on existing edge effects extending up to 50m into each patch (Bali 2000), no new areas of this community will be exposed to new edge effects as a result of the proposal. The proposal is unlikely to significantly alter the microhabitat conditions such that it will result in the proliferation of weeds in an area where they do not already occur.

The proposal will not have an impact on the fire regime in the study area.

How is the proposal likely to affect habitat connectivity?

White Box, Yellow Box, Blakely's Red Gum Woodland in the region is highly fragmented as a result of extensive land clearing for agricultural land uses. As a result, the remaining patches of Box Gum Woodland are generally isolated from other patches of the community.

Construction of the pipeline will require clearing of a 30 m corridor that will intersect three of the four patches of White Box, Yellow Box, Blakely's Red Gum Woodland in the study area and result in the fragmentation of each of these patches into two separate patches. The effect of this fragmentation to habitat connectively however is likely to be small. The proposal is unlikely to form a barrier to ecological processes occurring across these patches (such as pollination and seed dispersal). Nor would a 30 m gap between patches form a barrier for the faunal species that are likely to be using these isolated patches of woodland, in conjunction with paddock trees, as stepping stones to move across the fragmented landscape.

In order to minimise fragmentation and impacts to habitat connectivity, the proposed alignment has been selected to traverse larger patches of vegetation at their narrowest

point, such as the large paddock patch south of Hervey Road, or where there the existing tree cover is thinner across the road corridor patches.

How is the proposal likely to affect critical habitat?

The Department of Environment and Climate Change maintains a register of critical habitat (Department of Environment and Climate Change 2007c). No critical habitat has been declared for White Box, Yellow Box, Blakely's Red Gum Woodland nor are the patches within the study area considered critical to the survival of the ecological community.

Conclusion

White Box, Yellow Box, Blakely's Red Gum Woodland is a endangered ecological community that has been extensively cleared as a result of its association with arable soils which have historic and current value as agricultural lands. As a result of the extensive clearing and associated agricultural land uses, Box Gum Woodlands have generally be reduced to small isolated patches of shade trees in paddock or narrow linear strips of vegetation within road corridors.

The small patches of Box Gum Woodlands within paddocks were highly modified as a result of routine cropping, grazing, pasture improvement and weed intrusion. As a result these patches generally had low native diversity, no recruitment of canopy trees and low likelihood of natural regeneration. As a result, patches in this condition did not qualify as the endangered ecological community as listed under the *Threatened Species Conservation Act 1995*.

Three patches of the community that qualify as the endangered ecological community as listed under the *Threatened Species Conservation Act 1995* will be traversed by the proposal. At these locations, construction of the pipeline will require clearing of 30m resulting in a loss of 1.7ha of the community.

Despite the direct impacts, the proposal is unlikely to have a significant impact on Box Gum Woodlands. The construction of the pipeline will not alter the existing disturbance regime of these communities. The proposal will also not form a barrier to ecological processes occurring within the patches, or fauna likely to be utilising these habitats to move across the fragmented landscape matrix. Finally, the proposal will not effect any listed critical habitat or habitat considered critical to the survival of the ecological community.

E2.2 Fuzzy Box Woodland on alluvials of South West Slopes, Darling Riverine Plains & the Brigalow Belt South

Fuzzy Box Woodland on alluvials of South West Slopes, Darling Riverine Plains and the Brigalow Belt South (Fuzzy Box Woodland) is listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995.* Patches of this community that are co-dominated by *E. albens, E. melliodora* or *E. blakelyi* may also be consistent with the *Environment Protection and Biodiversity Conservation Act 1999* listing of Box Gum Woodlands.

Fuzzy Box Woodland as listed under the *Threatened Species Conservation Act 1995* occurs mainly in the Dubbo-Narromine-Parkes-Forbes area (an area that the study region is within). *Eucalyptus conica* is more widely distributed than this community on the Western Slopes of NSW and may occur in association with other eucalypt species to form other communities

(NSW Scientific Committee 2004). Less than 5% of Fuzzy Box Woodland is estimated to remain compared to pre-European times due to past clearing (NSW Scientific Committee 2004).

Two patches of Fuzzy Box Woodland were identified in the study area in road corridors on the western side of Hervey Range (refer to Figure 3-1 in the body of the report). Both of these patches were dominated by an association of *E. conica* and *E. microcarpa* (Grey Box). One of the patches also includes *E. melliodora* and *E. polyanthemos* (Red Box). These patches were in moderate condition (condition class 2) with a relatively intact natural soil profile, seed bank and an understorey dominated by native species. Both of these patches qualify as Fuzzy Box Woodland as listed as the Endangered Ecological Community under the *Threatened Species Conservation Act 1995*.

It is likely that the original extent of this community would have been much greater that the current extent, particularly extending along the alluvial flats adjacent to the River Red Gum Woodlands (Department of Environment and Climate Change 2007d) before merging into Box Gum Woodlands on the alluvial plains, low ranges and rounded hills.

E2.2.1 Significance Assessment - Environmental Planning and Assessment Act 1979

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

Not applicable to the assessment of endangered ecological communities.

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

The proposal traverses two patches of Fuzzy Box Woodland. These are located at (from west to east):

- in the Kadina Road corridor south of Burrill Creek
- in an unnamed road corridor at the western end of the alignment.

Construction of the pipeline will require clearing of 30m corridor through these patches of Fuzzy Box Woodland. At each of these locations however, an alignment has been chosen to avoid areas of higher tree density and minimise the number of trees affected.

The total areas that will be cleared within this community is 0.5 ha. This represents approximately 1% of the predicted 49.2 ha of Fuzzy Box Woodland identified within 1km of the pipeline.

These areas will be rehabilitated following construction of the pipeline, however planting of large trees characteristic of the community above the pipeline will be unsuitable for safety reasons.

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

Not applicable to the assessment of endangered ecological communities

How is the proposal likely to affect current disturbance regimes?

Remnants of this community within the study area have been highly modified by extensive clearing for agricultural land uses, grazing, fragmentation, isolation, edge effects and weed intrusion. In addition, these impacts have modified natural disturbance regimes in the regions such as the effects of wildfire.

Construction of the pipeline however will require clearing of a 30m corridor including through two patches of Fuzzy Box Woodland which will have a direct impact through the clearing of 0.5 ha, and be a cause of disturbance to the community.

The patches of Fuzzy Box Woodland in the study area are generally small, or linear patches that are largely exposed to edge effects. Based on existing edge effects extending up to 50m into each patch (Bali 2000), no new areas of the community will be exposed to new edge effects as a result of the proposal. The proposal is unlikely to significantly alter the microhabitat conditions such that it will result in the proliferation of weeds in areas where they do not already occur.

The proposal will not have an impact on the fire regime in the study area.

How is the proposal likely to affect habitat connectivity?

Fuzzy Box Woodland in the region is highly fragmented as a result of extensive land clearing for agricultural land uses. As a result, the remaining patches of Fuzzy Box Woodland are isolated from other patches of the community.

Construction of the pipeline will require clearing of 30m however, that will intersect two roadside patches of Fuzzy Box Woodland and result in the fragmentation of each of these patches into two separate patches. The effect of this fragmentation to habitat connectively however is likely to be small. The proposal is unlikely to form a barrier to ecological processes occurring across these patches (such as pollination and seed dispersal). Nor would a 30 m gap between patches form a barrier for the faunal species that are likely to be using these isolated patches of woodland, in conjunction with paddock trees, as stepping stones to move across the fragmented landscape.

In order to minimise fragmentation and impacts to habitat connectivity, the proposed alignment has been selected to traverse the roadside patches at location where the tree cover is thinner such as under an existing powerline easement at Kadina Road.

How is the proposal likely to affect critical habitat?

The Department of Environment and Conservation maintains a register of critical habitat (Department of Environment and Climate Change 2007c). No critical habitat has been declared for Fuzzy Box Woodland nor are the patches within the study area considered critical to the survival of the ecological community.

Conclusion

Fuzzy Box Woodland is an endangered ecological community that has been extensively cleared as a result of its association with arable soils that have historic and current value as agricultural lands. As a result of the extensive clearing and associated agricultural land uses, Fuzzy Box Woodland has generally been reduced to isolated linear strips of vegetation within road corridors.

Two patches of Fuzzy Box Woodland will be traversed by the proposal. At these locations, construction of the pipeline will require clearing of 30 m corridor resulting in the loss of 0.5 ha of the community.

Despite the direct impacts, the proposal is unlikely to have a significant impact on Fuzzy Box Woodlands. The construction of the pipeline however will not alter the existing disturbance regime of these communities. The proposal will also not form a barrier to ecological processes occurring within the patches, or fauna likely to be utilising these habitats to move across the fragmented landscape matrix. Finally, the proposal will not effect any listed critical habitat or habitat considered critical to the survival of the ecological community.

E2.3 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (as listed under the *Environment Protection and Biodiversity Conservation Act 1999*)

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Grassy Woodland and Derived Grasslands) is listed as a Critically Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The definition of this ecological community differs slightly from Box Gum Woodland listed under the *Threatened Species Conservation Act 1995* and patches that qualify at the state level do not automatically qualify at the national level. Patches of Fuzzy Box Woodland may also be consistent with this commonwealth listing.

Similar to the State listing, Box Gum Grassy Woodland and Derived Grasslands are characterised by grassy woodland communities in which and the dominant, or prior dominant, species were *Eucalyptus albens* (White Box), *E. melliodora* (Yellow Box) and/or *E. blakelyi* (Blakely's Red Gum). This definition includes derived grasslands of the woodland community in which there is a species-rich understorey of native tussock grasses, herbs and scattered shrubs, however in which the canopy trees have been removed.

- Under the *Environment Protection and Biodiversity Conservation Act 1999* listing however, a patch of Box Gum Grassy Woodland and Derived Grasslands, the size and number of native species in the understorey are determining factors (see identification key in section 2.3.4 of main report).

Five patches of Box Gum Woodland and Fuzzy Box Woodland in the study area were consistent with the definition of the ecological community. These were located at:

- the paddock patch of Box Gum Woodland adjacent to Little River (in close proximity only)
- the Box Gum Woodland in the road corridor at Obley Road
- the Box Gum Woodland in the road corridor at within an unnamed road corridor to the west of the Molong Dubbo Railway line crossing point.
- the Fuzzy Box Woodland in the Kadina Road corridor south of Burrill Creek
- the Fuzzy Box Woodland in the unnamed road corridor at the western end of the alignment.

The patch of White Box, Yellow Box, Blakely's Red Gum Woodland listed under the *Threatened Species Conservation Act 1995* that consists of large paddock patch south of

Hervey Road between Hervey range and Obley Road (vegetation survey point 32) did not quality as the critically endangered ecological community listed under the *Environment Protection and Biodiversity Conservation Act 1999* as it did not possess 12 or more native species in the understorey nor were any 'important' species present.

E2.3.1 Significance assessment - Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999*, an action is likely to have a significant impact on a critically endangered or endangered community if there is a real chance or possibility that it will result in one or more of the following.

Reduce the extent of an ecological community

Construction of the pipeline will require clearing of a 30 m corridor including through four patches of Box Gum Grassy Woodland and Derived Grasslands. At each of these locations however, an alignment has been chosen to avoid the areas of higher tree density core of the patch and minimise the number of trees affected.

In total, 1.0 ha of the Box Gum Grassy Woodland and Derived Grasslands will be cleared as a result of the proposal.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

Construction of the pipeline will require clearing of a 30 m wide corridor including though four patches of Box Gum Grassy Woodland and Derived Grasslands resulting a clearing of a total of 1.0 ha of the community. Construction of the pipeline will intersect roadside patches and result in the fragmentation of each of these patches into two separate patches. The effect of this fragmentation to habitat connectively however is likely to be small. The proposal is unlikely form a barrier to ecological processes occurring across these patches (such as pollination and seed dispersal). Nor would a 30 m gap between patches form a barrier for the faunal species that are likely to be using these isolated patches of woodland, in conjunction with paddock trees, as stepping stones to move across the fragmented landscape matrix. Under the definition of the community, all fragmented patches within 70 m of another patch are considered to be part of the same patch (Bali 2000) in recognition of the ability of ecological processes to function across clearing greater than that formed by the proposal.

In order to minimise fragmentation and impacts to habitat connectivity, the proposed alignment has been selected to traverse the roadside patches at locations where the tree cover is thinner such as under an existing powerline easement at Kadina Road.

Adversely affect habitat critical to the survival of an ecological community

No critical habitat has been listed for Box Gum Grassy Woodland and Derived Grasslands under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment and Water Resources 2007a).

Habitat critical to the survival of an ecological community may, however, also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or

- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The extent of the ecological community that would be cleared as a result of the proposal does not represent habitat critical to the survival of the ecological community under this definition.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The project would modify the soil profile within the patches traversed by the Box Gum Grassy Woodland and Derived Grasslands . This modification of the soil profile would be contained to with the 30 m wide construction corridor. This would destroy the native seed bank in the soil that is modified, however would not prevent these areas from being re-established by native groundcover species following construction. The proposal will not destroy or modify any other abiotic factors required for the survival of the ecological community.

The extent of the soil that would be modified by the proposal is not essential to the community's long term survival.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

Remnants of Box Gum Grassy Woodland and Derived Grasslands within the study area have been highly modified by extensive clearing for agricultural land uses, grazing, fragmentation, isolation, edge effects and weed intrusion. In addition, these impacts have modified natural disturbance regimes in the regions such as the effects of wildfire.

Construction of the pipeline however will require clearing of 30m corridor including though five patches of the community which will have a direct impact, and be a cause of disturbance to the community.

The patches of Box Gum Grassy Woodland and Derived Grasslands in the study area are generally small, or linear patches that are largely exposed to edge effects. Based on existing edge effects extending up to 50 m into patch (Bali 2000), no new areas of the community will be exposed to new edge effects as a result of the proposal. The proposal is also unlikely to significantly alter the microhabitat conditions such that it will result in the proliferation of weeds in areas where they do not already occur.

The proposal will not have an impact on the fire regime in the study area.

As such, the proposal is unlikely to substantially change the species composition in the patches of Box Gum Grassy Woodland and Derived Grasslands in the study area.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to assisting invasive species, that are harmful to the listed ecological community, to become established; or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community

Construction of the pipeline will require clearing of 30 m corridor including through five patches of the community, which will have a direct impact on the quality of the community within the construction footprint. The patches of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland at these locations, however, are generally small linear patches, or on the edge of a larger patch, and are likely to be subject to a range of edge effects.

Based on existing edge effects extending up to 50 m into patch (Bali 2000), no new areas of the community will be exposed to new edge effects as a result of the proposal. The proposal is also unlikely to significantly alter the microhabitat conditions such that it results in the proliferation of weeds in areas where they do not already occur.

Interfere with the recovery of an ecological community

A recovery plan has not been prepared for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland under the *Environment Protection and Biodiversity Conservation Act 1999*. Conservation Management Networks for Grassy Box Woodlands however have been established to aims to co-ordinate the protection and ongoing management of remnants of grassy Box woodlands. Two Grassy Box Woodland Sites are located at Geurie to the north of the study area, however none are located within the study area.

The clearing of 1.0 ha of Box Gum Grassy Woodland and Derived Grasslands will not positively contribute to the recovery of the Critically Endangered Ecological Community. However, is also unlikely to significantly affect the recovery of the community across its broader extent within the region.

Conclusion

Five patches of Box Gum Grassy Woodland and Derived Grasslands were identified within the study area of which four would be directly affected by the project. These sites were all located within road corridors.

Construction of the pipeline will require clearing of a 30 m wide corridor and result in a reduction of the overall extent of the community of 1.0 ha. The clearing will also fragment the patches into two or more patches.

Despite the direct impacts, the proposal is unlikely to have a significant impact on Box Gum Grassy Woodland and Derived Grasslands. The project is unlikely to form a barrier to ecological processes occurring within the patches, or fauna likely to be utilising these habitats to move across the fragmented landscape. No critical habitat for the community will be affected. Soil is the only abiotic factor that will be modified by the proposal; however this modification will not prevent the establishment of native species in the study area following construction.

The patches of Box Gum Grassy Woodland and Derived Grasslands within the study area are all modified as a result of fragmentation, isolation and edge effects and the proposal is unlikely to change microhabitat conditions in a manner that results in a change in species composition, reduced the quality or prevents the recover of the community in the areas beyond the study area.

E3. *Tylophora linearis*

Tylophora linearis is a slender, almost hairless twiner of the family Apocynaceae that is listed as Endangered under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*.

Tylophora linearis occurs in the Barraba, Mendooran, Temora and West Wyalong districts in the North West Slopes and the Central Western Slopes botanical subdivisions (Royal Botanic Gardens 2005). The species has been recorded previously in dry scrub and open forest dominated by *Eucalyptus fibrosa*, *E. sideroxylon*, *E. albens*, *Callitris endlicheri*, *C. glaucophylla* and *Allocasuarina luehmannii*. It also grows in association with *Acacia hakeoides*, *A. lineata*, *Myoporum* spp. and *Casuarina* spp. (Department of Environment and Conservation 2005d).

Although not recorded within the subject site or previously within the locality, vegetation communities traversed by the proposal along Hervey Range provide potential habitat for the species. The species has also been recorded previously within Goobang National Park beyond the extent of the project locality (Department of Environment and Climate Change 2007a). Potential habitat assessed for this species included the Ironbark / Black Cyprus Pine Woodland; Red Stringybark Woodland; and, Tumbledown Red Gum and Dwyers Red Gum Woodland.

E3.1 Significance Assessment - *Environmental Planning and Assessment Act 1979*

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

No *Tylophora linearis* were recorded in the study area and given the targeted surveys for the species, it is considered unlikely that a local population is large if present The proposal will result however, in the loss of 13.3 ha of potential habitat for *Tylophora linearis* consisting of Ironbark / Black Cyprus Pine Woodland; Red Stringybark Woodland; and, Tumbledown Red Gum and Dwyers Red Gum Woodland. This represents a represents 1% of similar habitat identified within 1 km.

The proposal is also unlikely to create a barrier to species responsible for the pollination of the species or prevent the dispersal of the species seed (which are predominantly spread by wind and gravity).

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

No *Tylophora linearis* were recorded in the study area and given the targeted surveys for the species, it is considered unlikely that a local population is large if present. The proposal will result however, in the loss of 13.3 ha of potential habitat for *Tylophora linearis* consisting of Ironbark / Black Cyprus Pine Woodland; Red Stringybark Woodland; and, Tumbledown Red Gum and Dwyers Red Gum Woodland. This represents a represents 1% of similar habitat identified within 1 km.

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

Tylophora linearis occurs from Queensland (Department of Environment and Climate Change 2007d) to Victoria (Royal Botanic Gardens 2007). The study area is however located at the western limit of the *Tylophora linearis* in NSW which Goobang National Park.

How is the proposal likely to affect current disturbance regimes?

The potential habitats for *Tylophora linearis* identified along Hervey Range have been modified through clearing, logging, altered fire regimes and grazing by sheep and feral goats. Construction of the pipeline will result in a further disturbance to potential habitat.

The proposal does not include any ongoing activates that are likely to modify the existing disturbance regime to the remaining areas of potential habitat adjoining the proposal such as modification of the fire regimes or hydrology.

Vegetation clearing has potential to introduce new edge effects to some areas of potential *Tylophora linearis* habitats along Hervey range. This has been minimised as far as possible by following existing forest trail or other cleared areas. In addition, as a result of selective logging in the past, introduction of new edge effects are unlikely to result in significant changes to the microhabitat conditions within the areas of potential *Tylophora linearis* habitat in the adjacent to the subject site.

How is the proposal likely to affect habitat connectivity?

The proposal would involve in the clearing of a 30 m corridor that will intersect potential *Tylophora linearis* habitats associated with Harvey Range to the north and south. The proposal will however not form a barrier to ecological processes occurring across these patches (such as pollination and seed dispersal) and is therefore unlikely to affect habitat connectivity for the *Tylophora linearis*.

How is the proposal likely to affect critical habitat?

The Department of Environment and Climate Change maintains a register of critical habitat (Department of Environment and Climate Change 2007c). No critical habitat has been declared for *Tylophora linearis* nor are the patches of habitat within the study area considered critical to the survival of the species.

Conclusion

Tylophora linearis was not recorded within the study area or previously within the locality. The species has been recorded however within Goobang National Park which is the western limit of the species. Similar habitat to those within Goobang National Park was identified within the subject site.

The proposal will result however, in the loss of 13.3 ha of potential habitat for *Tylophora linearis* consisting of Ironbark / Black Cyprus Pine Woodland; Red Stringybark Woodland; and, Tumbledown Red Gum and Dwyers Red Gum Woodland. This represents a represents 1% of similar habitat identified within 1 km.

The proposal is however unlikely to result in a significant impact to the *Tylophora linearis.* If present in the subject site, the number of *Tylophora linearis* is unlikely to be large. The

construction of the pipeline however will not alter the existing disturbance regime of areas of potential *Tylophora linearis* habitat. The proposal will also not form a barrier to ecological processes occurring within the patches such as pollination or seed dispersal. Finally, the proposal will not affect any listed critical habitat or habitat considered critical to the survival of the ecological community.

E3.2 Significance assessment - *Environment Protection and Biodiversity Conservation Act 1999*

Under the *Environment Protection and Biodiversity Conservation Act 1999*, an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will result in one or more of the following.

Lead to a long-term decrease in the size of a population

No *Tylophora linearis* were recorded in the study area and given the targeted surveys for the species, it is considered unlikely that a local population is large if present. As such, long-term decrease in the size of a population is likely to be small.

The proposal will result however, in the loss of 13.3 ha of potential habitat for *Tylophora linearis* consisting of Ironbark / Black Cyprus Pine Woodland; Red Stringybark Woodland; and, Tumbledown Red Gum and Dwyers Red Gum Woodland. This represents a represents 1% of similar habitat identified within 1 km.

Reduce the area of occupancy of the species

No *Tylophora linearis* were recorded in the study area and given the targeted surveys for the species, it is considered unlikely that a local population is large if present. As such, a decrease in the area of occupancy is likely to be small.

The proposal will result however, in the loss of 13.3 ha of potential habitat for *Tylophora linearis* consisting of Ironbark / Black Cyprus Pine Woodland; Red Stringybark Woodland; and, Tumbledown Red Gum and Dwyers Red Gum Woodland. This represents a represents 1% of similar habitat identified within 1 km.

Fragment an existing population into two or more populations

The proposal would involve in the clearing of a 30 m corridor that will intersect potential *Tylophora linearis* habitats associated with Harvey Range to the north and south respectively. The proposal will however not form a barrier to ecological processes occurring across these patches (such as pollination and seed dispersal) and is therefore unlikely to increase fragmentation of potential habitats for the *Tylophora linearis*.

Adversely affect habitat critical to the survival of a species

No critical habitat has been listed for the *Tylophora linearis* under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment and Water Resources 2007a).

Habitat critical to the survival of an endangered species may, however, also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal

- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The habitats that would be cleared as a result of the proposal does not represent habitat critical to the survival of *Tylophora linearis* under this definition.

Disrupt the breeding cycle of a population

The proposal is unlikely to directly affect the breeding cycle of *Tylophora linearis.* No individuals were identified within the subject site that will be directly affected. The proposal is also unlikely to create a barrier to species responsible for the pollination of the species or prevent the dispersal of the species seed (which are predominantly spread by wind and gravity).

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

The proposal is likely to result in a decrease the availability of suitable habitat for *Tylophora linearis* in the study area in the order of 16.4 ha. This however represents a small proportion (1%) of the similar habitat available in the study area and is unlikely to be of an extent that would result in the decline of the species.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Potential *Tylophora linearis* habitat within the subject site is modified as a result of past land uses that include the establishment of numbers weed species. The proposal has potential to result in the introduction or spread of weed species within the potential *Tylophora linearis* habitat.

The proposal is however unlikely to result in the proliferation or establishment of any weeds that are likely to be harmful to *Tylophora linearis* such as species that are allopathic or that are likely to modify the structure or microhabitat conditions of the vegetation communities in which *Tylophora linearis* occurs.

Introduce disease that may cause the species to decline

Tylophora linearis is not known to be threatened by any disease nor is the project likely to result in the introduction of any new diseases.

Interfere with the recovery of the species

A recovery plan has not been prepared for *Tylophora linearis* under the *Environment Protection and Biodiversity Conservation Act 1999* nor is one in preparation at the time of preparing this report.

Removal of potential *Tylophora linearis* habitat will not benefit the recovery of the species, however it is also unlikely to significantly interfere with the recovery of the species.

Conclusion

Tylophora linearis was not recorded within the study area or previously within the locality. The species has been recorded however within Goobang National Park to the north and south, and potential habitat was identified within the subject site that will be cleared as a result of the project consisting of Ironbark / Black Cyprus Pine Woodland; Red Stringybark Woodland; and, Tumbledown Red Gum and Dwyers Red Gum Woodland..

The proposal will result however, in the loss of 13.3 ha of potential habitat for *Tylophora linearis* consisting of Ironbark / Black Cyprus Pine Woodland; Red Stringybark Woodland; and, Tumbledown Red Gum and Dwyers Red Gum Woodland. This represents a represents 1% of similar habitat identified within 1 km.

The proposal is however unlikely to have a significant impact on *Tylophora linearis.* The proposal will not increase fragmentation of potential habitats, adversely effect habitat critical to the species, disrupt the species breeding cycle or result in the establishment of weed or diseases that may cause the *Tylophora linearis* to decline.

E4. *Swainsona recta* and *Swainsona sericea*

Swainsona recta and *Swainsona sericea* have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and, potential impacts as result of the project.

E4.1 *Swainsona recta* (Mountain Swainson-pea)

Swainsona recta are a slender, erect perennial herb that is listed as Endangered under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*.

Swainsona recta occurs in grassland and open woodland dominated by *E. blakelyi, E. melliodora, E. rubida and E. goniocalyx*, usually on stony hillsides (Department of Environment and Climate Change 2007d; Royal Botanic Gardens 2004). Essential habitat for the species is forb rich grassy ground-layer (Department of Environment and Climate Change 2007d) indicating that the species is relatively disturbance sensitive and unlikely to persist at highly modified sites.

No *Swainsona recta* were recorded in the study area. The known records of the species in the locality are located in Catombal Range, which is avoided by the proposal route, however areas of species rich Box Gum Grassy Woodland and Derived Grasslands consistent with the *Environment Protection and Biodiversity Conservation Act 1999* listing of the Threatened ecological community have been considered as potential habitat for this species. Five patches of this woodland occur in the study area of which four will be directly affected by the project.

E4.2 *Swainsona sericea* (Silky Swainson-pea)

Swainsona sericea is a small prostrate or erect perennial herb that is listed as Vulnerable under the *Threatened Species Conservation Act 1995*. This species is not listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

Swainsona sericea occurs in grassland and eucalypt woodland (Royal Botanic Gardens 2004) although it appears to occur over a greater range of habitat types than Swainsona recta including semi-arid Sand Dune Hummock Pine Woodland and heavy, cracking clays on gilgai puffs (Department of Sustainability and Environment 2000).

No *Swainsona sericea* were recorded in the study area, however the areas of species rich Box Gum and Fuzzy Box Woodland have been considered as potential habitat for this species.

E4.3 Significance Assessment - *Environmental Planning and Assessment Act 1979*

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

No *Swainsona recta* or *S. sericea* were recorded in the study area and given the targeted surveys for the species, it is considered unlikely that a local populations are large if present The proposal will result however, in the loss of 1.0 ha of potential habitat for *Swainsona recta* or *S. sericea* consisting of Box Gum Grassy Woodland and Derived Grasslands.

The proposal is unlikely to indirectly affect the lifecycle of *Swainsona recta* or *S. sericea* surrounding the subject site as it. The proposal is unlikely to create a barrier to species responsible for the pollination of the species or prevent the dispersal of the species seed.

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

The proposal will result in the loss of 1.0 ha of potential habitat for *Swainsona recta* or *S. sericea* consisting of Box Gum Grassy Woodland and Derived Grasslands across four patch of the community.

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

Neither *Swainsona recta* nor *S. sericea* are at their known limit of distribution within the study area.

Swainsona recta range extends from Gulargambone in the north to Victoria in the south to Narromine in the West. *S. sericea* extends from north of Armidale in the north to Victoria in the south and to far western NSW.

How is the proposal likely to affect current disturbance regimes?

Remnants of this community within the study area have been highly modified by extensive clearing for agricultural land uses, grazing, fragmentation, isolation, edge effects and weed intrusion. In addition, these impacts have modified natural disturbance regimes in the regions such as the effects of wildfire.

Construction of the pipeline however will require clearing of a 30 m wide corridor including though patches of potential *Swainsona recta* and *S. sericea* habitat which will have a direct impact, and be a cause of disturbance, to potential habitat.

The proposal does not include any ongoing activates that are likely to modify the existing disturbance regime to the remaining areas of potential habitat adjoining the proposal such as modification of the fire regimes or hydrology.

The patches of potential *Swainsona recta* and *S. sericea* habitat in the study area are generally small or linear patches that are largely exposed to edge effects. Based on existing edge effects extending up to 50 m into each patch (Bali, 2005) no new areas of the community will be exposed to new edge effects as a result of the proposal. The proposal is also unlikely to significantly alter the microhabitat conditions such that it will result in the proliferation of weeds in area where they do not already occur.

How is the proposal likely to affect habitat connectivity?

Potential *Swainsona recta* and *S. sericea* habitat in the region is highly fragmented as a result of extensive land clearing for agricultural land uses. As a result, the remaining patches of potential *Swainsona recta* and *S. sericea* habitat are generally isolated from other patches of equivalent habitat.

Construction of the pipeline will require clearing of a 30 m wide corridor that will intersect five of the six patches of potential *Swainsona recta* and *S. sericea* habitat in the study area and result in the fragmentation of each of these patches into two separate patches. The effect of this fragmentation to habitat connectively however is likely to be small. The proposal is unlikely to form a barrier to ecological processes occurring across these patches (such as pollination and seed dispersal).

How is the proposal likely to affect critical habitat?

The Department of Environment and Climate Change maintains a register of critical habitat (Department of Environment and Climate Change 2007c). No critical habitat has been declared for *Swainsona recta* or *S. sericea* nor are the patches of potential habitat within the study area considered critical to the survival of the ecological community.

Conclusion

The proposal will however result in the loss of 1.0 ha of potential habitat for *Swainsona recta* or *S. sericea* consisting of Box Gum Grassy Woodland and Derived Grasslands across four patch of the community. No *Swainsona recta* and *S. sericea* was recorded within the study area, and *S. sericea* has not been recorded previously within the locality.

The construction of the pipeline however is unlikely to have a significant impact on *Swainsona recta* or *S. sericea.* The proposal will not alter the existing disturbance regime of areas of potential *Swainsona recta* and *S. sericea* habitat. The proposal will also not form a barrier to ecological processes occurring within the patches such as pollination or seed dispersal. Finally, the proposal will not affect any listed critical habitat or habitat considered critical to the survival of the ecological community.

E4.4 Significance assessment - *Environment Protection and Biodiversity Conservation Act 1999* (*Swainsona recta* only)

Under the *Environment Protection and Biodiversity Conservation Act 1999*, an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will result in one or more of the following.

Lead to a long-term decrease in the size of a population

No *Swainsona recta* were recorded in the study area and given the targeted surveys for the species, it is considered unlikely that a local populations are large if present The proposal will result however, in the loss of 1.0 ha of potential habitat for *Swainsona recta* or *S. sericea* consisting of Box Gum Grassy Woodland and Derived Grasslands. This is unlikely to result in a long term decrease in the local population.

Reduce the area of occupancy of the species

No *Swainsona recta* were recorded in the study area and given the targeted surveys for the species, it is considered unlikely that a local populations are large if present The proposal will result however, in the loss of 1.0 ha of potential habitat for *Swainsona recta* or *S. sericea* consisting of Box Gum Grassy Woodland and Derived Grasslands. This is unlikely to result in a significant decrease in area of occupancy of a local population.

Fragment an existing population into two or more populations

The proposal would involve in the clearing of a 30 m wide corridor that will intersect five patches of potential *Swainsona recta* habitat associated Box Gum Grassy Woodland and Derived Grasslands . These patches area already highly fragmented from other areas of equivalent habitat.

The proposal will not however, form a barrier to ecological processes occurring across these patches (such as pollination and seed dispersal) and is therefore unlikely to increase fragmentation of potential habitats for the *Swainsona recta*.

Adversely affect habitat critical to the survival of a species

No critical habitat has been listed for the *Swainsona recta* under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment and Water Resources 2007a).

Habitat critical to the survival of an endangered species may, however, also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The habitats that would be cleared as a result of the proposal does not represent habitat critical to the survival of *Swainsona recta* under this definition.

Disrupt the breeding cycle of a population

The proposal is unlikely to directly affect the breeding cycle of *Swainsona recta.* No individuals were identified within the subject site that will be directly affected. The proposal is also unlikely to create a barrier to large native bees responsible for the pollination of the species (Buza et al. 2000).

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

The proposal is likely to result in a decrease the availability of suitable habitat for *Swainsona recta* in the study area in the order of 2.3 ha. This however represents a small proportion of the similar habitat available in the study area and is unlikely to be of an extent that would result in the decline of the species.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Potential *Swainsona recta* habitat within the subject site is modified as a result of past land uses that include the establishment of numbers weed species. The proposal is however unlikely to result in significant change to weeds that are likely to be harmful to *Swainsona recta* such as species that are allopathic or that are likely to modify the structure or microhabitat conditions of the vegetation communities in which *Swainsona recta* occurs.

Introduce disease that may cause the species to decline

Swainsona recta are not known to be threatened by any disease nor are the project likely to result in the introduction of any new diseases.

Interfere with the recovery of the species

A recovery plan has not been prepared for *Swainsona recta* under the *Environment Protection and Biodiversity Conservation Act 1999* however one was in preparation at the time of preparing this report (although not available) (Department of Environment and Climate Change 2007b).

Removal of potential *Swainsona recta* will not benefit the recovery of the species, however it is also unlikely to significantly interfere with the recovery of the species.

Conclusion

The proposal will however result in the loss of 1.0 ha of potential habitat for *Swainsona recta* habitat consisting of Box Gum Grassy Woodland and Derived Grasslands across four patches of the community. No *Swainsona recta* were recorded within the study area although it has not been recorded previously within the locality.

The construction of the pipeline however is unlikely to have a significant impact on *Swainsona recta*\. The proposal will not increase fragmentation of potential habitats, adversely effect habitat critical to the species, disrupt the species breeding cycle or result in the establishment of weed or diseases that may cause the *Swainsona recta* to decline. As such, the proposal is unlikely to have a significant impact on *Swainsona recta.*

E5. Threatened woodland birds

Threatened woodland birds have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and, potential impacts as result of the project. Woodland species of bird considered under the Heads of Consideration for the current proposal include:

- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Hooded Robin (*Melanodryas cucullata cucullata*)
- Black-chinned Honeyeater (*Melithreptus gularis gularis*)
- Gilbert's Whistler (*Pachycephala inornata*)
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)
- Speckled Warbler (*Pyrrholaemus sagittatus*)
- Diamond Firetail (*Stagonopleura guttata*)
- Turquoise Parrot (*Neophema pulchella*).

All eight species are part of a group of woodland birds considered to be declining within Australia (Reid 1999; Trail & Duncan 2000) and are listed as Vulnerable under the *Threatened Species Conservation Act 1995*.

Threats that affect these species include: clearing of woodland resulting in loss and fragmentation of habitat; modification and destruction of ground habitat through heavy grazing and compaction by stock, removal of litter and fallen timber, introduction of exotic pasture grasses and frequent fire (Department of Environment and Climate Change 2007d; Reid 1999; Trail & Duncan 2000).

Fauna habitat for woodland birds within the study area included riparian/riverine woodland, open forest and open woodland. Descriptions of each species are presented below.

Brown Treecreeper (eastern subspecies) - *Climacteris picumnus victoriae*

Brown Treecreepers occur in eucalypt woodland and adjoining vegetation. Sometimes this species is recorded in semi-cleared pasture; in grasslands scattered with trees in cleared paddocks outside woodlands or in shelterbelts fringing cleared lands (Higgins et al. 2001). It is sedentary and nests in tree hollows (Garnett & Crowley 2000) breeding in pairs or communally in small groups within territories ranging in size up to 11 ha. The nest is a collection of grasses, feathers and other soft material, placed in a suitable tree hollow or similar site (Higgins et al. 2001). Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (Pizzey & Knight 1997).

This species was recorded within open woodland and open forest along the entire length of the pipeline easement between Wellington and Alectown.

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

Hooded Robins occur in lightly wooded country, usually open eucalypt woodland, mallee and acacia shrublands. Movements are not well known, however, they are thought to be resident or sedentary, but may undertake some local movements (Department of Environment and Conservation 2006), possibly in response to drought and food availability (Pizzey & Knight 1997). Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m and up to to 5 m above the ground (Higgins & Peter 2002).

This species was recorded in open forest and open woodland fauna habitats during surveys between Wellington and Obley Road (northern half of the study area)

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

This species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Its also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees (Department of Environment and Climate Change 2007d). It is a gregarious species usually seen in pairs and small groups of up to 12 birds (Higgins & Davies 1996). Feeding territories are large, making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least five hectares. Nectar is taken from flowers, and honeydew is gleaned from foliage (Higgins & Davies 1996).

This species was not recorded during surveys but suitable habitat exists in open forest and woodland fauna habitats throughout the study area.

Gilbert's Whistler

The male Gilbert's Whistler is a brownish-grey, with a black patch between the red eyes and bill, and a bright chestnut throat. The female is more uniformly brownish-grey and has a pale eye-ring. Birds weigh 29 - 33 g and have a length of 19 - 20 cm (Department of Environment and Climate Change 2007d). Gilbert's Whistler occurs in ranges, plains and foothills in arid and semi-arid timbered habitats. In New South Wales it occurs mostly in mallee shrubland, but also in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests (Department of Environment and Climate Change 2007d).

This species was not recorded during the current survey but suitable habitat occurs in open woodland and woodland habitats throughout the study area.

Grey-crowned Babbler – *Pomatostomus temporalis temporalis*

The Grey-crowned Babbler is found mainly in rural districts where it predominantly lives in roadsides and private land (Schulz 1991). Suitable habitats are usually abundant with leaf-litter and debris; often dominated by eucalypts including box and ironbark species, partly-cleared woodland, acacia shrubland and adjoining farmland (Higgins 1999). Grey-crowned Babblers are unlikely to occur in regrowth forest, large patches of forest or woodland and forest with dense understorey or grassland with few trees (Schulz 1991).

An understorey of young trees and shrubs, in the 10 to 25 cm diameter at breast height range, is used for nest sites and shelter, and a relatively sparse ground layer with more litter and less ground cover is preferred by the species (Adam & Robinson 1996). Within that broad habitat category, they prefer sites with large trees, a scattered understorey of small trees or shrubs and a sparse ground layer of litter and short grass (Davidson & Robinson 1992). At the local scale, the species is common in edge habitats where there is access to both tree-cover and open ground. Historically this edge habitat would be found near larger trees in mature woodland habitat, but is now largely restricted to roadside vegetation and the edges of remnant patches (Robinson et al. 2001). The Grey-crowned Babbler is a prolific nest builder, building nests throughout the year for both breeding and roosting (Counsilman 1979).

This species was recorded within open forest fauna habitat throughout the study area.

Speckled Warbler- *Pyrrholaemus sagittatus*

Speckled Warblers prefers eucalypt dominated vegetation that has a grassy understorey, often on rocky ridges or in gullies (NSW Scientific Committee 2001). The bird is a sedentary species that breeds in pairs and trios, and feeds on seeds and insects on the ground and in understorey vegetation and builds domed nests on the ground in grass tussocks, dense leaf litter and fallen branches (Reid 1999). Speckled Warblers occur at low densities (0.19 - 0.54 per hectare) and have relatively large home ranges of 6-12 ha for pairs or trios of birds (Higgins & Peter 2002).

This species was recorded during surveys in open forest and riparian/riverine fauna habitat.

Diamond Firetail - *Stagonopleura guttata*

Diamond Firetails are found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Woodlands. They occur also in open forest, mallee, native grasslands, and in secondary grasslands derived from other communities (Trail & Duncan 2000). They feed exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). They are usually encountered in flocks of between 5 to 40 birds, with groups separating into small colonies to breed, between August and January (Department of Environment and Climate Change 2007d). Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. The species appears to be sedentary, although some populations move locally (Higgins & Peter 2002).

This species was recorded within riparian/riverine fauna habitat adjacent to Little River

Turquoise Parrot – ***Neophema pulchella***

The Turquoise Parrot is a highly distinctive bird with bright green upperparts and a turquoise-blue crown and face. Its shoulders are turquoise-blue, grading to deep blue at the flight-feathers. It has a chestnut-red patch on the upper-wing. The upper-breast of the Turquoise Parrot has an orange tint, while the yellow abdomen may have an orange centre. Females and immature individuals are generally duller, have whitish lores, a green, rather than yellow throat and breast and no red on the shoulder and upper-wing area (Department of Environment and Climate Change 2007d).

The Turquoise parrot lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. This species prefers to feed in the shade of a tree and

spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter (Department of Environment and Climate Change 2007d).

This species was not recorded during the current survey, but suitable habitat occurs….

E5.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

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

The project involves the removal of 41.4 ha of vegetation including open forest, open woodland, woodland and riparian/riverine fauna habitat suitable for all species of woodland bird.

The vegetation and habitats to be removed are generally small fragments of larger patches of vegetation or long and thin and are already subject to edge effects. Given the highly modified landscape of the study area it is unlikely the small fragments of suitable vegetation and fauna habitat the pipeline bisect would be core habitat for woodland species of bird in that the majority require habitat patches greater than 100 ha in order to maintain viable populations.

These fauna habitats may play a role in connecting larger patches of vegetation that contain resident populations. However, given the small scale of impacts of the proposal relative to the availability of similar habitat in local and regional area it is unlikely important resources necessary for the life cycle of these species will be significantly affected by the Proposal.

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

The Proposal would remove fauna habitat ranging in condition from poor to good. The majority of the habitat to be removed in this area is generally linear, thin or edges of larger vegetation fragments that are already edge affected. Some habitat to be removed would include specific habitat features such as mature Eucalyptus trees used for foraging by Black-chinned Honeyeaters and down timber for Speckled Warblers.

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

Woodland species of bird are commonly found within eucalyptus forests throughout NSW. Therefore no threatened species of woodland birds that occur or have the potential to occur within the study area are at the limit of their known distribution.

How is the proposal likely to affect current disturbance regimes?

The project would not significantly affect fire regimes (intensity and frequency), flooding or other disturbance regimes. The project is adjacent to existing roads, electrical easements and extensive agricultural lands. The general pattern of disturbance would stay similar to what currently exists.

How is the proposal likely to affect habitat connectivity?

The Proposal will remove 41.4 ha of poor to good condition habitat, which is generally linear and thin, or the edge of larger vegetation fragments and already edge affected. Even though this vegetation to be removed does play a role in connecting larger patches of vegetation in the landscape, given the relatively large home range and mobility of each species, and the small scale of impacts of the proposal within the 30 m construction footprint this loss of vegetation is unlikely to result in isolation of habitat for the seven species of bird.

How is the proposal likely to affect critical habitat?

The Department of Environment and Climate change maintains a register of critical habitat. The land within the study area is not listed as a critical habitat and it is not considered critical to the survival of the eight woodland species of bird.

Conclusion

The project would remove 41.4 ha of habitat for woodland birds. Given the relatively large home range and mobility of each species, this loss of vegetation is unlikely to result in significant impact on the species.

E6. Regent Honeyeater (*Xanthomyza phrygia*)

Status

The Regent Honeyeater is listed as Endangered under both the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1999* as well as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat and distribution

Regent Honeyeaters inhabit dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak (Department of Environment and Conservation 2006). The woodlands they inhabit support a significantly high abundance and species richness of bird. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes (Higgins et al. 2001).

Ecology

The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Nectar and fruit from the mistletoes *Amyema miquelii, A. pendula* and *A. cambagei* are also eaten during the breeding season (Oliver 2000). When nectar is scarce, lerps and honeydew comprise a large proportion of the diet. Insects make up about 15% of the total diet and are important components of the diet of nestlings (Higgins et al. 2001). A shrubby understorey is an important source of insects and nesting material (Oliver et al. 1998).

Colour-banding of Regent Honeyeater has shown that the species can undertake large-scale nomadic movements in the order of hundreds of kilometres (Higgins et al. 2001). However, the exact nature of these movements is still poorly understood. It is likely that movements are dependent on spatial and temporal flowering and other resource patterns. To successfully manage the recovery of this species a full understanding of the habitats used in the non-breeding season is critical (Department of Environment and Conservation 2006).

There are three known key breeding areas, two of them in NSW - Capertee Valley and Bundarra-Barraba regions (Geering & French 1998). The species breeds between July and January in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River She-oak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and She-oaks (Oliver 2000). An open cup-shaped nest is constructed of bark, grass, twigs and wool (Oliver et al. 1998).

Threats to this species include:

- Historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development, particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands.
- Continuing loss of key habitat tree species and remnant woodlands from strategic agricultural developments, timber gathering and residential developments.

- Suppression of natural regeneration of overstorey tree species and shrub species from overgrazing. Riparian gallery forests have been particularly impacted by overgrazing.
- Inappropriate forestry management practices that remove large mature resource-abundant trees. Firewood harvesting in Box-Ironbark woodlands can also remove important habitat components.
- Competition from larger aggressive honeyeaters, particularly Noisy Miners, Noisy Friarbirds and Red Wattlebirds.
- Egg and nest predation by native birds (Department of Environment and Climate Change 2007d).

This species was not recorded during the current survey, but is considered likely to occur based on the suitability of habitat.

E6.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

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

The Proposal will remove approximately 41.4 ha of habitat for this species including potential foraging and resources. It is unlikely, however, that an established breeding population of Regent Honeyeater is present in the study area and none were recorded during current surveys.

It is therefore unlikely that the proposal would disrupt the breeding cycle of a local population of Regent Honeyeater.

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

The study area contains approximately 41.4 ha of fauna habitat suitable as marginal foraging resources for the Regent Honeyeater. Given that it is unlikely an established breeding population of Regent Honeyeater is present in the study area and the small scale of impacts of the proposal relative to the availability of similar habitat in local and regional area it is unlikely the proposal will significantly affect the availability of foraging habitat in the study area and locality for this species. Furthermore, the large home range of the species allows offsite foraging resources to be accessed.

It is unlikely that the action would affect the availability of habitat for the Regent Honeyeater to the extent that the species is likely to decline.

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

In eastern Australia the Regent honeyeater is distributed from north east Victoria to south east Queensland. In NSW the distribution is patchy and mainly confined to two main breeding areas - the Capertee Valley and Bundarra-Barraba region of NSW (Geering &

French 1998). Therefore the study area is not at the distributional limit of the Regent Honeyeater.

How is the proposal likely to affect current disturbance regimes?

The project would not significantly affect fire (intensity and frequency), flooding or other disturbance regimes. The project is adjacent to areas cleared by agriculture and generally the pattern of disturbance would stay similar to what currently exists.

Therefore it is unlikely the proposal will affect current disturbance regimes.

How is the proposal likely to affect habitat connectivity?

The study area contains marginal habitat and foraging resources for the Regent Honeyeater that range in condition from poor to good. These habitats include Open forest, woodland and open woodland areas that area distributed throughout the study area and wider locality.

Regent Honeyeaters are highly mobile and have a large foraging range that allows them to use similar habitat resources in the study area and locality. Therefore, it is highly unlikely that the proposed action would affect connectivity between suitable habitats for the regent honeyeater or alter the distribution of habitat across the landscape.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species. The site is unlikely to be critical to the survival of the species.

Conclusion

The Regent Honeyeater is unlikely to be significantly affected by the Proposal.

E6.2 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Will the action lead to a long-term decrease in the size of a population of a species?

The project would remove approximately 41.4 ha of habitat for this species including foraging and potential nesting resources. It is unlikely, however, that an established breeding population of Regent Honeyeater is present in the study area. Any unidentified populations of Regent Honeyeater that forage in the area would not be restricted to the habitat within the site due to the species' large home range.

The areas proposed for vegetation removal is not considered to be a significant amount in relation to the amount of similar habitat that will remain unaffected in the wider local area. This species is highly mobile and similar foraging and roosting habitat can be accessed in the local area. Although the Proposal may temporarily affect the dynamics of the local population, the Proposal is unlikely resulting in a long-term decline of the local population.

Will the action reduce the area of occupancy of the species?

41.4 ha of suitable foraging habitat for the Regent Honeyeater will be removed within the 30 m construction footprint of the proposed gas pipeline and power station. This vegetation only represents 1% of the potential foraging resources within a 1 Km radius of the proposal.

A local population of Regent Honeyeater would not be restricted to habitat resources in the construction corridor. This species is highly mobile and has a large foraging range that would allow it to use similar habitat resources in the study area and locality.

The action would not reduce the area of occupancy for Regent Honeyeater.

Will the action fragment an existing population into two or more populations?

Regent Honeyeaters are highly mobile and have a large foraging range that allows them to use similar habitat resources in the study area and locality. Given that only 41.4 ha of suitable habitat will be removed (1% of available habitat within 1 km of the proposal), the small scale of impacts of the proposal relative to the availability of similar habitat in local and regional area, it is highly unlikely that the action would isolate habitat and fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

It is unlikely that there is an established breeding population of Regent Honeyeater within the study area. Any unidentified populations of Regent Honeyeater that forage in the area would not be restricted to the habitat within the site, due to the large home range.

Therefore, the habitat in the study area is not considered critical to the survival of the species.

Will the action disrupt the breeding cycle of a population?

The project will remove approximately 41.4 ha of habitat for this species including foraging and potential nesting resources. It is unlikely, however, that an established breeding population of Regent Honeyeater is present in the study area.

It is therefore unlikely that the action would disrupt the breeding cycle of a local population of Regent Honeyeater.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The study area contains marginal foraging resources for Regent Honeyeater that range in conditions from poor to moderate. The action is unlikely to significantly decrease the availability of foraging habitat in the study area and locality. The large home range of the species allows offsite foraging resources to be accessed and isolation of habitat would not result from the action.

It is unlikely that the action would isolate and decrease the availability of quality habitat to the extent that the species is likely to decline.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

It is highly unlikely that invasive species (such as introduced predators) that are harmful to the Regent Honeyeater would become further established as a result of the action.

Will the action introduce disease that may cause the species to decline?

No. It is highly unlikely that disease would be increased by the action.

Will the action interfere with the recovery of the species?

The Action Plan for Australian Birds (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Regent Honeyeater recovery (Menkhorst et al. 1999) include:

- Maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites.
- Monitor trends in the Regent Honeyeater population size and dispersion across its range to allow assessment of the efficacy of management actions.
- Facilitate research on strategic questions which will enhance the capacity to achieve the long-term objectives. In particular, determine the whereabouts of Regent Honeyeaters during the non-breeding season and during breeding season absences from known sites. Identify important sites and habitat requirements at these times.
- Maintain and increase community awareness, understanding and involvement in the recovery effort.
- Maintain the captive population of Regent Honeyeaters at a size which will provide adequate stock to: provide insurance against the demise of the wild population; continuously improve captive-breeding and husbandry techniques; provide adequate stock for trials of release strategies; and maintain 90% of the wild heterozygosity in the captive population.

Based on the potential ecological impacts of the project on the species as discussed above, it is unlikely that the action would interfere with the recovery of this species.

Conclusion

The Regent Honeyeater is unlikely to be significantly affected by the project.

E7. Superb Parrot (*Polytelis swainsonii*)

Status

The Superb Parrot is listed as Vulnerable under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*.

Description

The Superb Parrot is a distinctive large, bright grass-green parrot with a long, narrow tail and sharply back-angled wings in flight. Males have yellow foreheads and throats and a red crescent that separates the throat from the green breast and belly. Females are slightly duller green and have a dull, light blue wash in place of the males' red and yellow markings (Department of Environment and Climate Change 2007d).

Distribution

The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round (Department of Environment and Climate Change 2007d).

Habitat and ecology

The Superb Parrot generally inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box.

This species may forage up to 10 km from nesting sites, primarily in grassy box woodland.

In the study area:

This species was recorded during the current survey. Suitable habitat for this species occurs within open forest and riparian/riverine vegetation.

E7.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

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

The project will remove approximately 41.4 ha of suitable habitat for this species including foraging and potential nesting resources. The main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round (Department of Environment and Climate Change 2007d) Therefore it is unlikely, , that an established breeding population of Superb Parrot is present in the study area. It is

therefore unlikely that the proposal would disrupt the breeding cycle of a local population of this species.

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

The study area contains approximately 41.4 ha of marginal foraging resources for the Superb Parrot that ranges in condition from poor to good. Given that this only represents X% of potential foraging resources within 1 km of the proposal and the availability of habitat in the wider locality the proposal is unlikely to significantly affect the availability of foraging habitat for this species. Furthermore, the large home range of the species allows offsite foraging resources to be accessed.

It is unlikely that the action would affect the availability of habitat for the Superb Parrot to the extent that the species is likely to decline.

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

The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round (Department of Environment and Climate Change 2007d).

The proposal is not at the limit of distribution for this species.

How is the proposal likely to affect current disturbance regimes?

The project would not significantly affect fire (intensity and frequency), flooding or other disturbance regimes. The project is adjacent to already highly cleared areas from agriculture and generally the pattern of disturbance would stay similar to what currently exists.

Therefore it is unlikely the proposal will affect current disturbance regimes.

How is the proposal likely to affect habitat connectivity?

The study area contains marginal habitat and foraging resources for the Superb Parrot that ranges in condition from poor to good. This fauna habitat is distributed throughout the study area and is not isolated to the construction corridor. Given that the Superb Parrot is highly mobile and has a large foraging range that allows them to use similar habitat resources in the study area and locality it is highly unlikely that the proposed action would affect connectivity between suitable habitats for the Superb Parrot.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date,

no critical habitat has been declared for this species. The site is unlikely to be critical to the survival of the species.

Conclusion

The Superb Parrot is unlikely to be significantly affected by the project.

E7.2 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

The Superb Parrot that forage in the site is not considered an 'important population' because:

- the population in the study area is not a key source population either for breeding or dispersal
- the population is not necessary for maintaining genetic diversity
- the population is not at the limit of the species range

Will the action lead to a long-term decrease in the size of an important population of a species?

The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. For this reason the local population of superb parrot within the study area is not considered an important population.

However, given that there is no breeding population that relies on nesting resources within the study area it is unlikely the removal of 41.4 ha of potential habitat for this species will lead to a long term decrease in the size of the local population.

Will the action reduce the area of occupancy of an important population?

The local population of Superb Parrot within the study area is not considered an important population.

The proposal involves the removal of native vegetation and some cleared open country. Some tree hollows suitable for roosting will also be removed. However, in a regional context, similar foraging and nesting habitat is likely to be well-represented in several highly vegetated areas including Goobang National Park in the west, Catombal Range in the east and Nangar range in the north. The proposal is therefore unlikely to remove a significant area of known foraging and potential nesting habitat and will not reduce the area of occupancy for this species.

Will the action fragment an existing important population into two or more populations?

The local population of Superb Parrot within the study area is not considered an important population.

The proposal will not isolate habitat for the Superb Parrot as the proposed pipeline will not create a barrier to movement for these highly mobile species.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the Superb Parrot.

Habitat critical to the survival of threatened species may, however, also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006).

The extent of the habitat that would be cleared as a result of the proposal does not represent habitat critical to the survival of the Superb Parrot.

Will the action disrupt the breeding cycle of an important population?

The local population of Superb Parrot within the study area is not considered an important population.

The proposal involves the removal of 41.4 ha of potential foraging and nesting habitat for the Superb Parrot. Hollow-bearing trees that may provide potential roosting sites for this species will be removed as a result of the proposal. However similar resources are available and would be accessible in the study area and the wider region that will not be affected by the proposal.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposal involves the removal of native vegetation and some cleared open country. Some tree hollows suitable for nesting will also be removed. However, in a regional context, similar foraging and nesting habitat is likely to be well-represented in several highly vegetated areas including Goobang National Park in the west, Catombal Range in the east and Nangar range in the north. The proposal is therefore unlikely to remove a significant area of known foraging and potential nesting habitat for this species.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

The proposal is unlikely to introduce any new invasive species to the area.

Will the action interfere substantially with the recovery of the species?

The proposed pipeline does not present a significant barrier to species' movement, and would not result in the fragmentation of existing populations or the disruption of species' life-cycles. In addition, no critical habitat has been declared within the proposal corridor and the availability of adjacent foraging habitat combined with the high mobility of the species further suggests that the recovery of the Superb Parrot would not be substantially affected.

Conclusion

The proposal is unlikely to have a significant impact on the Superb Parrot in the study area. Although 41.4 ha of potential foraging habitat will be removed, similar habitat is available in both the local and regional area.

E8. Bush Stone-curlew (*Burhinus grallarius)*

Status

The Bush Stone-curlew is listed as Endangered under the *Threatened Species Conservation Act 1995*.

Description

The Bush Stone-curlew stands about 55 cm tall. It has a grey to light brown back, marked with black blotches, and a streaked rump. It has buff and white underparts with dark streaks, and a black band that runs from near its eye down its neck. This species has large, bright yellow eyes and a hunch-shouldered stance on long spindly legs. When disturbed it lies flat on the ground, with its head and neck outstretched (Department of Environment and Climate Change 2007d)

Habitat and Distribution

This species requires sparsely grassed, lightly timbered, open forest of woodland. In southern Australia they often occur where there is a well structured litter layer and fallen timber debris. They feed on a range of invertebrates and small vertebrates, as well as seeds and shoots (NSW National Parks and Wildlife Service 1999a, 2003a).

The Bush Stone-curlew is found throughout Australia. Only in northern Australia is it still common and in the south-east it is either rare or extinct throughout its former range (Department of Environment and Climate Change 2007d).

In the study area:

This species was not recorded during surveys, despite targeted survey including call playback. However, the Bush Stone-curlew does have the potential to occur within open woodland habitats within the study area.

E8.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

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

The project involves the removal of 18.3 ha of open woodland habitat for this species. This habitat is unlikely to be core habitat for Bush Stone-curlew in that the habitat is generally degraded with little structure remaining apart from the upper canopy. The vegetation and habitats to be removed are generally scattered throughout the study area and are already subject to edge effects. However, this habitat will play a role in connecting larger patches of vegetation that may contain resident populations. In general however, important resources necessary for the life cycle of this species are unlikely to be significantly affected by the project.

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

The Proposal would remove approximately 18.3 ha of habitat ranging from poor to moderate condition. The vegetation and habitats to be removed are generally scattered throughout the study area and are already subject to edge effects.

Currently 70 % of vegetation within 30 m of the proposed gas pipeline and power station comprises between 10 and 30% cover, which is below a recognised threshold (30%) below which Threatened species of woodland bird may decline (Reid 2000) and close to a critical threshold (10%) below which there is a significant decline in the diversity of woodland birds (Bennett & Radford 2004). With the Proposal, the extent of cover would be reduced which may see a minor reduction in the diversity of species present. The percentage of cover will still remain, however, above the 10% level.

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

The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner and Tasmania (Department of Environment and Climate Change 2007d) .The site is not at the distributional limit of this species.

How is the proposal likely to affect current disturbance regimes?

The Proposal would not significantly affect fire regimes (intensity and frequency), flooding or other disturbance regimes. The Proposal is located in a highly agricultural landscape and generally the general pattern of disturbance would stay similar to what currently exists.

How is the proposal likely to affect habitat connectivity?

The Proposal will remove approximately 18.3 ha of habitat in poor condition, which is generally scattered throughout the study area and already edge affected. This vegetation does however play a role as a corridor within the wider landscape connecting larger patches of remnant vegetation.

Due to the relatively large home range of the species (birds are known to move over 1 km away from nests (Marchant & Higgins 1993), loss of vegetation is unlikely to result in isolation of habitat for the species. Therefore, it is unlikely that local populations of these species would become fragmented or isolated from other areas of habitat as a result of the construction and operation of the Proposal.

How is the proposal likely to affect critical habitat?

The Department of Environment and Climate Change maintains a register of critical habitat. The land within the study area is not listed as a critical habitat and it is not considered critical to the survival of the Bush Stone-curlew.

Conclusion

The Proposal would remove approximately 18.3 ha of potential habitat for the Bush Stone-curlew. Given the extent of vegetation that would be retained, it is unlikely that the proposed clearing would have a significant impact on this species.

E9. Glossy Black-cockatoo (*Calyptorhynchus lathami*)

Status

The Glossy Black-cockatoo is listed as Vulnerable under Schedule 2 of the *Threatened Species Conservation Act 1995*.

The Riverina population of Glossy Black-cockatoos is listed as Endangered under Part 2 of Schedule 1 of the *Threatened Species Conservation Act 1995*. The local population within the study area does not form part of this population and is consequently not listed as endangered.

Description

The Glossy Black-cockatoo is a dusky brown to black cockatoo with a massive, bulbous bill and a broad, red band through the tail. The red in the tail is barred black and edged with yellow. The female usually has irregular pale-yellow markings on the head and neck and yellow flecks on the underparts and underwing. They are smaller than other black cockatoos (about 50 cm in length), with a smaller crest (Pizzey & Knight 1997).

Habitat

The Glossy Black-cockatoo is dependent on *Allocasuarina* trees, and prefers woodland dominated by Allocasuarina, or open sclerophyll forests or woodlands, with middle stratum of *Allocasuarina* below *Eucalyptus* or *Angophora*; often confined to remnant patches in hills and gullies, surrounded by cleared agricultural land (Higgins 1999). Glossy Black-cockatoos prefer to live in rugged country, where extensive clearing has not taken place (NSW National Parks and Wildlife Service 1999b).

The species forages arboreally among branches of fruiting Allocasuarina. Prefers mature, sparse trees, between 2 and 10 m tall; dense regrowth (e.g. after bushfire.) It rarely forages in other shrubs or small trees of low woodlands or understorey (Arnett & Pepper 1997).

The species breeds in hollow stumps or spout of living or dead limb of eucalypt tree, or holes in trunks of tall tree. It breeds mainly within woodland or remnant woodland, but has been also recorded in dead, ringbarked eucalypt in cleared country. Entrances to hollows are either a hole in the side of a trunk, broken top of stump, or end of spout or limb (NSW National Parks and Wildlife Service 1999b).

Ecology

Glossy Black-cockatoos mostly roost in the canopy of live, leafy trees; preferring eucalypt trees, but will use other species, usually a kilometre from feeding site and during breeding season, within 30 m of nesting tree. Glossy Black-cockatoos feed exclusively on the seeds of mature *Allocasuarina* trees, occasionally taking wood-boring insect larvae, seeds of eucalypts, angophoras, hakeas and acacias (Higgins 1999).

Evidence of the bird is often indicated by a layer of cracked cones and fragments that have accumulated under favoured casuarina trees. A study in Eden, on the south coast of NSW, indicated that the Glossy Black-cockatoo is selective in its choice of food trees, choosing casuarinas that produce seeds with a high nutrient value (Crowley & Garnett 2001).

Glossy Black-cockatoos are dependent on large hollow-bearing eucalypts for nest sites. One or two eggs are laid between March and August (Garnett et al. 1999).

Distribution

The Glossy Black-cockatoo has a patchy distribution in Australia, having once been widespread across most of the south-eastern part of the country. It is now distributed throughout an area which extends from the coast near Eungella in eastern Queensland to Mallacoota in Victoria. In New South Wales, the current distribution of the Glossy Black-cockatoo covers areas from the coast to the tablelands, and as far west as the Riverina and Pilliga Scrub (NSW National Parks and Wildlife Service 1999b).

In study area:

Stands of Allocasuarina are found along the proposed route of the pipeline however no feeding signs including cracked cones were observed during the current survey.

Potential foraging and nesting resources were located in riparian/riverine fauna habitats adjacent the Macquarie River and some isolated Allocasuarina species were observed in open grassland/paddock in the southern section of the study area.

Twenty one sightings of this species have been recorded within 10km of the subject site (Department of Environment and Climate Change 2007a)

Threats

Specific threats to Glossy Black-cockatoo identified by the Department of Environment and Conservation (2005c) include:

- reduction of suitable habitat through clearing for development
- loss of tree hollows
- excessively frequent fire which reduces the abundance and recovery of she-oaks
- illegal bird smuggling and egg-collecting.

E9.1 Significance assessment - *Environmental Planning and Assessment Act 1979*

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

The proposed route has been aligned to avoid significant stands of *Allocasuarina* foraging resources as well as breeding habitat.

Significantly large areas of adjoining habitat containing foraging habitats and hollow-bearing trees will be retained. Therefore the potential removal of habitat by the proposal is unlikely to have a significant affect on the viability of the local population, and would not place it at risk of extinction.

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

Glossy Black-cockatoos occur extensively throughout east New South Wales suggesting that their preferred habitats occur over a wide geographic area. Only two locations within the study were identified as suitable foraging habitat for the Glossy Black-cockatoo. These include the riparian/riverine habitat adjacent Macquarie river and isolated paddock trees

throughout cleared grassland areas. Therefore, the proposal is unlikely to represent a significant area in relation to the regional distribution of habitat for the Glossy Black-cockatoo.

Glossy Black-cockatoos are dependent on *Allocasuarina* and prefer woodland dominated by this species. Small fragments of Allocasuarina are scattered throughout the study area however no feeding signs including cracked cones were observed during the current survey. Therefore it is unlikely the removal of vegetation will affect habitat of this species.

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

Glossy Black-cockatoos occur in coastal and inland eastern Australia from Eungall National Park in Queensland to Wingan Inlet in eastern Victoria, with an isolated population on Kangaroo Island (Pizzey & Knight 1997). Therefore, this species is not at its distributional limit within the study area.

How is the proposal likely to affect current disturbance regimes?

Much of the proposed pipeline route occurs within already cleared or fragmented habitats that include a range of disturbances commonly found in agricultural landscapes.

The proposal will require clearing of vegetation and habitats in relatively intact areas and as such will introduce new edge effects to these sites. In total, the removal of 41.4 ha of vegetation will create new edge effects that may include weeds, increased levels of predation, increased noise and changed hydrological regimes.

How is the proposal likely to affect habitat connectivity?

The movements of Glossy Black-cockatoos are poorly known (Crowley & Garnett 2001), although the species appears to occupy one area permanently, though individuals and sub groups may move around within it. Glossy Black-cockatoos are known to fly large distances of up to 12 km when moving between breeding and feeding areas, and flocks are said to move locally when preferred foraging areas become depleted of food (Higgins 1999).

The proposal will not isolate habitat for the Glossy Black-cockatoo.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species (Department of Environment and Conservation, Threatened Species Unit). Areas of habitat containing foraging habitats and hollow-bearing trees occur adjacent to the site and would be retained. The habitat to be removed is unlikely to be critical to the survival of this species.

Conclusion

The proposal is not likely to have a significant impact on the Glossy Black-cockatoo as areas of suitable habitat for these species have been indirectly avoided through the route selection process.

E10. Forest Owls

Three large forest owls have been considered together as a group because of the similarity of habitats and the likely impacts of the proposal. The three species are:

- Powerful Owl (*Ninox strenua*)
- Masked Owl (*Tyto novaehollandiae*)
- Barking Owl (*Ninox connivens*).

E10.1 Powerful Owl (*Ninox strenua*)

Status

The Powerful Owl is listed as vulnerable under Schedule 2 of the *Threatened Species Conservation Act 1995.*

Description

The Powerful Owl is a typical hawk-owl, with staring yellow eyes and no facial-disc and is one of the largest forest owl species in Australasia (Simpson & Day 1996). Adults reach 60 cm in length, have a wingspan of up to 140 cm and weigh up to 1.5 kg (Pizzey & Knight 1997). The upper parts of the Powerful Owl are dark, greyish-brown with indistinct off-white bars. The underparts are whitish with dark greyish-brown V-shaped markings. Juvenile Powerful Owls have a white crown and underparts that contrasts with its small, dark streaks and dark eye patches. The slow, deep and resonant double hoot call of this species may be heard at any time of the year, but it is more vocal during the winter breeding season (NSW National Parks and Wildlife Service 1998).

Habitat

The Powerful Owl inhabits a range and mosaic of vegetation types, from woodland and open sclerophyll forest (on productive sites) to tall open wet forest and rainforest, with mesic gullies and permanent streams (Debus & Chafer 1994). The owl requires large tracts of forest or woodland habitat but can also occur in fragmented landscapes. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine (*Syncarpia glomulifera*), Black She-oak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angophora floribunda*), Cherry Ballart (*Exocarpus cupressiformis)* and a number of eucalypt species. Open eucalypts on hillsides are used infrequently (Higgins 1999).

Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80 - 240 cm) that are at least 150 years old. The nest sites are situated 12 – 40 m above the ground, often at the head of a gully, or on the face of a hill (Kavanagh & Debus 1994). During the breeding season, the male Powerful Owl roosts in a "grove" of up to 20-30 trees, situated within 100-200 m of the nest tree where the female shelters (NSW National Parks and Wildlife Service 1998).

Ecology

The main prey items are medium-sized arboreal marsupials, particularly the slow-moving Greater Glider, as well as Common Ringtail Possum and Sugar Glider. There may be marked regional differences in the prey taken by Powerful Owls (Kavanagh et al. 1995). For example in southern NSW, Ringtail Possum make up the bulk of prey in the lowland or coastal habitat. At higher elevations, such as the tableland forests, the Greater Glider may constitute almost all of the prey for a pair of Powerful Owls (Kavanagh 1992). Birds comprise about 10% of the diet, with flying foxes important in some areas (Schulz 1997).

As most prey species require hollows and a shrub layer, these are important habitat components for the species (Department of Environment and Conservation 2005c).

It is possible that this species forages along the forest edge where it consumes hares, rabbits and open country birds. Each bird must catch as many as 80 to 100 possums and gliders a year with catches at two to three day intervals to survive. Allowing for breeding and the rearing of one or two young owls, each territory may have to produce about 250-300 possums a year (or their equivalent) for the owls to survive (Kavanagh et al. 1995).

Powerful Owls are monogamous and mate for life, often up to 30 years or more. Nesting occurs from late autumn to mid-winter, but is slightly earlier in north-eastern New South Wales (late summer - mid autumn). Clutches consist of two dull white eggs and incubation lasts approximately 38 days (Higgins 1999). Outside of the breeding season, mated males and females roost apart, although always within calling distance. During the day, the birds roost on bar branches, often 20 m in the air, where they can gain a clear view of the surrounding area (Debus & Chafer 1994). Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400 - 1,450 ha (Debus 1995).

Distribution

The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In New South Wales, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains. Powerful Owl are now uncommon throughout its range where it occurs at low densities (Department of Environment and Conservation 2005c).

In the north coast bioregion it has been recorded from the Tweed, Brunswick, Richmond, Clarence, Bellinger, Macleay, Hastings, Manning and Hunter River valleys (Department of Environment and Conservation 2005a).

Currently, the majority of potential habitat for the Powerful Owl is restricted to conservation reserves and State Forests, although this species also occurs within large areas of forest on other public lands and on private land, including suburban bushland. The Powerful Owl has been recorded in many national parks and State forests throughout its range in NSW ((Department of Environment and Conservation 2005a; Kavanagh & Debus 1994).

In the study area:

Powerful Owl was recorded within riparian/riverine fauna habitat adjacent Macquarie River within the study area. Large hollow-bearing trees that have the potential be used by this species were recorded adjacent to the proposed pipeline route.

Threats

Specific threats to Powerful Owl identified by the Department of Environment and Conservation (2005c) include:

- historical loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development. This loss also affects the populations of arboreal prey species, particularly the Greater Glider which reduces food availability for the Powerful Owl
- inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees. Loss of hollow-bearing trees reduces the availability of suitable nest sites and prey habitat
- can be extremely sensitive to disturbance around the nest site, particularly during pre-laying, laying and downy chick stages. Disturbance during the breeding period may affect breeding success
- high frequency hazard reduction burning may also reduce the longevity of individuals by affecting prey availability
- road kills
- secondary poisoning
- predation of fledglings by foxes, dogs and cats.

E10.2 Masked Owl (*Tyto novaehollandiae*)

Status

The Masked Owl is listed as Vulnerable under Schedule 2 of the *Threatened Species Conservation Act 1995.*

Description

The Masked Owl is a medium-sized owl (40 - 50 cm long), with dark eyes set in a prominent flat, heart-shaped facial disc that is encircled by a dark border. The feet are large with fully feathered legs down to the toes. Masked Owls have several colour forms, with wide variation in plumage. The upperparts are grey to dark brown with buff to rufous mottling and fine, pale spots. The wings and tail are well barred. The underparts are white to rufous-brown with variable dark spotting. The palest birds have a white face with a brown patch around each eye with the darkest birds having a chestnut-coloured face. Masked Owl are cryptic in nature and are often confused with the Barn Owl (Pizzey & Knight 1997).

Habitat

The Masked Owl inhabits dry sclerophyll forest, wet sclerophyll gullies and woodland generally with a low sparse understorey, however is known to utilise open and partially cleared habitats (Marchant & Higgins 1993). Kavanagh et al. (1995) suggest that the species may have a preference for forest types with a dry and open understorey and mosaic of dense and sparse groundcover.

The Masked Owl is a shy and secretive species that roosts by day predominantly in tree hollows, although occasionally in thick foliage and caves. Nest and roost sites are often associated with large hollows in wet sclerophyll gullies where hollows may be used for several years (Debus & Rose 1994; Department of Environment and Conservation 2005c).

Nests have been located in vertical trunk or spout hollows 10 to 30 m above ground (Debus & Rose 1994). Large roomy hollows are preferred for nesting, with depths varying from 0.4 to 5 m (Kavanagh et al. 1995). Nest trees are often an isolated stem or emergent above the canopy. Most recorded nest sites have been in live eucalypts, however the species has also been observed nesting in dead trees (Gibbons & Lindenmayer 1997).

Ecology

The Masked Owl preys upon some species of hollow-dependent marsupial, however it is primarily a predator of small terrestrial mammals in eucalypt forest and woodland, and on ecotones between these and open areas (Debus & Rose 1994). The female is larger than the male and it is thought that each sex takes a different range of prey animals. However, in general this species feeds mainly on terrestrial mammals up to the size of a rabbit. Rats feature prominently in their diet (Kavanagh 1996). In Tasmania this species is known to prey on native and introduced rodents, bandicoots, Sugar Gliders, Ring-tailed Possums, rabbits, bats and birds including raptors and domestic poultry (Marchant & Higgins 1993).

Masked Owls are highly mobile and pairs occupy a large home range of approximately 500 to 1,000 ha. The species mates for life and maintains permanent territories. Like other Tyto owls, Masked Owl are an opportunistic species and may breed at any time of the year, with most eggs laid from March to July (Kavanagh 1996).

Distribution

The Masked Owl occurs from sea level to 1,100 m, predominantly within 300 km from the coast (Garnett & Crowley 2000). The Masked Owl is sparsely distributed along the entire New South Wales coastline and are also abundant in the western plains. Overall records for this species fall within approximately 90% of New South Wales, excluding the most arid north-western corner.

In the study area:

Masked Owl was not recorded during the current survey. Suitable habitat for this species occurs within riparian/riverine woodland adjacent major water courses. open forest, open woodland and cleared areas may provide marginal foraging habitat for this species.

Threats

Specific threats to Masked Owl identified by the Department of Environment and Conservation in the Draft Recovery Plan for Large Forest Owls (Department of Environment and Conservation 2005c) include:

- loss of mature hollow-bearing trees and changes to forest and woodland structure, which leads to fewer such trees in the future
- clearing of habitat for grazing, agriculture, forestry or other development
- a combination of grazing and regular burning is a threat, through the effects on the quality of ground cover for mammal prey, particularly in open, grassy forests
- secondary poisoning from rodenticides
- being hit by vehicles.

E10.3 Barking Owl (*Ninox connivens*)

Status

The Barking Owl (*Ninox connivens*) is listed as Vulnerable under the *Threatened Species Conservation Act 1995*.

Description

The Barking Owl is a typical hawk-owl, with staring, yellow eyes and no facial-disc. It is grey to greyish-brown above, with white spots on the wings and almost white underneath with greyish-brown vertical streaks. The larger male may be up to 45 cm in length, larger than the Southern Boobook (*Ninox novaeseelandiae*) and smaller than the Powerful Owl (*N. strenua*) (Department of Environment and Climate Change 2007d).

Distribution

The Barking Owl is found throughout Australia except for the central arid regions and Tasmania. It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains (Department of Environment and Climate Change 2007d).

Habitat and Ecology

The Barking Owl inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as *Acacia* and *Casuarina* species, or the dense clumps of canopy leaves in large Eucalypts.

The Barking Owl feeds on a variety of prey including invertebrates, birds and mammals such as smaller gliders, possums, rodents and rabbits. Breeding occurs during late winter and early spring (Department of Environment and Climate Change 2007d).

E10.4 Significance assessment - *Environmental Planning and Assessment Act 1979*

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

The project involves the removal of 41.4 ha of native vegetation affected by different degrees of disturbance. This vegetation includes foraging areas that may potentially be used by large forest owls. Three hollow-bearing trees with potential to be used by these species for breeding were recorded in or near the construction footprint. Given the small scale impacts and the availability of similar foraging and nesting habitats in the study area and wider locality that will remain unaffected it is unlikely the proposal will affect the lifecycle of these species of forest owl.

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

The proposal involves the removal of 41.4 ha of native vegetation affected by different degrees of disturbance. This vegetation includes foraging areas that may potentially be used for breeding by large forest owls. No hollow-bearing trees actively used by these species for breeding were recorded in or near the construction footprint. Similar habitat will be retained in adjacent areas continuing to provide resident owls with foraging and breeding resources. The removal of this habitat is not considered to be significant in a regional context.

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

The study area is not at the distributional limit of any of the species of large forest owl.

How is the proposal likely to affect current disturbance regimes?

Parts of the proposal occur within already cleared or fragmented habitats that include a range of disturbances commonly found in agricultural landscapes. Current disturbance regimes will remain unaffected by the proposal.

How is the proposal likely to affect habitat connectivity?

The proposed route will not isolate habitat for these highly mobile species. The extent of the construction corridor is 30 m in which large forest owls will readily fly above to access other areas of foraging habitat.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species. The site is unlikely to be critical to the survival of the species.

Conclusion

The proposal is unlikely to have a significant impact on the large forest owls. Suitable habitat is available, and will remain so, adjacent to the proposal.

E11. Grey Falcon (*Falco hypoleucos*)

Status

The Grey Falcon is listed as Vulnerable under the T*hreatened Species Conservation Act 1995.*

Description

The Grey Falcon is a medium-sized, compact, pale falcon with a heavy, thick-set, deep-chested appearance. Upperparts are uniform light grey, shading to blackish on the primaries, forming conspicuous dark wing tips. The tail has narrow blackish bars. The chin, throat and cheeks are white, and the rest of the under body is pale grey. The eye-ring, cere and base of the bill are bright orange-yellow, and the tip of the bill black (Department of Environment and Climate Change 2007d).

Distribution

The Grey Falcon is sparsely distributed in New South Wales, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. There are possibly less than 5000 individuals left. Population trends are unclear, though it is believed to be extinct in areas with more than 500mm rainfall in New South Wales.

Habitat and ecology

The Grey Falcon is usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, and is occasionally found in open woodlands near the coast. Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse (Department of Environment and Climate Change 2007d).

In the study area

The Grey Falcon was recorded foraging within cleared agricultural lands in the study area during the current survey. Suitable nesting habitat for this species occurs in the riparian/riverine vegetation along major water courses whilst open woodland/forest and cleared areas provide foraging habitat.

E11.1 Significance assessment - *Environmental Planning and Assessment Act 1979*

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

The proposal involves the removal of 41.4 ha of native vegetation affected by different degrees of disturbance. Of this 41.4 ha only 3 ha of riparian/riverine fauna habitat likely to be used for nesting by the Grey Falcon will be affected. In addition, given the small scale impacts associated with the proposal and the remaining vegetation within the study area and locality that will remain unaffected, it is unlikely the lifecycle processes of this species (i.e. nesting and foraging) will be affected.

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

The proposal involves the removal of 41.4 ha of native vegetation affected by different degrees of disturbance. This vegetation includes foraging areas that may potentially be used for breeding by the Grey Falcon. Similar habitat will be retained in adjacent areas continuing to provide Grey Falcon with foraging and breeding resources. The removal of this habitat is not considered to be significant in a local and regional context.

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

The study area is not at the distributional limit of the Grey Falcon.

How is the proposal likely to affect current disturbance regimes?

Parts of the proposal occur within already cleared or fragmented habitats that include a range of disturbances commonly found in agricultural landscapes. Current disturbance regimes will remain unaffected by the proposal.

How is the proposal likely to affect habitat connectivity?

The proposed route will not isolate habitat for these highly mobile species. The Grey Falcon will readily fly above cleared areas to access other areas of foraging habitat.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General of the Department of Environment and Climate Change maintains a register of critical habitat. To date, no critical habitat has been declared for this species. The site is unlikely to be critical to the survival of the species.

Conclusion

The proposal is unlikely to have a significant impact on the Grey Falcon. Suitable habitat is available, and will remain so, adjacent to the proposal.

E12. Blue-billed Duck (*Oxyura australis*)

Status

The Blue-billed Duck is listed as Vulnerable under the *Threatened Species Conservation Act 1995*

Description

The Blue-billed Duck is a small and compact duck, with a length of 40 cm. The male's head and neck are glossy black, and the back and wings are a rich chestnut to dark-brown. During the summer breeding season the male's bill turns bright blue. The female is brownish-black above, with narrow bands of light brown and mottled light brown and black below. The female's bill is dark grey-green. In the non-breeding season the male resembles a dark female (Department of Environment and Climate Change 2007d).

Distribution

The Blue-billed Duck is endemic to south-eastern and south-western Australia. It is widespread in New South Wales, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away (Department of Environment and Climate Change 2007d).

Habitat and ecology

The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached (Department of Environment and Climate Change 2007d).

Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Blue-billed Ducks usually nest solitarily in vegetation over deep water between September and February. They will also nest in trampled vegetation in sedges or Spike-rushes, where a bowl-shaped nest is constructed (Department of Environment and Climate Change 2007d).

Threats to this species include:

- Frequent burning which reduces the diversity of woody plant species.
- Destruction or degradation of breeding habitat through drainage, flood mitigation works and ground water extraction.
- Regulation of river flows and water harvesting schemes can poses a major threat to flooding regimes of inland wetland breeding areas.
- Clearing and overgrazing of Cumbungi and Lignum.
- Increased salinity can result in degradation and loss of tall dense wetland vegetation used for nesting.

- Illegal hunting.
- Pesticides and herbicide pollution of wetlands
- Rubbish dumping (Department of Environment and Climate Change 2007d)

The Blue-billed duck was recorded within the Macquarie River during the current survey.

E12.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

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

When breeding, the Blue-billed Duck is dispersed on deep fresh swamps and lakes, densely vegetated throughout where rushes or sedges provide soft vegetation for nest building. It is uncommon for this species to breed on river frontages (Marchant & Higgins 2004).

The Blue-billed duck was observed along the Macquarie River during the current survey. The proposed gas pipeline will cross the Macquarie River approximately 20 km west of the town of Wellington. To minimise impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River.

No nests that may potentially be used by the Blue-billed duck (generally created between September and February) were observed on the edges of the Macquarie River in the study area. Given that directional drilling is unlikely to interfere with riparian vegetation and the study area does not provide suitable breeding habitat, it is unlikely the proposal will affect the lifecycle of this species.

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

The study area contains foraging resources for the Blue-billed Duck. The proposed gas pipeline will cross the Macquarie River approximately 20 km west of the town of Wellington. To minimise impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River.

Therefore the proposal is unlikely to significantly affect the availability of foraging habitat in the study area and wider locality. Furthermore, the large home range of the species allows foraging resources away from the study area to be accessed.

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

In New South Wales the Blue-billed Duck is widespread but mostly confined to the Murray Darling Basin (Department of Environment and Climate Change 2007d). Therefore the study area is not at the distributional limit of the Blue-billed Duck.

How is the proposal likely to affect current disturbance regimes?

The Proposal would not significantly affect fire (intensity and frequency), flooding or other disturbance regimes. The Proposal is adjacent to cleared areas from agriculture and generally the pattern of disturbance would stay similar to what currently exists.

Therefore it is unlikely the proposal will affect current disturbance regimes.

How is the proposal likely to affect habitat connectivity?

The study area contains habitat and foraging resources for the Blue-billed Duck. Furthermore, this species is highly mobile and have a large foraging range that allows them to use similar habitat resources in the study area and locality.

Therefore, it is highly unlikely that the proposed action would affect connectivity between suitable habitats for the Blue-billed Duck.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species. The site is unlikely to be critical to the survival of the species.

Conclusion

The Blue-billed Duck is unlikely to be significantly affected by the Proposal.

E13. Microchiropteran bats

Three microchiropteran bat species have been included in this assessment because they are likely to be affected similarly by the proposal. Threatened species assessed below include the following species:

- Greater Long-eared Bat (*Nyctophilus timoriensis*) – recorded within study area
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Little Pied Bat (*Chalinolobus picatus*) – recorded within study area

E13.1 Greater Long-eared Bat (*Nyctophilus timoriensis*)

Status

The Greater Long-eared Bat is listed as Vulnerable under both the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1995*.

Description

The Greater Long-eared Bat is uniformly dark grey-brown. The ears are approximately 3 cm long and larger than the head. It has a low ridge of skin running between the eyes and across the nose. It has a head and body length of 5 - 7 cm and weighs about 14 grams (Department of Environment and Climate Change 2007d).

Distribution

The distribution of the Greater Long-eared Bat coincides approximately with woodland areas across the arid and semi-arid regions of Australia (Strahan 1995). In eastern Australia the distribution of this species corresponds strongly with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species (Department of Environment and Climate Change 2007d).

Habitat and Ecology

The Greater Long-eared Bat inhabits a variety of vegetation types including mallee, *Allocasuarina luehmannii* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland (Department of Environment and Climate Change 2007d).

This species roosts in tree hollows, crevices, and under loose bark and mating generally takes place in autumn with one or two young born in late spring to early summer (Department of Environment and Climate Change 2007d) .

The Greater Long-eared Bat was recorded in open forest habitat adjacent to Goobang National Park in the southern half of the study area.

E13.2 Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)

Status

The Yellow-bellied Sheathtail Bat is listed as Vulnerable under the *Threatened Species Conservation Act 1995*.

Description

The Yellow-bellied Sheathtail Bat is a distinctive, large, microchiropteran bat up to 87 mm long. This species has long, narrow wings, a glossy, jet-black back, and a white to yellow belly extending to the shoulders and just behind the ear. Characteristically, it has a flattened head and a sharply-pointed muzzle. The tail is covered with an extremely elastic sheath that allows variation in the tail-membrane area (Churchill 1998).

Habitat

Yellow-bellied Sheathtail Bats occur in almost all habitats including wet and dry sclerophyll forest, open woodland, *Acacia* shrubland and grasslands. This species roosts in hollows of live and dead trees, the outside walls of buildings, under exfoliating bark, or in burrows of terrestrial mammals in treeless areas. They have also been found in the abandoned nests of Sugar Glider (*Petaurus breviceps*) or birds (Richards 1998).

Ecology

Yellow-bellied Sheathtail Bats forage above the tree canopy. Foraging height varies with the height of the canopy; they fly high and fast. In more open country they forage lower to the ground (Lumsden & Bennett 1995). This species eats a variety of prey mainly beetles (up to 90%) but also long-horned grasshoppers, shield bugs and few flying ants (Churchill 1998).

Yellow-bellied Sheathtail Bats tend to be solitary for most of the year but may form small groups of up to six. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown and there is speculation about a migration to southern Australia in late summer and autumn (Richards 1998).

Distribution

The Yellow-bellied Sheathtail Bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range (most of Victoria, south-western New South Wales and adjacent South Australia) it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes (Department of Environment and Conservation 2005d).

E13.3 Little Pied Bat (*Chalinolobus picatus*)

Status

The Little Pied Bat (*Chalinolobus picatus*) is listed as Vulnerable under the *Threatened Species Conservation Act 1995*

Description

The Little Pied Bat is a distinctive black and white bat that weighs 4 – 8 g to. The head and body are about 4.5 cm in length and the tail is 3.5 cm. The fur is glossy black on the back,

grey on the belly, with white fur along the flanks forming a 'V' in the pubic area (Department of Environment and Climate Change 2007d).

Distribution

The Little-Pied Bat is found in inland Queensland and New South Wales (including Western Plains and Slopes) extending slightly into South Australia and Victoria (Department of Environment and Climate Change 2007d).

Habitat and ecology

The Little-Pied Bat occurs in dry open forest, open woodland, mulga woodlands, chenopod shrub lands, cypress-pine forest, mallee and Bimbil box vegetation communities throughout its distribution. This species generally roosts in caves, rock outcrops, mine shafts, tunnels, and buildings and is also known to occupy tree hollows. This species can tolerate high temperatures and dryness but need access to nearby open water (Department of Environment and Climate Change 2007d).

Within the study area:

Calls from the Little-pied bat were recorded using an Anabat II bat detector in both riparian/riverine forest fauna habitat (adjacent Little River) and open forest fauna habitat within the study area.

E13.4 Significance assessment - *Environmental Planning and Assessment Act 1979*

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

The proposal involves the removal of 41.4 ha of potential foraging habitat for these three species. In addition six hollow-bearing trees that may provide potential roosting sites for Greater Long-eared, Yellow-bellied Sheathtail Bats and Little-Pied Bat will be removed as a result of the proposal. However similar resources are available and would be accessible in the study area and the wider region that will not be affected by the proposal.

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

The proposal involves the removal of 41.4 ha of native vegetation. Some tree hollows suitable for roosting will also be removed. However, in a regional context, similar foraging and roosting habitat is likely to be well-represented in several highly vegetated areas including Goobang National Park in the west, Catombal Range in the east and Nangar range in the north. The proposal is therefore unlikely to remove a significant area of known foraging and potential roosting/breeding habitat.

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

Both the Greater long-eared bat, Yellow-bellied Sheathtail bat and Little-Pied Bat considered in this assessment are not at the limit of their distribution within the study area.

How is the proposal likely to affect current disturbance regimes?

Parts of the proposal occur within already cleared or fragmented habitats that include a range of disturbances commonly found in agricultural landscapes. However the proposal will require clearing of vegetation and habitats in relatively intact areas and as such will introduce new edge effects to these sites. In total, 41.4 ha of forest/woodland and riparian/riverine vegetation will be affected.

How is the proposal likely to affect habitat connectivity?

The proposal will not isolate habitat for microchiropteran bats as the proposed pipeline will not create a barrier to movement for these highly mobile species.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General of the Department of Environment and Climate Change maintains a register of critical habitat. To date, no critical habitat has been declared for these species. The site provides foraging habitat for these species. No maternity roosts occur within the site and further areas of habitat are found extensively within the study area and broader region. The site is unlikely to be critical to the survival of these species.

Conclusion

The proposal is unlikely to have a significant impact on species of microchiropteran bat. Although habitat will be removed, similar habitats are available in the local and regional area that would not be affected.

E13.5 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

The Greater Long-eared Bats that forage in the site are not considered an 'important population' because:

- the population in the study area is not a key source population either for breeding or dispersal
- the population is not necessary for maintaining genetic diversity
- the population is not at the limit of the species range

Will the action lead to a long-term decrease in the size of an important population of a species?

The population of Greater Long-eared Bats in the study area is not considered to be an important population.

The proposal involves the removal of 41.4 ha of foraging habitat for the Greater Long-eared Bat. Hollow-bearing trees that may provide potential roosting sites for this species will also be removed as a result of the proposal. However similar resources are available and would be accessible in the study area and the wider region that will not be affected by the proposal.

In a regional context, similar foraging and roosting habitat is likely to be well-represented in several highly vegetated areas including Goobang National Park in the west, Catombal

Range in the east and Nangar range in the north. Given the availability of resources in the wider locality, the proposal will not lead to a long term decrease in the size of the local population of this species.

Will the action reduce the area of occupancy of an important population?

The population of Greater Long-eared Bats in the study area is not considered to be an important population.

The proposal involves the removal of 41.4 ha of native vegetation. Some tree hollows suitable for roosting will also be removed. However, in a regional context, similar foraging and roosting habitat is likely to be well-represented in several highly vegetated areas including Goobang National Park in the west, Catombal Range in the east and Nangar range in the north. The proposal is therefore unlikely to remove a significant area of known foraging and potential roosting/breeding habitat and will not reduce the area of occupancy for this species.

Will the action fragment an existing important population into two or more populations?

The population of Greater Long-eared Bats in the study area is not considered to be an important population.

The proposal will not isolate habitat for microchiropteran bats as the proposed pipeline will not create a barrier to movement for this highly mobile species.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the Greater Long-eared Bat.

Habitat critical to the survival of threatened species may, however, also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006).

The extent of the habitat that would be cleared as a result of the proposal does not represent habitat critical to the survival of Greater Long-eared Bat.

Will the action disrupt the breeding cycle of an important population?

The population of Greater Long-eared Bats in the study area is not considered to be an important population.

The proposal involves the removal of 41.4 ha of foraging habitat for the Greater Long-eared Bat. Hollow-bearing trees that may provide potential roosting sites for this species will be removed as a result of the proposal. However similar resources are available and would be accessible in the study area and the wider region that will not be affected by the proposal.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposal involves the removal of native vegetation. Some tree hollows suitable for roosting will also be removed. However, in a regional context, similar foraging and roosting habitat is likely to be well-represented in several highly vegetated areas including Goobang National Park in the west, Catombal Range in the east and Nangar range in the north. The proposal is therefore unlikely to remove a significant area of known foraging and potential roosting/breeding habitat for this species.**Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?**

The proposal is unlikely to introduce any new invasive species to the area.

Will the action interfere substantially with the recovery of the species?

The proposed pipeline does not present a significant barrier to species' movement, and would not result in the fragmentation of existing populations or the disruption of species' life-cycles. In addition, no critical habitat has been declared within the proposal corridor and the availability of adjacent foraging habitat combined with the high mobility of the species further suggests that the recovery of the Greater Long-eared Bat would not be substantially affected.

Conclusion

The proposal is unlikely to have a significant impact on Greater Long-eared Bat in the study area. Although foraging habitat will be removed, similar habitat is available in both the local and regional area.

E14. Squirrel glider (*Petaurus norfolcensis*)

Status

The Squirrel Glider is listed as Vulnerable under Schedule 2 of the *Threatened Species Conservation Act 1995*.

Endangered populations are listed under Part 2 of Schedule 1 of the *Threatened Species Conservation Act 1995*. Two endangered populations of Squirrel Glider are listed under the Act including the Barrenjoey Peninsula and Wagga Wagga Local Government Area populations. The population of Squirrel Glider in the study area does is not considered be endangered.

Description

Adult Squirrel Gliders have a head and body length of about 20 cm. They have blue-grey to brown-grey fur above and white on the belly. The prehensile tail is broad, long and bushy and soft with a dark tip. There is a dark stripe from between the eyes to the mid-back and the tail is soft and bushy averaging about 27 cm in length (Strahan 1995).

Habitat

Squirrel Gliders inhabit mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt, Forest Redgum and Bloodwood forest with banksia heath understorey in coastal areas. They also occurs in Grey Gum/Spotted Gum/Grey Ironbark dry hardwood forest of the central NSW Coast(Department of Environment and Conservation 2005a). Squirrel Gliders generally prefers mixed species stands with a shrub or gum-producing *Acacia* midstorey. Suitable vegetation communities include at least one flora species that would flower heavily in winter and one or more of the eucalypts should be smooth-barked (Department of Environment and Conservation 2005a).

Tree hollows greater than 5 cm diameter in both living and dead trees as well as hollow stumps are used as den sites for refuge and nesting (Gibbons & Lindenmayer 1997). Studies in Queensland showed that Squirrel Gliders used ironbark eucalypts and stags more than the hollows of smooth barked eucalypts and non-eucalypt tree species (Rowston 1998).

The abundance of Squirrel Gliders increases significantly with canopy height, canopy cover, the number of mature and old-growth trees and the number of tree hollows (Smith & Murray 2003).

Ecology

The diet includes *Acacia* gum, eucalypt sap, nectar, honeydew and manna, lichens with invertebrates and pollen providing protein (NSW National Parks and Wildlife Service 1999d).

Squirrel Gliders utilise tree hollows for diurnal shelter either alone or in family groups of up to six individuals and offspring that occupy the same hollow simultaneously. The size and composition of groups of gliders occupying a particular hollow varies from day to day because gliders regularly swap den trees (Van de Ree 2002). The nests are bowl-shaped and lined with leaf within tree hollows (Triggs 1996). The maximum age of a Squirrel Glider is 5-6 years and predation by owls are a common natural cause of mortality (NSW National Parks and Wildlife Service 1999d).

Squirrel Gliders are agile climbers and can glide for more than 50 m in one movement. Nightly movements are estimated as between 300 and 500 m. Home-ranges have been estimated as between 0.65 and 8.55 ha and movements tend to be greater for males than females. The home-range of a family group is likely to vary according to habitat quality and availability of resources, with more productive forests attributed to smaller home ranges (Quin 1995).

Distribution

Squirrel Gliders are widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria (Department of Environment and Conservation 2005a).

In the study area:

Squirrel Glider was not recorded in the current field surveys; however it has been recorded previously within Goobang National Park.

Threats

Specific threats to Squirrel Gliders identified by the Department of Environment and Conservation (2005d) include:

- loss and fragmentation of habitat
- removal of hollow-bearing trees
- loss of flowering understorey and mid-storey shrubs in forests
- individuals can get caught in barbed wire fences while gliding
- predation by foxes and cats
- inappropriate fire regimes may deplete food resources and isolate populations making them susceptible to regional.

E14.1 Significance assessment - *Environmental Planning and Assessment Act 1979*

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

The species was not recorded during the current survey and only few previous records of Squirrel Glider exist in the local area. The proposal involves the removal of a total of 7.7 ha of open forest habitat that offer foraging habitat for the Squirrel Glider. In addition 13 tree hollows suitable for Squirrel Glider occupancy were identified within the 30 m construction footprint of the proposal.

If this species is present within the study area significantly large areas of fauna habitat suitable for lifecycle processes in adjacent areas, including Goobang National Park would remain unaffected by the proposal.

Given the availability of habitat resources in the wider locality the proposal is considered unlikely to disrupt the lifecycle of this species.

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

The proposal involves the removal of a total of 7.7 ha of open forest that offers habitat for the Squirrel Glider.

Significantly large areas of similar habitat in adjacent areas including Goobang National Park would remain unaffected by the proposal. The removal of habitat for the Squirrel Glider is not considered significant in a local and regional context.

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

Squirrel Gliders are widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Therefore, the study area is not at the distributional limit for this species.

How is the proposal likely to affect current disturbance regimes?

Parts of the proposal occur within already cleared or fragmented habitats that include a range of disturbances commonly found in agricultural landscapes. Current disturbance regimes will remain unaffected by the proposal.

How is the proposal likely to affect habitat connectivity?

Squirrel Gliders are agile climbers and can glide for more than 50 m in one movement. Nightly movements are estimated as between 300 and 500 m. Home-ranges have been estimated as between 0.65 and 8.55 ha and movements tend to be greater for males than females. The home-range of a family group is likely to vary according to habitat quality and availability of resources (Quin 1995).

7.7 ha of suitable foraging habitat for the Squirrel Glider will be directly affected by the proposal. Given the agile movement and large home ranges of this species it is considered unlikely the proposal will affect habitat connectivity for this species.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General of the Department of Environment and Climate Change maintains a register of critical habitat. To date, no critical habitat has been declared for this species (Department of Environment and Conservation, Threatened Species Unit). Suitable habitat will be retained in adjacent areas (including Goobang National Park) and continue to provide foraging and breeding resources.

Conclusion

The proposal is unlikely to have a significant impact on Squirrel Glider in the study area. No individuals were recorded despite targeted survey and similar habitats to those likely to be affected by the proposal are available in both the local area and the wider region.

E15. Koala (*Phascolarctos cinereus*)

Status

The Koala is listed as vulnerable under the *Threatened Species Conservation Act 1995*.

Two population of Koala are currently listed as Endangered under Part 2 of Schedule 1 of the *Threatened Species Conservation Act 1995* (Hawks Nest and Tea Gardens area population and the Pittwater Local Government Area population). Koalas in the study area do not form part of these populations.

Description

The Koala is an arboreal marsupial with fur ranging from grey to brown above, and is white below. It has large furry ears, a prominent black nose and no tail. It spends most of its time in trees and has long, sharp claws, adapted for climbing. Adult males weigh 6-12 kg and adult females weigh 5–8 kg (NSW National Parks and Wildlife Service 2002).

Habitat

Koalas are found in areas where there are suitable feed trees, ranging from open eucalypt woodlands to dense forests. Like other folivores, this species tends to be associated with forests growing on high-nutrient soils along river flats and drainage lines, most of which have been cleared for farmland (NSW National Parks and Wildlife Service 1999c). The suitability of forest and woodland communities as habitat for Koalas is influenced by the size and species of trees present, soil nutrients, climate, rainfall and the size and disturbance history of the habitat patches. Koalas feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species (Moore & Foley 2000).

Ecology

Koalas are generally Inactive for most of the day, feeding and moving mostly at night. They spend most of their time in trees, but will descend and traverse open ground to move between trees. They are generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Home range size varies with quality of habitat, ranging from less than two to several hundred hectares in size (Lunney et al. 2000).

Young males reach sexual maturity at approximately two years, although they are generally excluded from mating by the dominant male. Females reach sexual maturity at approximately two years and can produce one offspring each year, generally in summer (Ellis et al. 2000).

Following birth, the young lives in the pouch for 6 months and on leaving the pouch it remains dependent on its mother, riding on her back. Young reach independence at about 12 months, although they can remain in the mother's home range for a further 2 - 3 years. After this period, young animals disperse to establish their own home range (Logan & Sanson 2003). Dispersal distances generally range from 1-11 km, although movements in excess of 50 km have been recorded (NSW National Parks and Wildlife Service 2002).

Most young disperse at two to three years of age and females remain in their natal area. If no suitable habitat is found by young individuals then they become nomadic (Lunney et al. 2000).

Distribution

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In New South Wales it mainly occurs on the central and north coasts with some populations in the western region. It was historically abundant on the south coast of New South Wales, but now occurs in sparse and possibly disjunct populations (NSW National Parks and Wildlife Service 2003b).

Although Koalas have been recorded in numerous conservation reserves and State Forests along the east coast and the slopes and tablelands of the Great Dividing Range, the species has poor representation in conservation reserves and is reliant predominantly upon freehold land and public outside the conservation reserve system (NSW National Parks and Wildlife Service 2003b).

In the study area:

This species was not recorded during the current survey despite targeted surveys including call playback, spotlighting and scat and track searches.

However despite the current survey, two individuals have been recorded within the locality including one in Goobang National Park and one potentially within road side vegetation in the town of Wellington (Department of Environment and Climate Change 2007a).

Suitable habitat for the Koala within the study area is found adjacent large watercourses in riparian/riverine vegetation.

Threats

Specific threats identified in the Koala Draft Recovery Plan by the NSW National Parks and Wildlife Service (2003b) includes:

- destruction of habitat by clearing for urban development, agriculture and mining, particularly on high nutrient content soils
- fragmentation of habitat by roads, urban development and agriculture, which creates barriers to movement, isolates individuals and populations, alters population dynamics and prevents gene flow and the ability to maintain recruitment levels
- mortality from attacks by dogs, road fatalities, fires, drought or other natural disasters, particularly in fragmented landscapes without suitable refuge areas
- degradation of habitat by fire, weed invasion, removal of important habitat trees and climate change
- in stressed populations, infection by Chlamydia, causing cystitis, keratoconjunctivitis, infertility and other symptoms.

E15.1 Significance assessment - *Environmental Planning and Assessment Act 1979*

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

The proposal involves the removal of a total of 3 ha of riverine/riparian habitat, which provides marginal foraging habitat for the Koala.

The results of the Koala survey and habitat analysis suggest that Koalas are not resident in the study area, given that no scats or scratching were observed on potential feed trees. However given the recent records of this species within the locality they are likely to use much of the area as transient habitat. No species recorded and lack of breeding females suggests that the study area would not be considered core Koala habitat.

It is unlikely that the removal of the extent of habitat would disrupt the lifecycle of this species.

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

Construction of the proposal will not remove or modify a significant area of known habitat for Koalas. Suitable habitat for this species occurs with the riparian/riverine habitat and woodland habitats within the study area. In these habitat types specific feed trees for the Koala including *Eucalyptus camaldulensis* and *E. albens* were recorded in high abundance. However no sign of feeding activity was observed within the study area, indicating these habitats provide only marginal foraging resources within the landscape.

Three hectares of suitable habitat will be cleared as a result of the proposal. Given that similar habitat will be retained in adjacent areas, continuing to provide Koalas with sufficient foraging and breeding resources. The removal of this habitat is not considered to be significant in a local and regional context.

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

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. The study area is not at the distributional limit for this species.

How is the proposal likely to affect current disturbance regimes?

Parts of the proposal occur within already cleared or fragmented habitats that include a range of disturbances commonly found in agricultural landscapes. However the proposal will require clearing of vegetation and habitats in relatively intact areas and may introduce new edge effects to these sites. In total, 3 ha of forest/woodland vegetation will be affected by new edge effects that may include weeds and increased levels of predation.

How is the proposal likely to affect habitat connectivity?

The proposal is unlikely to isolate habitat for Koala by creating barriers for movement.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General of the Department of Environment and Climate Change maintains a register of critical habitat. To date, no critical habitat has been declared for this species (Department of Environment and Climate Change, Threatened Species Unit). Suitable habitat will be retained in adjacent areas and continue to provide Koala with sufficient foraging and breeding resources.

Conclusion

The proposal is unlikely to have a significant impact on Koala in the study area. Although habitat will be removed, this is not considered core Koala habitat and similar habitat features are available in the wider local and regional area.

E16. Trout Cod (*Maccullochella macquariensis*)

Status

The Trout Cod (*Maccullochella macquariensis*) is listed as Endangered under both the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*.

Description

The Trout Cod is a large, elongated, deep-bodied fish that is very similar in appearance to the Murray Cod. This species has an overhanging upper jaw, a long, broad, rounded snout, a straight head profile, and relatively large eyes. It is generally blue-grey to dark brown on the back with a speckled pattern of dark grey to black spots. Trout Cod can grow to 85 cm and 16 kg, but are more common to 50 cm and 1.5 kg (Department of Environment and Climate Change 2007d).

Distribution

The Trout Cod is endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central New South Wales. The species was once widespread and abundant in these areas but has undergone dramatic declines in its distributional range and abundance over the past century. The last known reproducing population of Trout Cod is confined to the Murray River below Yarrawonga downstream to Tocumwal (Department of Environment and Climate Change 2007d).

Habitat and ecology

Trout Cod are often found close to cover and in relatively fast currents, especially in fairly deep water close to the bank, and often congregate around snags. They tend to remain at the one site and to have small home ranges. They are carnivores, preying mainly on other fishes as well as crustaceans and aquatic insects (Department of Environment and Climate Change 2007d).

Specific threats

Specific threats to the Trout Cod identified by the Department of Environment and Climate Change (2007) include:

- modification of natural river flows and temperatures as a result of river regulation, leading to spawning failures, reduced opportunities for dispersal, and reduced habitat quality
- habitat degradation through the removal of snags, changes in water quality associated with agriculture and other land uses, and siltation caused by clearing
- over-harvesting by recreational and commercial fishers has probably contributed to past declines
- Trout cod are now totally protected in New South Wales, Victoria and the ACT, but illegal fishing (and possibly hooking injuries in accidentally caught fish) may still pose a threat.
- competition from or interactions with introduced fish species such as trout, redfin perch and carp (Department of Environment and Climate Change 2007d).

Similarly the Department of Environment and Water Resources have also identified specific threats to this species. These include habitat degradation through the removal of woody debris, siltation and reductions in water quality as well as modification of waterways (Department of the Environment and Water Resources 2007b).

In the study area:

Suitable habitat for this species within study area occurs within the Macquarie River. A conservation stocking program has seen the species restocked into the Murrumbidgee and Macquarie Rivers over the last decade, but it is yet to be determined if these fish have established reproducing populations (Department of Environment and Climate Change 2007d).

E16.1 Significance assessment - *Environmental Planning and Assessment Act 1979*

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

Trout Cod spawn during spring (late September to late October), when water temperatures are between 14-22°C. Spawning appears to be triggered by increasing day length and increasing water temperatures. Trout Cod reach sexual maturity at 3-5 years of age at a weight of 0.75-1.5 kg (Department of the Environment and Water Resources 2007b). The eggs of the trout Cod are demersal and adhesive and are supposedly laid onto a hard surface (Department of the Environment and Water Resources 2007b). Eggs are known to hatch after 5-10 days at 18-20°C. Larvae live off the yolk sac for about 10-13 days before beginning to feed (Department of the Environment and Water Resources 2007b).

The proposed gas pipeline will cross the Macquarie River approximately 20 km west of the town of Wellington. To minimise impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River. This process is unlikely to interfere with water temperature and other important microhabitat features necessary for the lifecycle of the Trout Cod.

Therefore it is considered unlikely the Trout Cod would be negatively affected in terms of its life cycle or other population parameters by the proposal.

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

Trout Cod are often found close to cover and in relatively fast currents, especially in fairly deep water close to the bank, and often congregate around snags. They tend to remain at the one site and to have small home ranges (Department of the Environment and Water Resources 2007b).

To minimise impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River. This process is unlikely to interfere with important microhabitat feature including fallen timber and water currents. Therefore it is considered unlikely the proposal will affect the habitat for the Trout Cod in the Macquarie River.

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

The trout cod is endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central New South Wales (Department of the Environment and Water Resources 2007b).

The study area is not at the limit of distribution of the Trout Cod.

How is the proposal likely to affect current disturbance regimes?

The proposal will not affect current disturbance regimes for the Trout Cod. Mitigation measures would be included to avoid and minimise impacts to aquatic habitats. These mitigation measures include directional drilling instead of trenching for the construction of the pipeline in areas of aquatic habitat.

How is the proposal likely to affect habitat connectivity?

The proposed gas pipeline will cross the Macquarie River approximately 20 km west of the town of Wellington. To minimise impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River. This process is unlikely to interfere with fish passage and movement throughout the river.

Therefore the proposal is unlikely to affect habitat connectivity for this species.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Fisheries Management Act 1994*, the Director-General of the Department of Primary Industries maintains a register of critical habitat. To date, no critical habitat has been declared for this species (Department of Environment and Climate Change, Threatened Species Unit).

Conclusion

The proposed gas pipeline does not represent any significant threat to Trout Cod.

E16.2 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Will the action lead to a long-term decrease in the size of a population of a species?

The Trout Cod is endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central New South Wales. The species was once widespread and abundant in these areas but has undergone dramatic declines in its distributional range and abundance over the past century. The last known reproducing population of Trout Cod is confined to the Murray River below Yarrawonga downstream to Tocumwal (Department of Environment and Climate Change 2007d). A conservation stocking program has seen the species restocked into the Murrumbidgee and Macquarie Rivers over the last decade, but it is yet to be determined if these fish have established reproducing populations (Department of Environment and Climate Change 2007d).

Given that this mitigation measures has been employed to reduce the impact of the proposal on the aquatic habitat of the Macquarie River, it is unlikely the proposal will lead to a long term decrease in the size of the local population of Trout Cod (if present).

Will the action reduce the area of occupancy of the species?

The proposed gas pipeline will intersect the Macquarie River at one location within the study area; approximately 20 km west of the town of Wellington. To reduce impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River.

No important aquatic habitat features will be affected and in turn the proposal is unlikely to reduce the area of occupancy for this species.

Will the action fragment an existing population into two or more populations?

The proposed gas pipeline will intersect the Macquarie River at one location within the study area; approximately 20 km west of the town of Wellington. To reduce impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River. This process is unlikely to create a barrier for the movement and passage of fish within the waterway.

Therefore the proposal is unlikely to fragment an existing population (if present) into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the Trout Cod.

Will the action disrupt the breeding cycle of a population?

Trout Cod spawn during spring (late September to late October), when water temperatures are between 14-22°C. Spawning appears to be triggered by increasing day length and increasing water temperatures. Trout Cod reach sexual maturity at 3-5 years of age at a weight of 0.75-1.5 kg (Department of the Environment and Water Resources 2007b). The eggs of the trout Cod are demersal and adhesive and are supposedly laid onto a hard surface (Department of the Environment and Water Resources 2007b). Eggs are known to hatch after 5-10 days at 18-20°C. Larvae live off the yolk sac for about 10-13 days before beginning to feed (Department of the Environment and Water Resources 2007b).

The proposed gas pipeline will cross the Macquarie River approximately 20 km west of the town of Wellington. To minimise impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River. This process is unlikely to interfere with water temperature and other important microhabitat features necessary for the lifecycle of the Trout Cod.

Therefore it is considered unlikely the Trout Cod would be negatively affected in terms of its life cycle or other population parameters by the proposal.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Trout cod are often found close to cover and in relatively fast currents, especially in fairly deep water close to the bank, and often congregate around snags. They tend to remain at the one site and to have small home ranges (Department of Environment and Climate Change 2007d).

To minimise impacts to the aquatic habitat directional drilling will divert the pipeline under the Macquarie River. This process is unlikely to interfere with important microhabitat feature including fallen timber and water currents. Therefore it is considered unlikely the proposal will affect the habitat for the Trout Cod in the Macquarie River.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

The proposal is unlikely to introduce any new invasive species to the area.

Will the action introduce disease that may cause the species to decline?

No. It is highly unlikely that disease would be increased by the action.

Will the action interfere with the recovery of the species?

A conservation stocking program has seen the species restocked into the Murrumbidgee and Macquarie Rivers over the last decade, but it is yet to be determined if these fish have established reproducing populations (Department of Environment and Climate Change 2007d)

Given that impacts to aquatic habitats including microhabitat features will be minimised it is unlikely the proposal will interfere with the recovery of this species.

Conclusion

The proposed gas pipeline and power station does not represent any significant threat to Trout Cod.

E17. Attachment E References

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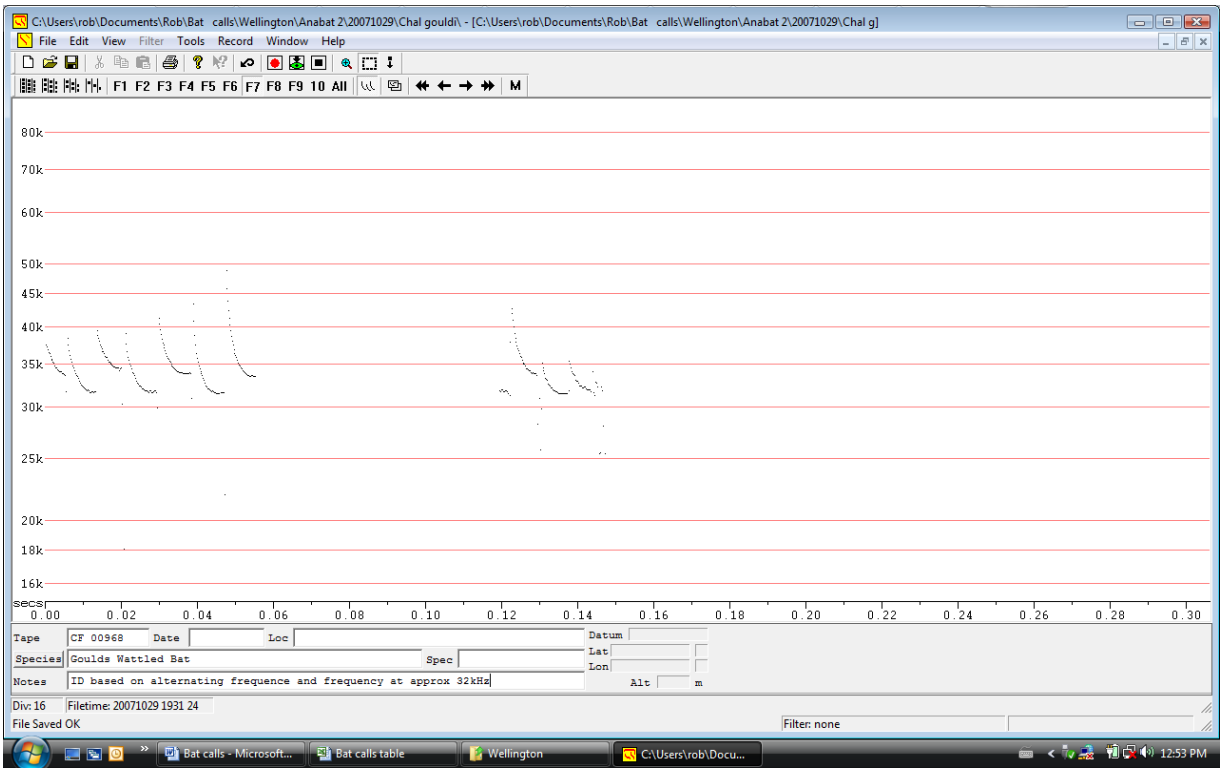
Attachment F

Bat calls recorded within the study area

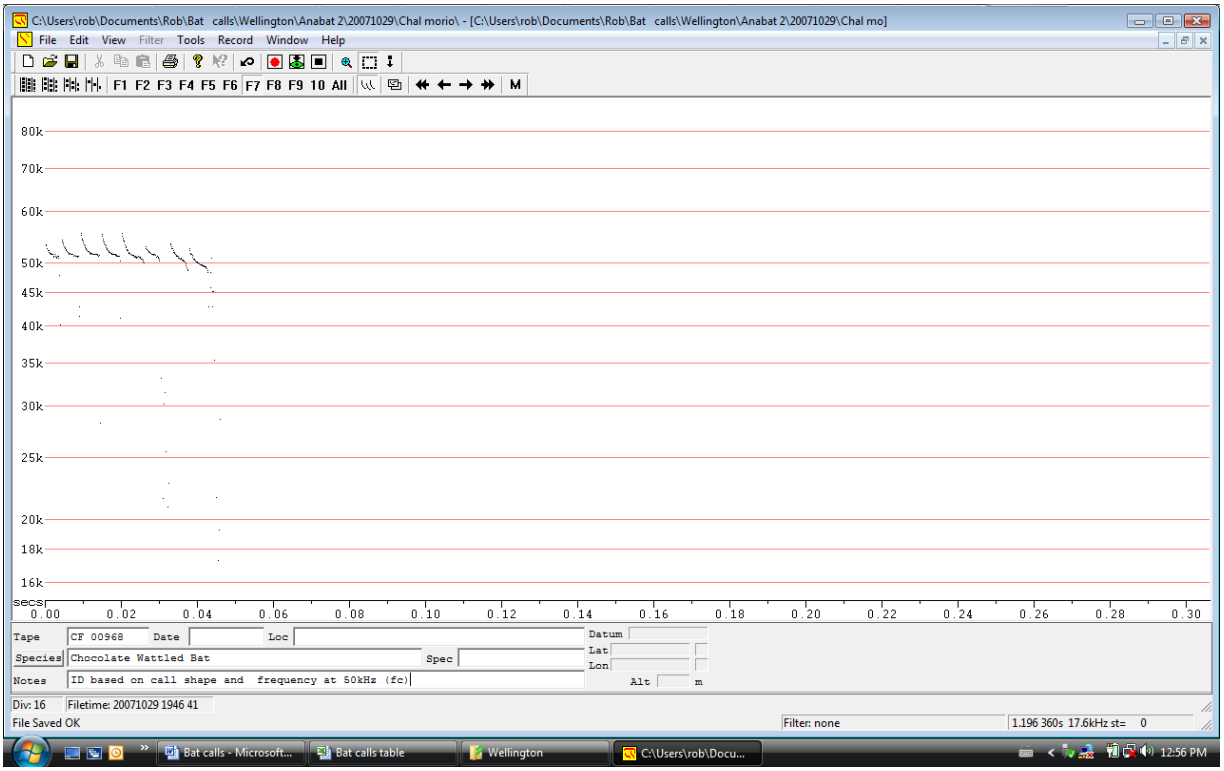
Attachment F Animals recorded in the study area

This attachment details a sample of the 'frequency vs. time' graphs for each species of microchiropetran bat recorded using an Anabat II Bat detector (Titley Electronics Pty Ltd) during current field surveys of the study area. This appendix also provides an indication of the number of bat calls processed and the percentage of these that were identified.

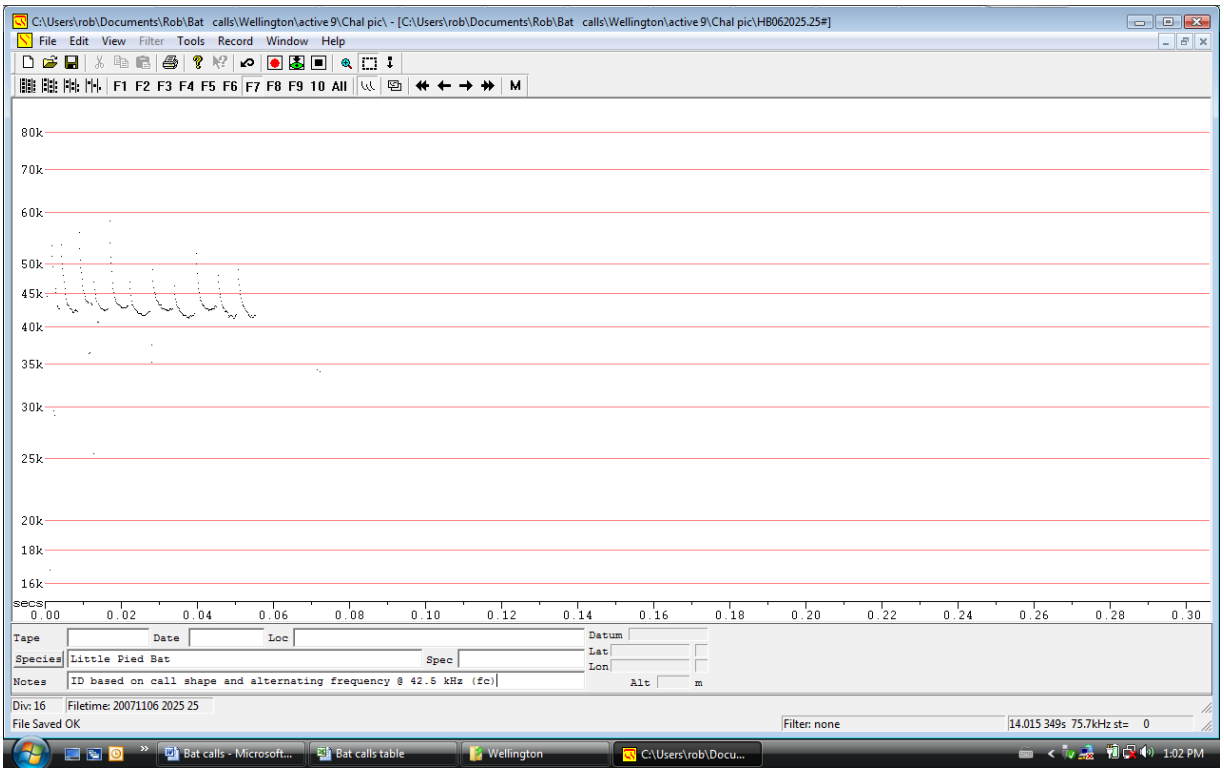
Goulds Wattled Bat (*Chalinolobus gouldii*)



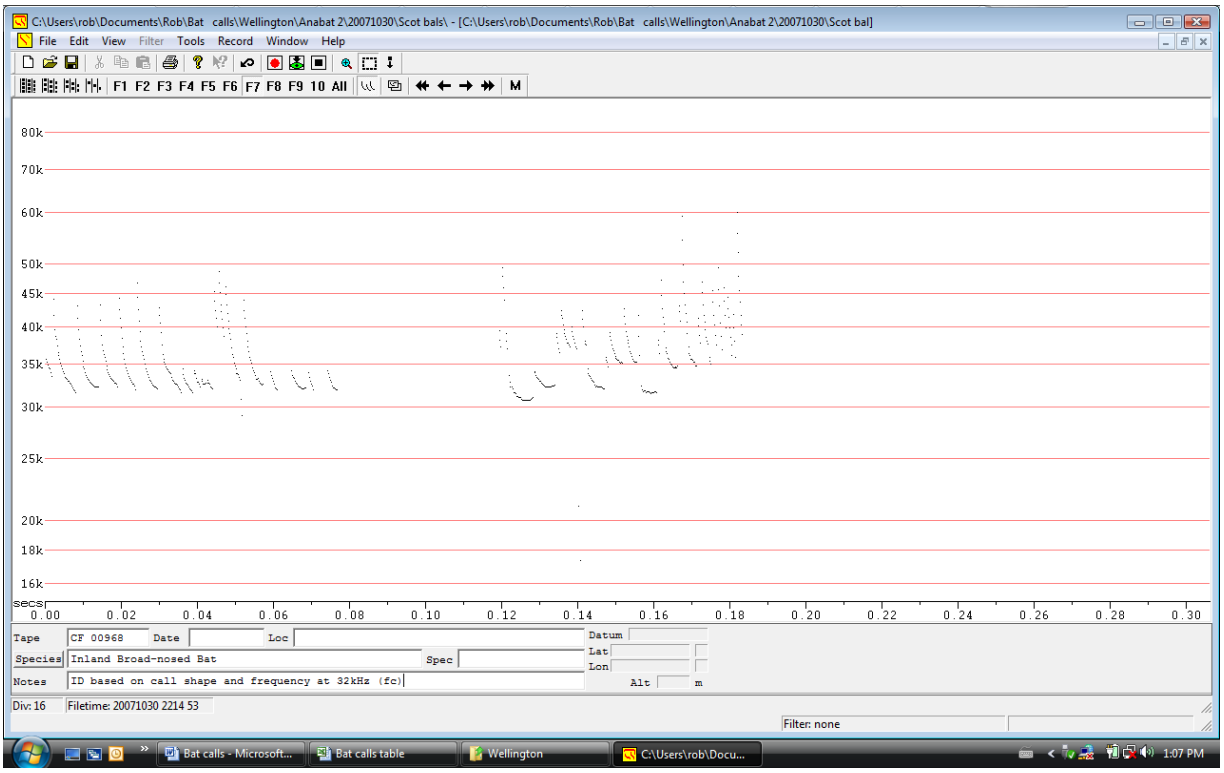
Chocolate Wattled Bat (*Chalinolobus morio)*



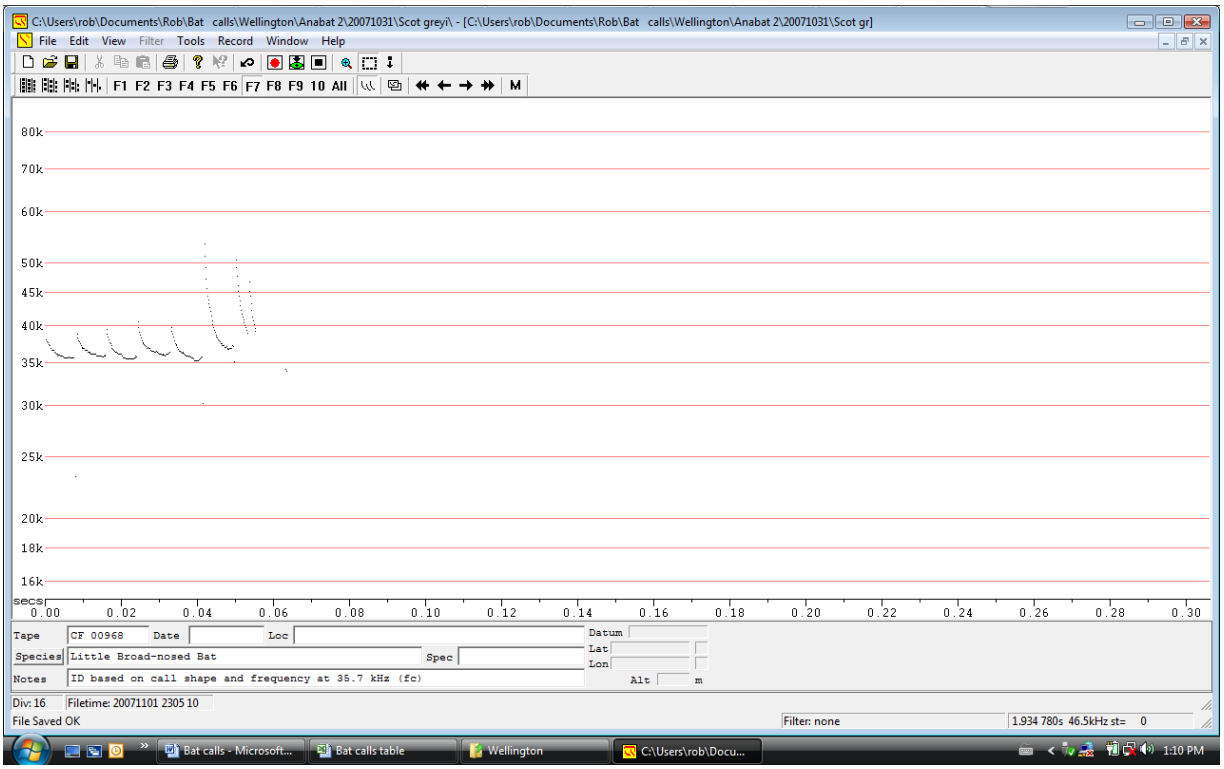
Little Pied Bat (*Chalinolobus picatus)*



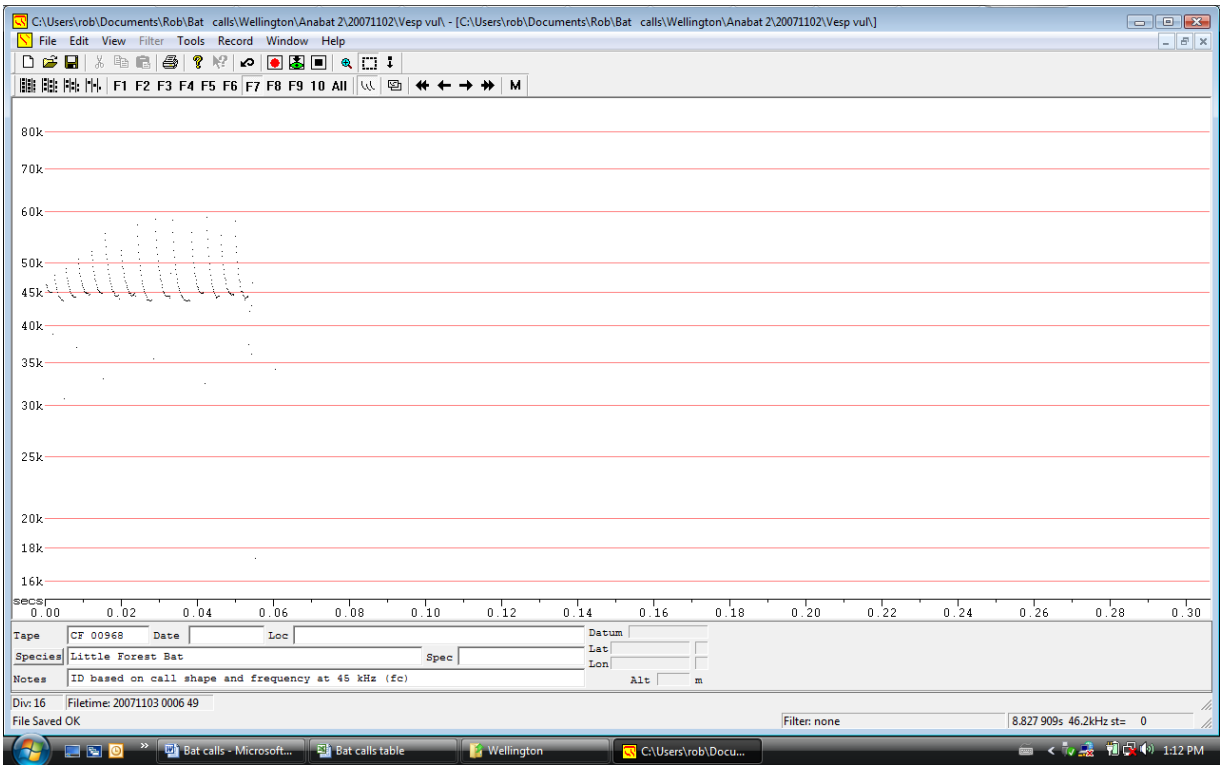
Inland Broad-nosed Bat (*Scotorepans balstoni)*



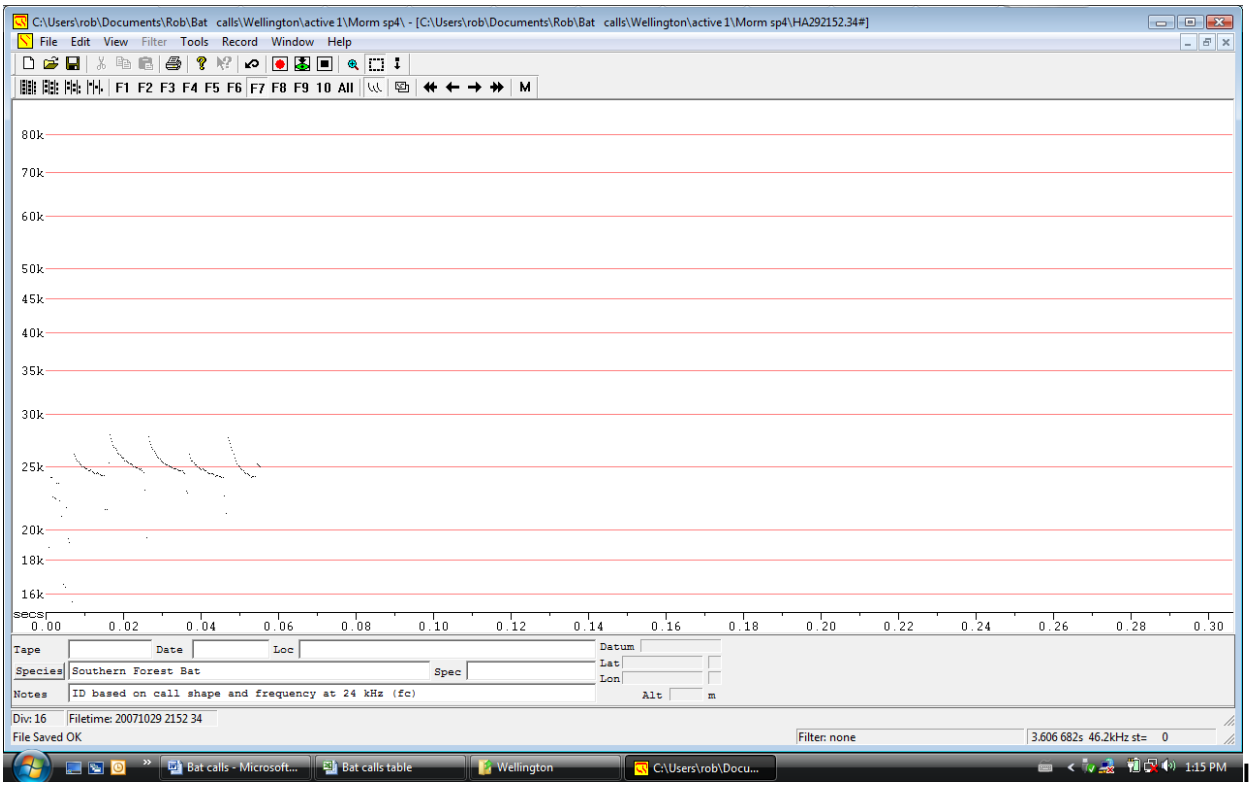
Little Broad-nosed Bat (*Scotorepans greyii)*



Little Forest Bat (*Vespadelus vulturnus)*



Southern Freetail Bat (*Mormopterus* species 4)



Inland Freetail Bat (*Mormopterus species 3*)

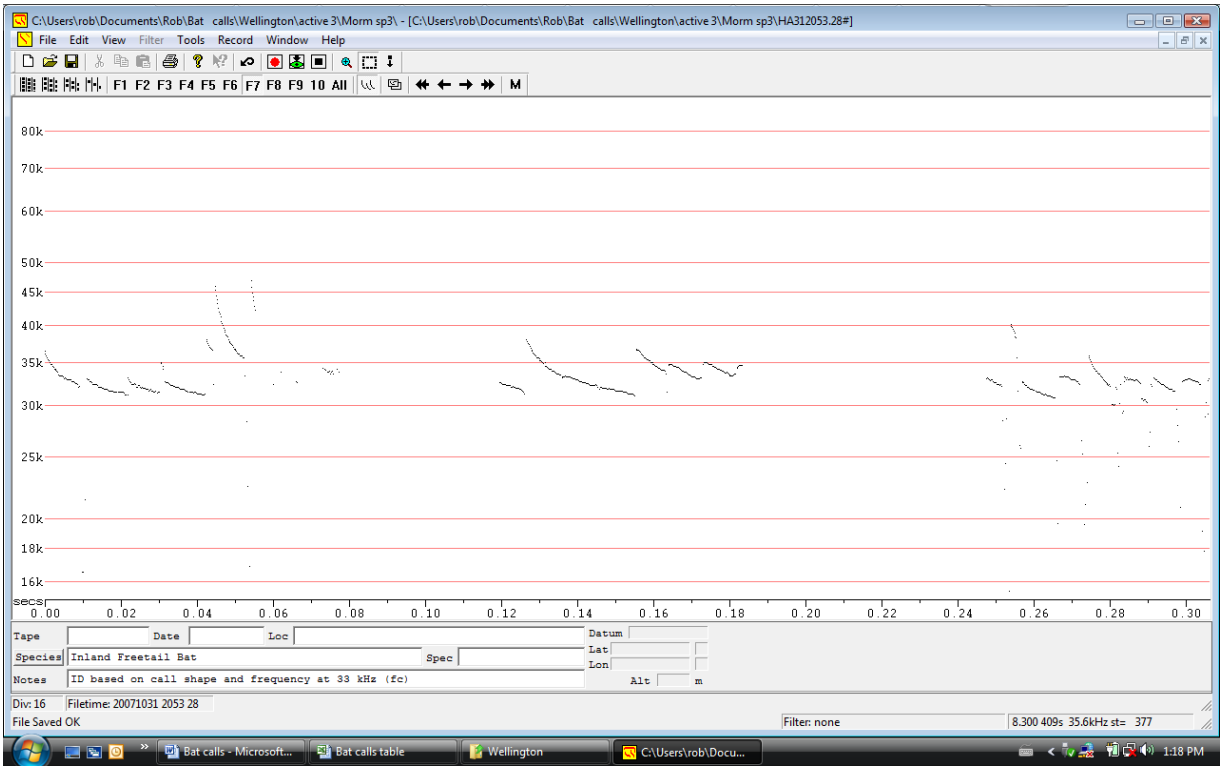


Table F-1: Number of bat calls processed and the percentage of these that were identified

Fauna habitat[1]	**RR**	**RR**	**RR**	**W**	**RR**	**OW**	**RR**	**CG**	**OW**	**RR**	**RR**	**RR**	**OF**	**OF**	**OF**
Number of files	498	72	47	14	46	8	295	9	46	1099	121	235	437	136	3063
Percentage of calls positively identified	10.44%	31.94%	36.17%	42.86%	10.87%	12.50%	22.71%	77.78%	47.83%	28.30%	24.79%	35.32%	6.18%	31.62%	29.95%
Species															
Gould's Wattled Bat *Chalinolobus gouldi*	1						3	1		1		43			49
Chocolate Wattled Bat *Chalinolobus morio*	17	2	2				1		1	4		3	4	3	37
Llittle Pied Bat *Chalinolobus picatus*	1									17	1	2			21
Inland Broadnosed Bat *Scoterepens balstoni*	5						5						1		11
Little Broad-nosed Bat *Scoterepens greyi*i		4					1								5
Little Forest Bat *Vespadelus vulturnus*	28	7	5	2	5	1	4	2	14	289	29	35	22	39	482
Inland Freetail Bat *Mormopterus* sp3		9	8				5								22

Fauna habitat[1]	**RR**	**RR**	**RR**	**W**	**RR**	**OW**	**RR**	**CG**	**OW**	**RR**	**RR**	**RR**	**OF**	**OF**	**OF**
Southern Freetail Bat *Mormopterus* sp 4		1	2	4			48	4	7					1	67
Percentage of calls identified to call complex	2.41%	29.17%	25.53%	21.43%	43.48%	12.50%	31.19%	22.22%	23.91%	41.95%	26.45%	14.47%	17.39%	23.53%	23.97%
Mormopterus spp (*Mormopterus* sp4 & sp3)	4	12	7		4				1	1	1			2	32
Goulds Wattled Bat (Chalinolobus gouldi) / Broadnosed Bat (Scortorepens balstoni)										1	1				2
Broad nosed Bat (Scoteanax ruepellii/ Scotorepens balstoni / Scotorepens greyii)	3		1		2				4			1			11
Goulds Watted Bat (*Chalinolobus gouldi*) / *Mormopterus* sp (*Mormopterus* sp3&4)	2	6	4	2	8		79	2			3	8	6	9	129
Long-eared Bat *Nyctophilus* sp	1	2		1	5		13		2	3		7		3	37

Fauna habitat[1]	**RR**	**RR**	**RR**	**W**	**RR**	**OW**	**RR**	**CG**	**OW**	**RR**	**RR**	**RR**	**OF**	**OF**	**OF**
Little Forest Bat *Vespadelus vulturnus* / East Bent-wing Bat *Miniopterus schreibersii oceanensis* / Little Pied Bat *Chalinolobus picatus*	2				1					262	12	15	53	6	351
Little Forest Bat *Vespadelus vulturnus* / East Bent-wing Bat *Miniopterus schreibersii oceanensis*		1				1			3	194	15	3	17	12	246
Little Forest Bat *Vespadelus vulturnus* / Little pied Bat *Chalinolobus picatus*									1	2					
Percentage of unidentified (poor quality) calls	87.15%	38.89%	38.30%	35.71%	45.65%	75.00%	46.10%	0.00%	28.26%	29.75%	48.76%	50.21%	76.43%	44.85%	46.08%

Notes: 1. Fauna habitat: RR: Riparian/Riverine forest, W: Woodland, OW: Open Woodland, CG: Cleared grassland/, OF: Open forest