

# Kyoto energypark

## Appendix A

Ecological Site Assessment  
CEG Consult  
(May 2008)

**ECOLOGICAL SITE ASSESSMENT  
(PART 3A ASSESSMENT)**

**KYOTO ENERGY PARK  
SCONE  
UPPER HUNTER LOCAL GOVERNMENT AREA**

**MAY 2008  
(REF: CE40)**

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(PART 3A ASSESSMENT)**

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**MAY 2008**

**Conacher Environmental Group**

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## EXECUTIVE SUMMARY

This Ecological Site Assessment has been prepared by *Conacher Environmental Group* to identify the ecological characteristics of land at Middlebrook and Mountain Stations in the Upper Hunter Shire area. This report also provides an ecological impact assessment for that land. The land has been proposed for development as an Energy Park. This report has been prepared to satisfy the Director General's Environmental Assessment Requirements (DGEAR), in accordance with Part 3A Major Infrastructure and Other Projects of the *Environmental Planning and Assessment Act 1979* (EPA Act).

### *Threatened Species Conservation Act (1995)*

No threatened flora species were observed within the subject site.

Seven threatened fauna species, the Glossy Black-Cockatoo, Speckled Warbler, Grey-crowned Babbler, Grey-headed Flying-fox, Yellow-bellied Sheath tailed-bat, Common Bentwing-bat and the Eastern Cave Bat, were observed within the subject site during surveys.

One endangered flora population, *Cymbidium canaliculatum* within the Hunter Catchment, was observed within the subject site.

One Endangered Ecological Community, White Box - Yellow Box - Blakely's Redgum Woodland (WBYBBRW) was observed within the subject site.

A full assessment of the impact of the proposal upon threatened species has been completed as part of the initial Flora and Fauna Assessment completed for the site. A 7-part test has been completed for the proposal in accordance with Section 5A of the *Environmental Planning and Assessment Act* (1979) and the *Threatened Species Conservation Act 1995* (1995). The 7-part test (Conacher Travers, 2007) concluded that the proposed development was not likely to have a significant effect on threatened species, populations or ecological communities or their habitats. It was concluded that a Species Impact Statement would not be required for the proposal.

### *Environment Protection and Biodiversity Conservation Act (1999)*

Regarding matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the proposal has been referred to the Department of Environment, Water, Heritage and the Arts due to expected impacts upon the Endangered Ecological Community, White Box-Yellow Box-Blakely's Redgum Grassy Woodlands and Derived Native Grasslands. The *EPBC Act* (1999) requires that any proposal that reduces the extent of an Endangered Ecological Community be referred to the Department of Environment, Water, Heritage and the Arts for review and assessment.

### *Impacts on Bat and Bird Species*

The site contains a number of bird and bat species that face a mortality risk as a result of the proposal. An assessment of impacts upon bird and bat species has been completed as part of this proposal. This includes assessment in accordance with Auswind's *Wind Farms and Birds: Interim Standards for Risk Assessment July 2005* and Department of Environment and Heritage's (Department of Environment, Water, Heritage and the Arts) *Cumulative Risk for Threatened and Migratory Species March 2006*.

The impact assessment identified that the Wedge-tailed Eagle and Nankeen Kestrel are most at risk of mortality as a result of the construction of turbines. The proposal will include all best practice management strategies in minimising impacts upon local bird and bat

populations. An Environmental Management Plan will be prepared for the site for the site. This will include adaptive management practices and an extensive post-construction monitoring program.

#### *Vegetation and Habitat Retention and Removal*

The proposal will result in the removal of vegetation and habitats for the construction of the turbines and related infrastructure. An assessment of the removal of vegetation and habitats has been completed as part of this report. This has been completed in accordance with the Department of Environment and Conservation and Department of Primary Industries Guidelines for Threatened Species Assessment (2005).

The proposal will require the removal of approximately 5.9 hectares of the endangered ecological community White Box - Yellow Box - Blakely's Redgum Woodland (WBYBBRW). Vegetation management strategies are proposed for the site to offset the removal of native vegetation.

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# SECTION 1

## INTRODUCTION

### 1.1 INTRODUCTION

*Conacher Environmental Group* has been engaged to complete an Ecological Site Assessment for the proposed Kyoto Energy Park at Scone in the Hunter Valley of NSW. This report provides details on the vegetation, fauna and ecological characteristics present on the site and an impact assessment in relation to the proposed development.

This report has been prepared in accordance with the Director Generals Environmental Assessment Requirements (DGEAR's) provided by the NSW Department of Planning as the terms of reference for its completion. This report also considers and addresses the various relevant sections of the *Environmental Planning and Assessment Act* (1979) and *Threatened Species Conservation Act* (1995) as required within the DGEAR's. The Ecological Site Assessment forms part of the Environmental Assessment to be prepared for the site.

### 1.2 SITE DETAILS

Table 1.1 summarises site cadastral details and Table 1.2 geographical characteristics.

TABLE 1.1 SITE DETAILS	
Location	"Middlebrook Station" Middle Brook Road Scone and Mountain Station on Merriwa Road Owens Gap, Scone.
Area	1923.76ha Middlebrook Station & 2030.12ha Mountain Station
Topographic Maps	Parkville 1:25,000, Bunnan 1:25,000 and Muswellbrook 1:100,000
Grid Reference	Middlebrook Station 291500E 6461500N MGA Mountain Station 287500E 6451500N MGA
LGA	Upper Hunter Shire Council
Existing Land Use	Pastoral
Proposed Development	Energy Park

TABLE 1.2 SITE CHARACTERISTICS	
Topography	Middlebrook Station: Undulating creek flats to steep rocky ridges and escarpments rising to undulating plateaus. Mountain Station: Elevated undulating plateaus falling to steep rocky slopes and escarpments and narrow gullies.
Slope	Varying from 5% to 80% along escarpments.
Aspect	Various, mostly east and west.
Soil Types of proposed development areas	Shallow to very shallow well to moderately drained Claustic Ridosols and Orthic Tenosols on crests and side slopes of the Wingen Maid soil landscape; Shallow to deep well to moderately drained Black Red and Brown Chromosols and Dermosols on crests and side slopes of the Ant Hill soil landscape; Moderately well drained, moderately deep Haplic Mesotrophic Black Dermosols across the plateau surfaces



TABLE 1.2 (Cont.) SITE CHARACTERISTICS	
Catchment	Hunter River
Drainage	Middlebrook Station: Overland flow into Middle Brook draining to Kingdom Ponds then the Hunter River to the east and draining to the west to Dart Brook then into the Hunter River. Mountain Station: Overland flow into Bullock and Little Bullock Gullies into Middle Brook to the east and draining into the Hunter River.
Vegetation	A total of seventeen (17) vegetation communities have been identified within the subject site by <i>Conacher Travers</i> or previous surveys (Hill <i>et al.</i> 2001 and Peak 2006). Refer to Section 2.2 for details

### 1.3 PROPOSED DEVELOPMENT

The proposed development is for the construction of an Energy Park (Figures 1.1 and 1.2) which will comprise the utilisation of a combination of various energy producing technologies as outlined below.

**Wind Turbine Generators:** It is proposed to construct 11 turbines on Middlebrook Station and a maximum of 31 turbines within Mountain Station. Turbines are expected to be up to 105m in hub-height with a blade length of 45-50m and will be positioned along the ridgelines to enable access to prevailing winds. Construction will require selective clearing of vegetation to provide for construction of anchorage pads and access roads.

**Solar Photovoltaic (PV) Plant:** The solar PV plant will cover approximately 15-21 hectares of existing cleared land on the plateau of Mountain Station, it is expected that clearing of native vegetation will not be required for its construction. Minor earthworks will be required for levelling and preparation of the area for installation of the solar array.

**Closed Loop Hydro Plant:** The closed loop hydro plant will be located within the central valley of Mountain Station where the steep slopes are able to provide sufficient water velocity to generate power. Construction of this plant will require selective removal of native vegetation and habitat disturbance to provide for the construction and access roads.

**Visitors and Education Centre:** This centre will be located on the cleared plateau of Mountain Station in the vicinity of the Solar PV Plant. The proposed area is already cleared and it is unlikely that further clearing for bushfire protection areas and access will be required.

**Electricity Transmission Lines:** This project will require the installation of some sections of electricity transmission lines to connect the proposed electricity generating facilities to the existing electricity infrastructure. Some parts of the existing electricity transmission infrastructure will also need to be upgraded. Several route options for the proposed power lines have been selected for consideration and assessment. This report assesses the preferred options known as Line Route 2 and 4.

#### Option 2 (66kV/33kV overhead transmission line)

The 66kV overhead line commences between wind turbines 30 and 31 located in the south-east of Mountain Station. It is proposed to follow the Crown easement travelling east, then along Winters Rd, Yarrandi Rd and Moobi Rd to the intersection of Bunnan Rd/Satur Rd and Liverpool St. From this point the transmission route travels east along Liverpool St. There are variations to this route prior to entering the Scone town area included as variations A, B and C.

A 33kV overhead line would be used to connect the Middlebrook Station turbines to the Mountain Station substation. This line would utilise the same pole as the 66kV line and the line route would be along Bunnan Rd between both sites.

This line route option predominantly follows existing roads, and is to be contained within the road reserve, except the far western end of route option 2. Here the route leaves the road and road reserve, travelling west into Mountain Station for approximately 200m within vegetated land.

#### **Option 4 (132kV/33kV overhead transmission line)**

The 132kV overhead line commences at the Mountain Station site substation and follows Bunnan Road to the intersection of Yarrandi Road. The route follows the Yarrandi Rd and Nandowra Rd in a southerly direction to the intersection of Sandy Creek Rd where it continues south along Back Muswellbrook Rd. At the intersection of Back Muswellbrook Rd and Burton Lane two variations have been considered as variation A and B. Option 4B is the preferred route as it continues along Burton Lane crossing the New England Highway to the Muswellbrook STS connection point.

A 33kV overhead line would be used to connect the Middlebrook Station turbines to the Mountain Station substation. This line would utilise the same pole as the 66kV line and the line route would be along Bunnan Rd between both sites.

This line route option predominantly follows existing roads, with the line replacing existing overhead lines within the road reserve.

The proposal also includes ancillary infrastructure and associated developments such as:

##### **Operational Infrastructure:**

- Substation and switchyard;
- Managers residence;
- Maintenance shed;
- Permanent tracks;
- Bushfire asset protection zones;
- Electrical and telephone services including underground and overhead lines.

##### **Facilities used during Construction only:**

- Construction offices and laydown area;
- Concrete batching plant.

The details of the proposal are provided as separate site plans.

## **1.4 SCOPE OF WORKS**

This report has been prepared to provide details on the ecological investigations completed within the site and provide an assessment of the site in relation to the proposed development. This Ecological Site Assessment has been prepared in accordance with the relevant sections of the Director Generals Environmental Assessment Requirements (DGEAR's) provided by the NSW Department of Planning as the terms of reference for the preparation of an Environmental Assessment for the site. The Ecological Site Assessment forms part of the Environmental Assessment to be prepared for the site.

This Ecological Site Assessment addresses those relevant sections of the DGEAR's as per the following:

*the Environmental Assessment must include a flora and fauna impact assessment identifying and considering any critical habitats, threatened species or ecological communities listed under both State and Commonwealth Legislation recorded on the site, along the transmission line route or the surrounding area. The Environmental Assessment must also detail measures to avoid or mitigate impacts associated with the siting and construction of any access roads and other infrastructure. Additionally it must address:*

- *the impact of the proposal on birds and bats from strikes and alteration to movement patterns resulting from turbines and transmission lines. An outline of an adaptive management program must be included;*
- *vegetation clearing during construction and maintenance, including details on the location, composition and quantity and likelihood of disturbance of White Box Yellow Box Blakely's Red Gum Woodland (Endangered Ecological Community);*
- *identification of any regional corridors; and*
- *an assessment of any potential impacts associated with the proposal on the Towarri National Park and the Hunter-Central Rivers Catchment Action Plan.*

The following policies and guidelines, as identified within the DGEAR's, are also considered or addressed as part of this Ecological Site Assessment:

- Draft Guidelines for Threatened Species Assessment (Department of Environment and Conservation, Department of Primary Industries 2005);
- Wind Farms and Birds: Interim Standards for Risk Assessment (Auswind 2005);
- Cumulative Risk for Threatened and Migratory Species (Department of Environment and Heritage 2006).

## **1.5 FORMAT OF THE ECOLOGICAL SITE ASSESSMENT**

This Ecological Site Assessment has been prepared to address the Director General's Environmental Assessment Requirements for the preparation of the Environmental Assessment. A large amount of information that forms the basis of this report is contained within previous reports completed for the site. These are:

- Flora and Fauna Assessment Report – provides all of the ecological survey and assessment information completed for the proposal.
- Referral of Proposed Action - Kyoto Energy Park Middlebrook Station and Mountain Station Scone. This document provides information on the occurrence of the federally listed endangered ecological community White Box – Yellow Box – Blakely's Redgum Grassy Woodland and Derived Native Grassland.
- Bird Impact Assessment – prepared to address the relevant concerns in regards impacts of the proposal on birds.

These reports should be accessed and read in conjunction with this Ecological Site Assessment.

The appendices within this report have been prepared to provide the relevant details provided within these reports, as they relate to this Ecological Site Assessment.

These appendices are:

Appendix I – Site Plans and Flora and Fauna Survey Details

Appendix II – EPBC Referral Information

Appendix III – Bird Impact Assessment

The Ecological Site Assessment summarises the information contained within these reports and appendices in addressing the DGEAR's as per the following sections:

**SECTION 1:** Introduction - Provides background details on the proposal and the subject site.

**SECTION 2:** Flora and Fauna Survey Methodologies and Results – Provides a summary of the flora and fauna surveys completed within the site.

**SECTION 3:** Threatened Species – Provides details on the threatened species assessment of the site according to the relevant State (Threatened Species conservation Act 1995) and Federal (Environment Protection and Biodiversity Conservation Act 1999) legislation.

**SECTION 4:** Identification of Key Habitats and Regional Corridors – This section provides information on local and regional corridors identified as part of the NPWS Key Habitats and Corridors Mapping program.

**SECTION 5:** Ecological Impact Assessment – Provides information on the ecological impacts of the proposal, as required by the DGEAR's. This includes information on:

- Impacts on bird species;
- Impacts on bat species;
- Impacts related to vegetation and habitat removal;
- Impacts on Towarri National Park;
- Impacts on Hunter Central Rivers Catchment Action Plan.

**SECTION 6:** Threatened Species (Part 3A) Assessment – This section contains an assessment of the proposal in accordance with the Department of Primary Industries *Guidelines for Threatened Species Assessment* (2005).

**SECTION 7:** Environmental Management – Recommendations in relation to environmental management during the construction and operational phases of the development. This includes an outline of an adaptive management program.

**SECTION 8:** Conclusion – Summarises and provides concluding remarks and recommendation in relation to the proposal.

## **1.6 BACKGROUND REPORTS**

The following reports were accessed in generating the assessment information for this report. This includes reports completed for the local area and specifically for the subject site and the Kyoto Energy Park proposal.

TABLE 1.3 BACKGROUND REPORT			
Author	Date	Title	Comment
Peake, T.	2005	The Vegetation of the Central Hunter Valley, NSW	Braodscale vegetation mapping of the Hunter Valley. Includes areas of the subject site. Used as a basis for field ground truthing and identification of vegetation communities on site.
Hill, L, Peake, T, Bell, S, Raine, A	2001	Vegetation Survey of Towarri National Park and Wingen Maid Nature Reserve and Cedar Brush Nature Reserves.	Vegetation mapping of lands adjacent to the subject site in Towarri National Park. Includes mapping of areas of subject site. Used as a basis for field ground truthing and identification of vegetation communities on site.
Conacher Travers	2007	Flora and Fauna Assessment Kyoto Energy Park Middlebrook Station and Mountain Station Scone	Report completed to assess the impacts of the proposal according to the <i>Threatened Species Conservation Act</i> (1995) and Section 5A of the <i>Environmental Planning and Assessment Act</i> (1979). Includes a 7-part test of significance. Completed prior to proposals status as a Part 3A application. This report forms the basis of the ecological survey and assessment used for this report. Attached as Appendix 4.
Conacher Environmental Group	2007	Referral of Proposed Action - Kyoto Energy Park Middlebrook Station and Mountain Station Scone	Referral of proposal to Department of Environment and Water Resources (Department of Environment, Water, Heritage and the Arts (DEWHA) in accordance with the Environmental Protection and Biodiversity Conservation Act (1999). DEWHA deemed the proposal to not be a controlled action. A copy of this referral is attached in Appendices.
Conacher Environmental Group	2008	Bird Impact Assessment	Assessment of impacts of proposal on birds. Completed in accordance with Auswinds Windfarms and Birds: Interim Standards for Risk Assessment. Attached as Appendix 3.

## SECTION 2

### FLORA AND FAUNA SURVEY DETAILS

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This section provides a summary of the flora and fauna survey methodology and results. Full details of survey methods and results are contained within the Flora and Fauna Assessment (Conacher Travers 2007) completed for the subject site and attached as Appendix 4. A summary of the flora and fauna survey methodologies, effort and results is attached as Appendix 1.

#### 2.1 FLORA

##### 2.1.1 Survey Methods

Surveys focused on areas likely to be impacted by the proposed development. On-site survey was carried out to determine the likely and actual occurrence of flora species and vegetation communities within the subject site. The methods utilised include:

- Literature Review;
- Aerial Photograph Interpretation;
- Field Survey including transects, quadrats and random meander searches;
- Endangered Ecological Community Condition Assessment;
- Seasonal Surveys.

Vegetation communities were classified according to a modified Walker and Hopkins (1990) methodology. For each vegetation community description, a structural classification is given followed by the dominant canopy species. Previous community descriptions (Hill *et al.* 2001; Peak 2006) are provided for each vegetation community. The status of each community as an Endangered Ecological Community (if applicable) is also provided. Field validation of the previous local area vegetation mapping (Hill *et al.* 2001; Peak 2006) was restricted to those areas immediately surrounding the proposal.

Flora surveys for the subject site were carried out on the 9<sup>th</sup>-11<sup>th</sup> May and 12<sup>th</sup>-14<sup>th</sup> June, 12-14 August and 17 September 2007.

##### 2.1.2 Survey Results

A total of seventeen (17) vegetation communities were identified within the subject site by Conacher Travers or previous surveyors (Hill *et al.* 2001 and Peak 2006). These communities, and the approximate area in hectares they occupy are:

1. Dry Rainforest Closed Forest
2. Ironbark - Box Open Forest
3. Ironbark Open Forest
4. Ironbark - Stringybark Open Forest
5. Grey Gum - Ironbark Open Forest
6. Grey Gum - Stringybark Open Forest
7. Grey Gum - Apple Open Forest
8. Slaty Gum Open Forest
9. Box Woodland (
10. Box - Ironbark Grassy Woodland
11. Box Ironbark - Red Gum Woodland
12. Exposed Ironbark Woodland

13. Exposed Ironbark Cyperus Woodland
14. Red Gum Woodland
15. Exposed Acacia Low Open Woodland
16. Rocky Heathland on Sandstone Benches
17. Grassland with Scattered Trees

Detailed descriptions of vegetation communities and a complete flora species list for the site are provided within Appendix I and the Flora and Fauna Assessment Report (*Conacher Travers, 2007*).

The vegetation communities within the site are shown in Figures FA3 and FA4 of the Flora and Fauna Assessment and included in the Appendices of this Report.

## 2.2 FAUNA

### 2.2.1 Survey Methods

#### *General Fauna Survey*

Fauna survey methods used were based upon the standard methods utilised by the NSW National Parks and Wildlife Service (NPWS 1999), State Forests of NSW (York *et al.* 1991), LHCCREMS (2002), Wyong Shire Council (Forest Fauna Surveys *et al.* 1999) and Department of Environment and Conservation (DEC 2006). The fauna groups targeted via various survey methods and the methods used and dates surveyed are provided in Table 2.1. A full description of the fauna survey effort is provided within the Flora and Fauna Assessment Report (*Conacher Travers, 2007*).

TABLE 2.1 FAUNA SURVEY DETAILS		
Fauna Group	Survey Method	Survey Date
Diurnal Birds	Bird census	27 April 2007, 10-12 Dec 2007, 26-29 Feb 2008
	Opportunistic observation	27 Apr 2007, 11 May 2007, 13 June 2007, 1-2 Aug 2007, 10-12 Dec 2007, 26- 29 Feb 2008
Nocturnal Birds	Spotlighting	8-10 May 2007, 1 Aug 2007
	Owl call playback	8-10 May 2007, 1 Aug 2007
Arboreal Mammals	Elliot trapping	8-10 May 2007, 1 Aug 2007
	Spotlighting	1 Aug 2007
Terrestrial Mammals	Opportunistic observation	1 Aug 2007
	Elliot trapping	8- 10 May 2007
	Cage trapping	8-10 May 2007
	Spotlighting	8- 10 May 2007, 1 Aug 2007
Bats	Sonar detection	8-10 May 2007, 1 Aug 2007, 26-27 Feb 2008
	Spotlighting	8-10 May 2007, 1 Aug 2007
Reptiles	Opportunistic observation	27 Apr 2007, 8- 11 May 2007, 1-2 Aug 2007, 10-12 Dec 2007, 26-29 Feb 2008
	Habitat search	27 Apr 2007, 8- 11 May 2007, 1-2 Aug 2007, 10-12 Dec 2007, 26- 29 Feb 2008
	Spotlighting	8- 11 May 2007, 26-27 Feb 2008
Frogs	Opportunistic observation	27 Apr 2007, 8-11 May 2007, 1 Aug 2007, 26-29 Feb 2008
	Habitat search	27 Apr 2007, 8-11 May 2007, 1 Aug 2007, 26- 29 Feb 2008
	Call identification	27 Apr 2007, 8-11 May 2007, 1 Aug 2007
	Spotlighting	27 Apr 2007, 8-11 May 2007, 1 Aug 2007, 26-27 Feb 2008

Environmental conditions (temperature, moon stage, rain and wind) were recorded for each survey period.

The fauna survey locations are shown in Figure FA1 and Figure FA2 of the Flora and Fauna Assessment and included in the Appendix I of this report.

### ***Specialist Bird Survey***

A specialist bird survey was carried out as part of the Bird Impact Assessment (attached as Appendix III) completed for the site in accordance with Auswind's *Wind Farms and Birds: Interim Standards for Risk Assessment* (Auswind 2005).

The specialist bird survey included:

1. Regional overview to provide a qualitative overview of bird usage of the subject site and surrounding region, and species occurrence. This involved a detailed review of existing data and a site inspection.
2. Point bird utilisation survey.
3. Roaming/opportunistic survey.

'Species of Concern' were determined during this survey. This includes species listed within the TSC Act or EPBC Acts, and species that exhibit behaviour that puts them at risk of regular collision with operating wind turbines (Auswind 2005).

Surveys were carried out in April, May, June, August December 2007 and February 2008.

Specialist bird survey methodology is described in greater detail within the Bird Impact Assessment attached as Appendix III.

## **2.2.2 Survey Results**

### ***General Fauna Surveys***

Fauna habitat types identified within the subject site included:

- Flower, nectar and seed producing tree and shrub species of the dry open forest, and woodland;
- Hollow bearing trees and stags;
- Sparse to dense shrub layer and understorey;
- Sparse to dense grassy layer;
- Moderately dense to sparse leaf litter layer;
- Fallen timber and hollow logs;
- Rocky outcrops and caves;
- Farm dams.

The fauna species observed within the subject site consisted of 85 bird, 26 mammal, 4 frog and 6 reptile species. Seven threatened species, as listed within the *TSC Act* (1995), were observed within the site during surveys. A complete list of fauna species observed within the site is provided within the Flora and Fauna Assessment Report (Conacher Travers, 2007).

Details on threatened fauna species observed within the subject site during surveys are included within Section 3.



### ***Specialist Bird Surveys***

A total of 251 bird species have been recorded within 50km of the subject site (Bionet 2008; NPWS 2008; EPBC Protected Matters). A total of 85 bird species were observed within the subject site during surveys.

A total of 62 'Species of Concern' were determined as a result of being threatened species or likely to be at risk of collision as a result of flying within the Rotor Sweep Area.

Full details of those bird species identified as being "Species of Concern" is provided within Section 5.

## SECTION 3

### THREATENED SPECIES

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#### 3.1 THREATENED SPECIES CONSERVATION ACT 1995

##### 3.1.1 Threatened Flora Species

The following is a summary of the assessment of threatened flora species within the subject site. Full details of the threatened species surveys and assessment are included within the Flora and Fauna Assessment prepared for the site (Conacher Travers 2007).

A search of the Atlas of NSW Wildlife (NPWS 2008) was undertaken to identify records of threatened flora species located within 10km of the site. In addition to the species listed within the Atlas of NSW Wildlife database, threatened species listed in the botanic gardens records, species identified by NPWS (2007), NPWS (2008) and local area records have been included for consideration.

Following detailed consideration of the habitats within the site and the requirements of those threatened flora species known from the local area, the following threatened flora species were identified as having suitable habitat present within the subject site:

- *Commersonia rosea*;
- *Cymbidium canaliculatum* (endangered population);
- *Diuris pedunculata* ;
- *Diuris tricolor* ;
- *Digitaria porrecta*;
- *Goodenia macbarronii* ;
- *Kennedia retrorse*;
- *Lasiopetalum longistamineum*;
- *Ozothamnus tessellatus*;
- *Philothea ericifolia*;
- *Pomaderris bodalla* ;
- *Pomaderris queenslandica* ;
- *Pomaderris reperta* ;
- *Prostanthera cineolifera*;
- *Prostanthera cryptandroides* subsp. *Cryptandroides* ;
- *Rulingia procumbens*;
- *Thesium australe*.

No threatened flora species were observed within the subject site during surveys.

One regionally significant plant species was observed within the subject site. This species was *Macrozamia concinna* (Burrawang). This species was identified by Hill et al. (2001) as having a conservation status of Nationally Rare but it is not currently listed on the schedules of the TSC Act (1995) or ROTAP lists.

### 3.1.2 Endangered Flora Populations

There are four (4) Endangered Flora Populations known within the local area:

- *Acacia pendula*;
- *Cymbidium canaliculatum*;
- *Eucalyptus camaldulensis*;
- *Leionema lamprophyllum* subsp. *obovatum*.

One endangered flora population, *Cymbidium canaliculatum*, was observed within the subject site.

Seven (7) clumps of this species were observed in the subject site within the Box Woodland vegetation community. Clumps are defined as single clusters which may contain multiple individual bulbs. Each of these populations will be retained as part of the proposal. One of these clumps is isolated within a paddock tree by more than 5km from the nearest other known specimen. It is questionable whether the species at this location will remain viable in the long term.

Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore, large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP.

### 3.1.3 Endangered Ecological Communities

There is one Endangered Ecological Community listed on Schedule 1, Part 3 of the TSC Act (1995) that is known to occur within the local area. This is the White Box - Yellow Box Blakely's Red Gum Woodland. This ecological community was observed within the subject site.

This endangered ecological community occupies approximately 649ha of the subject site and varies from highly disturbed isolated remnants to relatively undisturbed contiguous patches. The following table shows the extent of this EEC within the site within each of the identified corresponding vegetation communities.

<b>TABLE 3.1 EXTENT OF EEC WHITE BOX - YELLOW BOX - BLAKELY'S RED GUM WOODLAND WITHIN THE SUBJECT SITE</b>			
<b>Vegetation Community</b>	<b>Middlebrook Station (hectares)</b>	<b>Mountain Station (hectares)</b>	<b>Total (hectares)</b>
Box Woodland (Grassy Variant)	197	289	486
Box - Ironbark Grassy Woodland (in part)	163	0	163
<b>TOTAL</b>	<b>360</b>	<b>289</b>	<b>649</b>

### 3.1.4 Threatened Fauna Species

A search of the Atlas of NSW Wildlife (NPWS, 2007 and NPWS 2008) was undertaken to identify records of threatened fauna species located within 20km of the site.

There was considered suitable and/or sub-optimal habitat present within the subject site for the following threatened fauna species.

- Freckled Duck
- Red Goshawk
- Gang-gang Cockatoo
- Swift Parrot
- Turquoise Parrot
- Powerful Owl
- Brown Treecreeper
- Grey-crowned Babbler
- Black-chinned Honeyeater
- Hooded Robin
- Spotted-tailed Quoll
- Yellow-bellied Glider
- Brush-tailed Phascogale
- Grey-headed Flying-fox
- Eastern Freetail-bat
- Eastern False Pipistrelle
- Eastern Bentwing-bat
- Eastern Cave Bat
- Greater Broad-nosed Bat
- Black-necked Stork
- Square-tailed Kite
- Glossy Black-Cockatoo
- Superb Parrot
- Barking Owl
- Masked Owl
- Regent Honeyeater
- Speckled Warbler
- Painted Honeyeater
- Diamond Firetail
- Koala
- Squirrel Glider
- Brush-tailed Rock-wallaby
- Yellow-bellied Sheath-tail-bat
- Large-eared Pied Bat
- Little Bentwing-bat
- Greater Long-eared Bat
- Large-footed Myotis

The following threatened fauna species were observed within the subject site during surveys.

- Glossy Black-Cockatoo
- Grey-crowned Babbler
- Speckled Warbler
- Grey-headed Flying-fox
- Yellow-bellied Sheath-tail-bat
- Eastern Bentwing-bat
- Eastern Cave bat

The following information gives a description of observations of each of these threatened species within the subject site.

### ***Glossy Black-Cockatoo***

This species was observed foraging within Allocasuarina trees on the Glen Ridge on Middlebrook Station during surveys conducted on the 9 May 2007, chewed Allocasuarina cones were also observed on top of the Glen Ridge toward Castle Rock during surveys conducted on 2 August 2007.

### ***Speckled Warbler***

This species was observed in two separate locations upon the Glen Ridge on Middlebrook Station during surveys conducted on 8 & 9 May 2007 and again in the same location during surveys conducted on 1 and 2 August 2007.

### ***Grey-crowned Babbler***

A small group of two birds were observed in the foothills of the Glen Ridge at Middlebrook Station on all survey days. A larger group of approximately five birds were observed at the gate to the haul road at Middlebrook Station during surveys conducted on the 13 June 2007, this group was further observed during surveys conducted on the 1 and 2 August 2007 and again on the 10 and 11 December 2007.

**Grey-headed Flying-fox**

Two Grey-headed Flying-foxes were observed flying over the Glen Ridge on Middlebrook Station during nocturnal surveys conducted on the evening of the 9 May 2007.

**Yellow-bellied Sheath-tail-bat**

This species was detected foraging near the southern end of Glen Ridge during Anabat II surveys conducted on the evening of the 26 April 2007.

**Eastern Bentwing-bat**

This species was detected foraging along the northern sector of Glen Ridge on the evening of the 26 April and 8 May 2007 and along the southern end of Glen Ridge during Anabat II surveys conducted on the evening of the 26 April 2007. This species was also captured whilst roosting within the rafters of the shearing sheds on Mountain Station on the 10 May 2007 and positively identified.

**Eastern Cave Bat**

This species was detected via Anabat II detection surveys conducted on the 8<sup>th</sup> May 2007, foraging within the vicinity of the proposed maintenance shed on Mountain Station, Owens Gap and at the north-western spur area near a communications tower also on Mountain Station.

**3.1.5 Endangered Fauna Populations**

No endangered fauna populations are known from the local area.

**3.2 STATE ENVIRONMENTAL PLANNING POLICY (SEPP) NO. 44 KOALA HABITAT PROTECTION**

The subject area was assessed for activity by Koalas using the following methods.

- i. A search of the Atlas of NSW Wildlife (DECC 2008) was undertaken to identify records of koalas located in the area.
- ii. The site was surveyed on foot, with Koala food trees being inspected for signs of Koala usage. Trees were inspected and identified for the presence of Koalas, characteristic scratch and claw marks on the trunk and scats around the base of each tree. The proportion of trees showing signs of Koala use was calculated. Additionally the location and density of droppings if found were documented.
- iii. Koalas were also targeted during spotlight surveys.
- iv. Identification and an assessment of the density of tree species listed as Koala feed trees in State Environmental Planning Policy No. 44 - Koala Habitat Protection was undertaken across the site. An estimate of the percentage density of each tree species across the site was determined by averaging the percentage of stems counted.

No Koalas were observed during fauna surveys and there was no evidence of previous Koala habitation within the subject site.

White Box (*Eucalyptus albens*), Grey Gum (*Eucalyptus punctata*) and Forest Red Gum (*Eucalyptus tereticornis*) (Koala food tree species listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection), were observed within the subject site. These trees comprised more than the 15% of the vegetation communities they occurred in and defined under SEPP 44 for classification as Potential Koala Habitat. As such

areas of the subject site are considered to comprise Potential Koala Habitat as defined under SEPP 44. However no evidence of Koala utilisation of the site (scats, scratch marks or Koalas) was observed on the site. Due to the lack of sightings or evidence of this species within the subject site it is considered that the site does not form Core Koala Habitat.

### 3.3 ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The *Environment Protection and Biodiversity Conservation Act* (1999) requires that Commonwealth approval be obtained for certain actions. The Act provides an assessment and approvals systems for actions that have a significant impact on matters of national environment significance (NES). These may include:-

- Wetlands protected by international treaty (the Ramsar Convention)
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on a NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, the matter needs to be referred to the Department of Environment, Water, Heritage and the Arts (DEWHA).

No threatened flora species were observed within the subject site during surveys. One threatened fauna species the Grey-headed Flying-fox (*Pteropus poliocephalus*) was observed within the subject site during surveys.

One Endangered Ecological Community, White Box-Yellow Box-Blakely's Redgum Grassy Woodlands and Derived Native Grasslands, as listed within the EPBC Act, was observed within the subject site.

This endangered ecological community occupied approximately 649ha of the subject site and varied from highly disturbed isolated remnants to relatively undisturbed contiguous patches. The following table shows the extent of this EEC within the site within each of the identified corresponding vegetation communities.

<b>TABLE 3.2 EXTENT OF EEC WHITE BOX - YELLOW BOX - BLAKELY'S RED GUM WOODLAND AND DERIVED NATIVE GRASSLANDS WITHIN THE SUBJECT SITE</b>			
<b>Vegetation Community</b>	<b>Middlebrook Station (Hectares)</b>	<b>Mountain Station (Hectares)</b>	<b>Total (Hectares)</b>
Box Woodland (Grassy Variant)	197	289	486
Box - Ironbark Grassy Woodland (in part)	163	0	163
<b>TOTAL</b>	<b>360</b>	<b>289</b>	<b>649</b>

Within the provisions of the EPBC Act any proposal that reduces the extent of an EEC is required to be referred to the Department of Environment, Water, Heritage and the Arts (DEWHA) for their review and assessment.

This proposal was referred to the Department of Environment and Water Resources (Department of Environment, Water, Heritage and the Arts) as a result of the occurrence of this EEC within the subject site and the expected impacts of the proposal. A copy of this referral is attached as Appendix 3.

The Department of Environment, Water, Heritage and the Arts deemed this proposal to not be a controlled action. A copy of this correspondence is included in Appendix 2.

## SECTION 4

### IDENTIFICATION OF KEY HABITATS AND CORRIDORS

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Wildlife corridors are links between wildlife habitats, usually intact native vegetation, which link greater areas of vegetation or habitat. They are critical for maintaining ecological processes including the movement of animals and the continuation of viable populations.

The Department of Environment and Conservation (now Department of Environment and Climate Change) has mapped at a regional scale Key Habitats and Corridors in northern NSW to provide a framework of key fauna habitats and linking habitat corridors.

There are no areas mapped as corridors present within the subject site. There are regional and sub-regional corridor areas to the east of the site within the ridgelines and rangelands associated with the Glenbawn Dam catchment.

No areas within the site have been identified as key habitats within the DEC mapping. The nearest areas are to the east of the New England Highway and are associated with those regional and sub-regional corridor areas mentioned previously.

Areas of the subject are part of contiguous vegetation that is associated with the rangelands that extend to local National Parks and Nature Reserves. The vegetation within the site shows some connectivity to vegetation within Towarri National Park, adjacent to the northern boundary of Middlebrook Station. The ridgeline and rangeland vegetation also extends to the north to Wingen Maid Nature Reserve and Burning Mountain Nature Reserve.



## SECTION 5

### ECOLOGICAL IMPACT ASSESSMENT

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#### 5.1 IMPACTS ON BIRD SPECIES

##### 5.1.1 Background

Birds occasionally collide with operating wind turbines. According to the Australian Wind Energy Association Report (Auswind 2005) the risk of collision can depend on a number of factors, including technology (types of wind turbine, lighting, layout of turbines), site characteristics (vegetation and habitat types, proximity to bird concentrations, numbers of birds within an area), risk behaviour of birds and weather conditions.

Indirect impacts may also occur in the form of behavioural impacts such as avoidance of areas containing rotors, habitat disruption and displacement.

The risk of collision with rotors exists only for birds when in flight within the rotor-swept area. Birds may also be affected by turbulence caused by rotors however this has not been evaluated to date. The risk of collision may be dependent upon the height at which birds fly and the type of flight (eg hovering, circling, vertical and horizontal flight, flocking behaviour, slow and fast flight, nocturnal flight). Thus the risk of collision will vary between species. Other determinative factors may include surrounding vegetation and habitat types and weather conditions.

The probability of adverse bird interactions appears to be both site-specific and species specific. The most important step that can be taken to avoid adverse bird interactions is to locate facilities based on careful siting studies and away from critical habitats (Colson and Associates 1995). Given that the turbines need to be located in exposed areas subject to constant winds, then certain species that rely on habitats such as these are likely to be at greater risk.

In Australia collision rates are generally around one to two birds per turbine per year (AusWEA 2004). The most susceptible Australian birds are likely to include:

- birds of prey and owls, particularly soaring species such as eagles and kites;
- nocturnal migrating songbirds;
- locally breeding high-flying songbirds such as Magpie-larks;
- waterbirds including ibis, swans and ducks;
- shorebirds including migratory waders;
- Neophema parrots.

(source AusWEA 2002)

As the Australian wind energy industry develops more information is coming to light that the mortality rates at Australian Windfarms are lower than in the northern hemisphere, which appears to be due primarily to the lack of large numbers of night-migrating songbirds in Australia.

The cumulative risks posed by multiple numbers of wind farms have been investigated within Australia. This has been completed to address growing numbers of wind farms in Australia, particularly in southern Australia. Given that there are no other wind farms in the upper Hunter Region at present, cumulative risk posed by multiple wind farms would not seem to be a significant concern in regards to this proposal. An application has been preliminarily

approved for a windfarm at Nowlands Gap, Murrurundi in the Liverpool Range approximately 40km north of Scone. This is a relatively small wind farm with four turbines proposed. Given that there are no other wind farms in the upper Hunter Region at present, cumulative risk posed by multiple wind farms would not seem to be significant concern in regards to this proposal.

### 5.1.2 Potential Impacts

The major impact upon birds as result of the proposal is likely to be from the risk of mortality as a result of collision with rotor blades. To a lesser extent birds may be impacted upon by changes in behavioural patterns as a result of the presence of the turbines and through the removal of vegetation and habitats as a result of the construction of the turbines and associated infrastructure.

The following table shows the collision risk of bird “Species of Concern” observed during surveys or known from the local area. This calculation of the likelihood of movement within the rotor sweep area was based upon the behavioural and ecological characteristics of the various bird species and information collected during extensive field surveys. The collision risk is based upon the likelihood of movement within the rotor sweep area.

From the comprehensive bird list, “Species of Concern” were selected for further consideration as Level 1 Investigation – Initial Risk Assessment as per Auswind (2005).

“Species of Concern” include those species listed as threatened in Schedule 1 and 2 of the *Threatened Species Conservation Act 1995*, species listed as threatened or listed as migratory species within the *Environment Protection and Biodiversity Conservation Act 1999* as well as species that exhibit behaviour (flight) that puts them at risk of regular collision with operating wind turbines (Auswind 2005).

The Rotor Sweep Area refers to the area covered by the rotating blades of each turbine. This assessment covers the rotor swept area for the 105m high (Hub Height = 105m) wind turbine. Therefore, the Rotor Sweep Area would cover a range of between 60 metres above ground level and 150 metres above ground level.

TABLE 5.1 SPECIES OF CONCERN AND LIKELIHOOD OF MOVEMENT IN THE ROTOR SWEEP AREA				
Common name	Scientific Name	Suitable Habitat		Likelihood of Movement in RSA
		Middlebrook	Owens Gap	
<b>Acanthizidae</b>				
Speckled Warbler <sup>TS</sup>	<i>Pyrrholaemus sagittata</i>	√	√	L
<b>Accipitridae</b>				
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>	√	√	M
Brown Goshawk	<i>Accipiter fasciatus</i>	√	√	M
Grey Goshawk	<i>Accipiter novaehollandiae</i>	√	√	M
Wedge-tailed Eagle	<i>Aquila audax</i>	√	√	H
Spotted Harrier	<i>Circus assimilis</i>	√	√	M
Black-shouldered Kite	<i>Elanus axillaris</i>	√	√	M
Red Goshawk <sup>TS</sup>	<i>Erythrorhynchus radiatus</i>	√	√	M
White-bellied Sea-Eagle <sup>MS</sup>	<i>Haliaeetus leucogaster</i>	x	x	H
Whistling Kite	<i>Haliastur sphenurus</i>	√	√	M
Little Eagle	<i>Hieraaetus morphnoides</i>	√	√	H
Square-tailed Kite <sup>TS</sup>	<i>Lophoictinia isura</i>	√	√	M
Black Kite	<i>Milvus migrans</i>	√	√	M
<b>Anatidae</b>				
Blue-billed Duck <sup>TS</sup>	<i>Oxyura australis</i>	√	√	L
Freckled Duck <sup>TS</sup>	<i>Stictonetta naevosa</i>	√	√	L

**TABLE 5.1**  
**SPECIES OF CONCERN AND LIKELIHOOD OF MOVEMENT IN THE ROTOR SWEEP AREA**

Common name	Scientific Name	Suitable Habitat		Likelihood of Movement in RSA
		Middlebrook	Owens Gap	
<b>Apodidae</b>				
Fork-tailed Swift <sup>MS</sup>	<i>Apus pacificus</i>	√	√	H
White-throated Needletail <sup>MS</sup>	<i>Hirundapus caudactus</i>	√	√	H
<b>Ardeidae</b>				
Great Egret <sup>MS</sup>	<i>Ardea alba</i>	√	√	L
Cattle Egret <sup>MS</sup>	<i>Ardea ibis</i>	√	√	L
<b>Burhinidae</b>				
Bush Stone-curlew <sup>TS</sup>	<i>Burhinus grallarius</i>	√	√	L
<b>Cacatuidae</b>				
Little Corella	<i>Cacatua sanguinea</i>	√	√	H
Long-billed Corella	<i>Cacatua tenuirostris</i>	√	√	H
Glossy Black-Cockatoo <sup>TS</sup>	<i>Calyptorhynchus lathami</i>	√	√	H
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	√	√	H
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	√	√	H
Gang-gang Cockatoo <sup>TS</sup>	<i>Callocephalon fimbriatum</i>	√	√	H
Galah	<i>Cacatua roseicapilla</i>	√	√	M
<b>Ciconiidae</b>				
Black-necked Stork <sup>TS</sup>	<i>Ephippiorhynchus asiaticus</i>	√	√	L
<b>Climacteridae</b>				
Brown Treecreeper (eastern subspecies) <sup>TS</sup>	<i>Climacteris picumnus victoriae</i>	√	√	L
<b>Coraciidae</b>				
Dollarbird	<i>Eurystomus orientalis</i>	√	√	M
<b>Dicruridae</b>				
Black-faced Monarch <sup>MS</sup>	<i>Monarcha melanopsis</i>	√	√	L
Satin Flycatcher <sup>MS</sup>	<i>Myiagra cyanoleuca</i>	x	x	L
Rufous Fantail <sup>MS</sup>	<i>Rhipidura rufifrons</i>	√	√	L
<b>Estrildidae</b>				
Diamond Firetail <sup>TS</sup>	<i>Stagonopleura guttata</i>	√	√	L
<b>Falconidae</b>				
Brown Falcon	<i>Falco berigora</i>	√	√	M
Peregrine Falcon	<i>Falco peregrinus</i>	√	√	M
Nankeen Kestrel	<i>Falco cenchroides</i>	√	√	M
Australian Hobby	<i>Falco longipennis</i>	√	√	M
Black Falcon	<i>Falco subniger</i>	√	√	M
<b>Hirundinidae</b>				
White-backed Swallow	<i>Cheramoeca leucosternus</i>	√	√	M
Welcome Swallow	<i>Hirundo neoxena</i>	√	√	M
Tree Martin	<i>Hirundo nigricans</i>	√	√	M
Fairy Martin	<i>Hirundo ariel</i>	√	√	M
<b>Megapodiidae</b>				
Malleefowl <sup>TS, MS</sup>	<i>Leipoa ocellata</i>	x	x	L
<b>Meliphagidae</b>				
Painted Honeyeater <sup>TS</sup>	<i>Grantiella picta</i>	√	√	L
Regent Honeyeater <sup>TS, MS</sup>	<i>Xanthomyza phrygia</i>	√	√	L
<b>Meropidae</b>				
Rainbow Bee-eater <sup>MS</sup>	<i>Merops ornatus</i>	√	√	L
<b>Pachycephalidae</b>				
Olive Whistler <sup>TS</sup>	<i>Pachycephala olivacea</i>	√	√	L
<b>Petroicidae</b>				
Hooded Robin <sup>TS</sup>	<i>Melanodryas cucullata</i>	√	√	L
Hooded Robin (south-eastern form) <sup>TS</sup>	<i>Melanodryas cucullata cucullata</i>	√	√	L
<b>Psittacidae</b>				
Swift Parrot <sup>TS</sup>	<i>Lathamus discolor</i>	√	√	M
Turquoise Parrot <sup>TS</sup>	<i>Neophema pulchella</i>	√	√	L
Superb Parrot <sup>TS</sup>	<i>Polytelis swainsonii</i>	√	√	L

TABLE 5.1 SPECIES OF CONCERN AND LIKELIHOOD OF MOVEMENT IN THE ROTOR SWEEP AREA				
Common name	Scientific Name	Suitable Habitat		Likelihood of Movement in RSA
		Middlebrook	Owens Gap	
<b>Strigidae</b>				
Powerful Owl	<i>Ninox strenua</i>	√	√	M
Southern Boobook	<i>Ninox novaeseelandiae</i>	√	√	M
Barking Owl <sup>TS</sup>	<i>Ninox connivens</i>	√	√	M
<b>Rostratulidae</b>				
Australian Painted Snipe <sup>TS</sup>	<i>Rostratula australis</i>	x	x	L
Painted Snipe <sup>TS, MS</sup>	<i>Rostratula benghalensis</i>	x	x	L
<b>Scolopacidae</b>				
Latham's Snipe <sup>MS</sup>	<i>Gallinago hardwickii</i>	x	x	L
<b>Tytonidae</b>				
Sooty Owl <sup>TS</sup>	<i>Tyto tenebricosa</i>	x	x	L
Masked Owl <sup>TS</sup>	<i>Tyto novaehollandiae</i>	√	√	L
<sup>TS</sup> - Threatened Species as listed on the NSW TSC Act <sup>MS</sup> - Migratory Species as listed on the Commonwealth EPBC Act Likelihood of Movement in the RSA: L - Low, M - Moderate, H - High				

Based on the risk assessment completed for those bird species of concern (as contained within Appendix 3 Bird Impact Assessment), the following species have been afforded a high level of risk associated with collision with rotors based upon their observed occurrence within the subject site during surveys and exhibiting normal flight behaviour within the Rotor Swept Area (RSA).

- Wedge-tailed Eagle (*Aquila audax*);
- Nankeen Kestrel (*Falco cenchroides*);
- Australian Hobby (*Falco longipennes*);
- Galah (*Cacatua roseicapilla*);
- White-throated Needletail (*Hirundapus caudacatus*).

Other bird groups identified as being at high or medium risk of collision based on their occurrence within the site and flight behaviours include the Kites and Goshawks of the Family Accipitridae, Falcons of the Family Falconidae, Cockatoos of the Family Cacatuidae, Swallows and Martins of the Family Hirundinidae, Owls of the Family Strigidae, Dollarbird (Coraciidae) and Swift Parrot (Psittacidae).

Monitoring as part of ongoing environmental management will allow for data to be collected on the number and type of mortalities each year. Full details of the environmental management program are included within Section 6.

An extensive Bird Impact Assessment has been prepared for the site and is attached as Appendix 3.

The construction of the transmission line preferred route 1A also poses a risk to bird species. Birds are at risk of injury or mortality through striking transmission lines or towers. Birds may collide with power lines in flight as they are invisible to them or because they cannot avoid them during flight. Large birds that are not quick enough to change direction are more vulnerable (Partners in Flight 2005).

Birds may be attracted to power poles or transmission towers to perch, roost or nest. Large birds also may be electrocuted where they touch a power line and groundwire, another

energized wire or a pole at the same time, giving electricity a path to the ground (APLIC 2006).

Measures can be implemented to decrease the incidence of birds striking wires. Wires can be made more visible by using coloured or striped conductors. This has been observed to reduce mortality by up to 75%. Other measures increasing visibility or deterring birds away from lines and towers include devices which are hung from lines and swivel in the wind or glow in the dark (Partners in Flight 2005).

Structures can also be attached to poles to deter birds from perching, roosting or nesting. Condensers and lines can also be made safe so as to decrease the risk of electrocution via methods such as insulation, covering conductors or mounting safely (APLIC 2006).

## **5.2 IMPACTS ON BAT SPECIES**

### **5.2.1 Background**

Previous bat and wind turbine interaction studies are limited, providing little information on associated impacts. Results from some investigations (for example National Research Council 2007; Erickson *et al* 2005; Kunz *et al* 2007) have revealed that bats collide with turbines, particularly those that are constructed along forested ridge tops. However, large numbers of bats are not generally associated with collisions.

The following have been identified as potential impacts upon bats:

**Noise:** Sounds produced by wind turbines, which include audible and ultrasonic frequencies (some sounds are generated by the gear box in the nacelle, whereas others are produced by the rotation of the blades through air—often producing a “swishing” sound), may either attract bats—given their curiosity about novel objects in the environment—or confuse them upon detection.

**Lighting:** Insects attracted to lights on turbines may in turn attract foraging bats. If bats respond to high densities of flying insects near wind turbines, their chances of being struck by turbine blades are probably increased.

**Vortices:** Wind turbines produce obvious blade-tip vortices, and if bats get temporarily trapped in these moving air masses it may be difficult for them to escape. Rapid pressure changes associated with these conditions may lead to internal injuries, disorientation, and death of bats.

**Behaviour:** It is conceivable that bats are visually attracted to wind turbines. Migratory hoary bats reportedly seek the nearest available trees when daylight approaches (Dalquest 1943), thus bats may mistake the large, conspicuous monopoles of wind turbines for roost trees (Kunz and Lumsden 2003). Because bats are curious animals, they may be killed as they explore novel objects in their environment. Observations of bat activity at wind turbines in Iowa (Jain 2005) and in Sweden (Ahlén 2002) suggest that bats were not attracted to turbines. However, if bats were simply colliding with random objects, bat fatalities also would be expected at meteorological towers.

To date, no bat carcasses have been found near meteorological towers, even though these towers have been searched in several monitoring projects (Johnson 2005; Arnett *et al.* in prep.).

Bats use roosts as sites for resting, protection from weather and predators, rearing young, hibernation, digestion of food, mating, and social interactions (Kunz 1982a, b, c; Kunz and Lumsden (2003).

Linear corridor hypothesis: Many species of bats (especially red and hairy bats) are known to use linear corridors during migration and while foraging. Windfarms in forested regions can be developed along natural corridors such as ridge tops or corridors are created when access roads are constructed. If bats use such corridors where wind turbines are located, they may increase the chance of collision during migration or while foraging (Erickson et al 2005).

Acoustic failure hypothesis: Either migrating or foraging bats may fail to acoustically detect wind turbines, particularly moving blades. If the smooth cylindrical turbine masts are not detected by echolocating bats, then bats may collide directly with and be killed by these structures during flight. The functional range of echolocation by North American bats typically varies from 3–5 m. Migrating bats flying at a velocity of 5 m/s would have less than a second to respond to a wind turbine.

Visual failure hypothesis: Rotating rotor blades are subject to motion smear, thus making them difficult for organisms to see and respond appropriately. This hypothesis relates more to birds, but bats do use vision and bats may fail to visually detect wind turbine rotor blades.

Light attraction hypothesis: Bats may be attracted to the lights placed on wind turbines. Currently, these lights range from red lights or stroboscopic lights placed on alternative turbines, as recommended by the Federal Aviation Administration.

Acoustic attraction hypothesis: Bats may be attracted to sounds (audible and/or ultrasonic) produced by wind turbines. The uniform constant sounds made by the turbine generator and/or the variable “swishing” sounds made by rotating blades may attract bats and increase their risk of collision.

Motion attraction hypothesis: Curious bats may be attracted to the movement of rotating turbine blades. By investigating the moving blades, bats increase their risk of collision.

Insect concentration hypothesis: Flying insects rise in altitude with warm daily air masses and may become concentrated, particularly along ridge tops on certain nights. If the activity of migrating and locally foraging bats increases in response to high insect concentrations they increase their exposure to turbines and possible collision.

Insect attraction hypothesis: Flying insects may be attracted to the white turbine masts at night and then get trapped in the downstream wake of the rotors. Bats respond to these concentrations of insects in the wake and collide with the turbine in the process of feeding.

### 5.2.1 Potential Impacts

There were ten bat species recorded within the subject site during surveys. These were:

- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Freetail-bat (*Mormopterus sp*);
- White-striped Freetail-bat (*Nyctinomus australis*);
- Goulds Wattled Bat (*Chalinolobus gouldii*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Eastern Cave Bat (*Vespadelus australis*);
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*);

- Long-eared Bat (*Nyctophilus sp*);
- Little Forest Bat (*Vespadelus vulturnus*);
- Eastern Horseshoe Bat (*Rhinolophus megaphyllus*).

Of this total four species (Grey-headed Flying-fox, Eastern Bentwing-bat, Eastern Cave Bat and Yellow-bellied Sheath-tail-bat) are listed as threatened within the *Threatened Species Conservation Act* (1995). The Grey-headed Flying-fox is also listed on the *Environment Protection and Biodiversity conservation Act* (1999).

### ***Megachiropteran Bats***

The Grey-headed Flying-fox is found in a variety of habitats including rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated areas (Churchill, 1998). Grey-headed Flying-foxes congregate in large camps of up to 200,000 individuals, depending on availability of surrounding blossoming plants, from early until late summer (Churchill, 1998). Camps are commonly formed in gullies, typically not far from water and in vegetation with a dense canopy. Roost sites are an important resource where mating, birth and rearing of young occurs as well as providing refuge (Strahan, 1995).

Observations of this species within the subject site consisted of two individuals flying over the Glen Ridge. Based on observation during surveys, low numbers of individual Grey-headed Flying-foxes are likely to fly through the subject site as part of foraging or nomadic movements. This species is also likely to forage periodically within the subject site on flowering tree species. No camps are known within the vicinity of the subject site.

The subject site is not likely to be in the regular flight path of any locally occurring colony or camp of Grey-headed flying-foxes. Any collisions are likely to be isolated individuals and, based on the small number of observations of this species, extremely rare.

Monitoring as part of ongoing environmental management will allow for data to be collected on the number and type of mortalities each year should they occur. Full details of the environmental management program are included within Section 6.

The construction of the transmission line may have impacts upon the Grey-headed Flying-fox. This species is known to suffer mortality due to electrocution from power lines.

### ***Microchiropteran Bat Species***

Nine species of microchiropteran bat were recorded within the subject site during surveys. This includes three threatened species the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), Eastern Cave Bat (*Nyctophilus bifax*) and Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*).

Microchiropteran bat species occur across a range of forest, woodland and grassland vegetation types and habitats. The subject site contains suitable habitat types for microchiropteran bat species including key habitat types such as tree hollows and caves for roosting and maternity sites. These key habitat types will not be removed as part of the proposal.

The major impact posed by the proposal to microchiropteran bat species is though collision with rotor blades. There is a scarcity of information available in Australia in regards to the incidence of blade strike upon microchiropteran bats. The species most at risk as a result of this proposal would be high flying species foraging upon insects on the ridgetops within the

rotor sweep area. There is also some risk of bats being attracted to rotors and prone to blade strike or vortices impacts as per the hypotheses discussed in Section 4.2.1.

Based on flight behaviour and foraging ecology information the species at most risk of collision are the White-striped Freetail-bat and Yellow-bellied Sheathtail-bat. The White-striped Freetail-bat has low manoeuvrability and flies fast, foraging in open areas above the canopy. In Victoria this species forages in open areas usually 50 metres or more above the ground (Churchill 1998, Sinclair Knight Merz 1998). Hall and Richards (1972) identified this species as being known to suffer mortality from “Dunlite” wind generators.

The Yellow-bellied Sheathtail-bat forages above the tree canopy, flying high and fast. The foraging height varies with the height of the tree canopy.

Other species including the Eastern Bentwing-bat, Eastern Horseshoe Bat, Little Forest Bat, and Goulds Wattled Bat would seem to be at low, if any, risk as they forage low to the ground or within the canopy (Churchill 1998, Countrywide Ecological Services 2007).

Little information is available within the literature reviewed on the flight behaviour and foraging ecology of the Eastern Cave Bat, Freetail Bat and Long-eared Bat.

The construction of the turbines is likely to pose some level of risk to microchiropteran bat species, particularly the White-striped Freetail-bat and Yellow-bellied Sheathtail-bat. Other species are of lesser collision and mortality risk. The risk posed and subsequent population effects are though to be low however given the low expected incidence of collision and large amounts of suitable habitat available within the local area including Towarri National Park.

Monitoring as part of ongoing environmental management will allow for data to be collected on the number and type of mortalities each year. Full details of the environmental management program are included within Section 6.

## **5.3 VEGETATION AND HABITAT REMOVAL**

### **5.3.1 Background**

The construction of the Kyoto Energy Park will require selective clearing or modification of vegetation and habitats as part of the construction of the wind turbines, closed loop hydro plant and transmission lines. Some clearing may also be required for access tracks. Other activities associated with the proposal including the Solar PV plant, Visitors and Education Centre, Maintenance Shed, and Manager’s Residence will be limited to currently cleared areas.

### **5.3.2 Potential Impacts**

The following potential impacts have been identified in relation to the removal of native vegetation within the subject site.

- Potential removal of threatened flora populations and endangered ecological communities;
- Reduced quality of vegetation due to enhanced edge effects;



- Reduced habitat quality, diversity and connectivity;
- Erosion and sedimentation.

The following table provides details on the removal of vegetation within the subject site. The amount to be removed or modified for each vegetation community is supplied. This has been estimated for the turbine, access track and transmission line components of the proposal.

These totals are approximates only based on overlaying site layout plans on the vegetation community mapping. Given the large size of the site(s) and hence the small scale of the mapping, there is expected to be some error in these estimates.

It must be noted that in most cases this will be modification of vegetation only, as opposed to removal. The access tracks currently exist as informal tracks and trails that will require regrading and maintenance to 5 metres width. Minimal tree clearing will be required for access track construction.

It is expected that the amount of vegetation requiring removal for transmission line Options 2 and 4 will be low. The large majority of these routes occur along road reserves and current powerline easements and as such clearing will be minimal. The transmission line option will however require maintenance of vegetation within the site to a 20 metre easement. All trees and shrubs less than 3 metres in height can be retained within this easement. Where the transmission line traverses Mountain Station vegetation clearing will be minimal as wires can be slung between poles across gully areas. The majority of clearing required will be for the construction of the turbines (20x30 meter hard stand area and 10 metre perimeter).

Other facilities are predominantly located within currently cleared areas (Grassland with Scattered Trees) to minimise tree and vegetation removal.

<b>TABLE 5.2</b> <b>ESTIMATES FOR VEGETATION REMOVAL AND MODIFICATION FOR VEGETATION</b> <b>COMMUNITIES WITHIN THE SUBJECT SITE</b>			
	<b>Area to be Removed or Modified (Hectares)</b>		
<b>Vegetation Community (Total)</b>	<b>Development Component</b>		
<b>Mountain Station</b>	<b>Turbines</b>	<b>Access Tracks</b>	<b>Transmission Lines</b>
Grassland with Scattered Trees (628ha)	2.28	3.7	0.75
Box Woodland Grassy Forest (286ha)	0.36	0.75	1.5
Box Ironbark Red Gum Woodland (356ha)	0.96	0.75	-
Exposed Ironbark Woodland (597ha)	-		1.5
<b>Middlebrook Station</b>			
Grassland with Scattered Trees (1123ha)	-	0.1	0.8

TABLE 5.2 (Cont) ESTIMATES FOR VEGETATION REMOVAL AND MODIFICATION FOR VEGETATION COMMUNITIES WITHIN THE SUBJECT SITE			
	Area to be Removed or Modified (Hectares)		
Vegetation Community (Total)	Development Component		
Middlebrook Station	Turbines	Access Tracks	Transmission Lines
Ironbark Stringybark Open Forest (25ha)	0.12	0.25	1.5
Ironbark-Box Open Forest (306ha)	0.36	0.4	3
Box Woodland Grassy Forest (214ha)	0.72	1.25	-

### ***Threatened Flora Population and Endangered Ecological Communities***

One endangered flora population, *Cymbidium canaliculatum*, was observed within the subject site. The proposal will not require the removal of any individuals from this population.

One EEC White Box - Yellow Box - Blakely's Red Gum Woodland, was observed within the subject site. This EEC occupies an area of approximately 649ha.

All of the individuals of the endangered population will be retained as part of the proposal. Based on preliminary site layout plans the proposal will require the removal of a maximum of approximately 5.9 hectares of White Box - Yellow Box - Blakely's Red Gum Woodland. This consists of approximately 3.6 hectares within Middlebrook Station and 2.3 hectares on Mountain Station. Approximately 640 hectares of this endangered ecological community will be retained within the site.

The persistence and quality of the threatened population and EEC will be monitored throughout the operational phase of the proposal, and managed according to strategies outlined in the Environmental Management Plan to be prepared for the site (as detailed in Section 7).

Small areas of the endangered ecological community may also require removal for the construction of the proposed transmission lines (Options 2 and 4). This is considered to be negligible however as the proposed route will follow the road reserve from Mountain Station to Scone. A small amount of removal of the EEC, mostly isolated trees, may be required for the construction of the transmission line from the northern end of Mountain Station and southern end of Middlebrook Station to the road reserve.

### ***Vegetation Quality***

The removal and/or modification of small areas of native vegetation within the site may enhance edge effects and result in a decline in the quality of the vegetation. The primary threat to vegetation quality is weed incursion resulting from increased sunlight around vegetation edges, physical soil disturbance, and nutrification of soils and waterways.

All retained vegetation in the vicinity of activities on site will be monitored and managed according to the Environmental Management Plan to be prepared for the site. Vegetation monitoring will assess community structure and floristic composition and level of weed incursion.

A weed control program has been recommended as part of the proposal. The effectiveness of the program will be assessed regularly and adapted accordingly, based on monitoring outcomes. Correct implementation of recommended vegetation management strategies will ensure impacts on retained vegetation are minimised.

### ***Habitat Quality, Diversity and Connectivity***

The proposal will require the removal of small areas of native vegetation, which will result in the loss of some fauna habitats. However, the development has been designed so that only areas of degraded, lower quality vegetation are removed. Large areas containing higher quality habitat types will be retained as part of the proposal. Habitat types retained include:

- Flower, nectar and seed producing tree and shrub species of the dry open forest, and woodland;
- Hollow bearing trees and stags;
- Sparse to dense shrub layer and understorey;
- Sparse to dense grassy layer;
- Moderately dense to sparse leaf litter layer;
- Fallen timber and hollow logs;
- Rocky outcrops and caves;
- Farm dams.

Key habitat types such as aquatic areas (creeklines and drainage lines), hollow bearing trees, outcrop areas and caves will be retained as part of the proposal. Due to the large size of the site surveys have not been completed to determine if or how many hollow bearing trees may be required for removal. If hollow bearing trees are to be removed supplementary measures (nest boxes) will be implemented as part of the sites Environmental Management Plan.

Given the small amounts of vegetation to be removed the proposal is unlikely to impact on habitat connectivity or fauna movements.

### ***Erosion and Sedimentation***

The removal of native vegetation, particularly on slopes or in riparian areas, presents the risk of soils erosion and sedimentation of aquatic environments. Vegetation removal will not occur near drainage lines or dams, and will therefore not impact on aquatic environments. Some clearing and construction will be occurring on sloping land. Potential erosion hazards will be identified prior to the commencement of works during the construction phase of the development. Ameliorative measures shall be implemented for identified hazards, which may include silt fencing and sediment traps. Areas where vegetation has been removed will continue to be monitored during the operational phase to ensure the cleared area is not subject to on-going erosion. Management of erosion and sedimentation is to be detailed within the Environmental Management Plan. Correct implementation of recommended strategies will minimise erosion and sedimentation associated with vegetation removal.

## **5.4 IMPACTS ON TOWARRI NATIONAL PARK**

The subject site is adjacent to Towarri National Park. Towarri National Park was gazetted in 1998 following the purchase of several key properties (some of which were owned by the current landowner) that were combined with vacant crown land. The park covers an area of 5,035 hectares. New areas are expected to be added to the park (DEC 2004).

The National Park borders the northern boundary of the site (Middlebrook Station). There is also a small section of Towarri National Park separate to the main northern section that is adjacent to the western boundary of Middlebrook Station. The vegetation within the ridgelines on the subject site is part of a greater area of vegetation and habitat associated with the ranges, ridges and creekline areas that occur within Towarri National Park.

The position of these sections of Towarri National Park in relation to the subject site is shown in Figure A2 of Appendix 1.

There are a number of turbines proposed within Middlebrook Station that are close to the boundary of the national park. There are approximately seven turbines within one kilometre of the park boundary. The presence of these turbines poses some risk to bird and bat species that may use the vegetation and habitats within Towarri National Park. A full discussion of the threats to bird and bat species by the proposal is contained within Sections 5.1 and 5.2.

It is not expected that there will be any other impacts upon Towarri National Park as a result of the proposal.

## **5.5 IMPACTS ON HUNTER CENTRAL RIVERS CATCHMENT ACTION PLAN**

The Hunter-Central Rivers Catchment Management Authority was formed to co-ordinate the management of the natural resources in the Hunter-Central Rivers region, by involving local communities. It is one of 13 Catchment Management Authorities established in NSW. Its vision is *“Healthy and productive catchments through the ecologically sustainable management of our natural resources and environment, for the benefit of present and future generations”*.

The Hunter-Central Rivers Catchment Action Plan was prepared to provide a co-ordinated plan for all natural resource work in the region through partnerships and collaborations with government, industry, community groups and individuals. This plan outlines the most important natural resource issues in the region and guides how natural resource management and investment should occur. The Catchment Action Plan has been created according to law but is not a legally binding document.

The Catchment Action Plan lists the following as the main threats to resources within the Hunter-Central Rivers region (Appendix 3: The state and pressures on our natural resources):

- Population pressure;
- Lack of awareness and understanding of natural resource management issues;
- Climate change;
- Threats to the land:
  - Erosion
  - Acid sulphate soils
  - Salinity
- Threats to groundwater:
  - Overuse of groundwater
  - Pollution of groundwater
  - Degradation of groundwater dependent ecosystems
- Threats to rivers:
  - Loss of stream bank vegetation
  - Instream barriers to fish movement
  - Reduced quality of fish habitat

- Changes to river flows
  - Thermal water pollution
  - Water pollution
- Threats to estuaries and lakes:
  - Destruction and degradation of wetlands
  - Pollution
  - Loss of riparian vegetation
  - Boating
  - Weeds
  - Floodgates
  - Fishing
- Threats to coastal and marine areas:
  - Dune erosion
  - Rocky shelves
  - Weeds and pests
- Threats to biodiversity:
  - Vegetation clearing
  - Limited capacity of landholders to protect and improve biodiversity on their land
  - Pests or feral animals
  - Weeds.

Each of these identified threats is assessed individually below in relation to the proposal.

### **Population Pressure**

The proposal will result in a small local increase in population during the construction and operational phases of the development. However local labour is likely to be used predominantly. The proposal is not likely to result in any significant increase locally in relation to population pressure.

### **Lack of Awareness and Understanding of Resource Management Issues**

The proposal has been completed in accordance with strict resource management principles. This includes adherence to environmental assessment requirements, impact assessment guidelines and the principles of ecologically sustainable development. The proposed energy park and use of renewable fuel sources is by nature a reaction to poor resource management in the past and use and over dependence on non-renewable fuel sources.

### **Climate Change**

The construction stage of the Kyoto Energy Park will require the use of fossil-fuel powered technology, and the removal of some native vegetation within the site and along transmission lines. There will be carbon emissions associated with this stage of the development. During the operational phase, the energy park will be utilising wind energy for the production of electricity. No fossil fuel powered technology, other than service vehicles, will be used during this phase. The energy park will provide a carbon-free source of energy that will replace energy traditionally generated through coal burning. As such, it is expected that the Kyoto Energy Park will be carbon negative in the long term and a positive step towards promotion of the use of renewable energy sources and decreasing the expected impacts of climate change.

### **Threats to the Land**

It is not expected that the proposal poses any significant threat to the land or soils within the subject site. The clearing of vegetation for the turbines and associated facilities will result in the removal of approximately 5.9 hectares of vegetation. This poses a soil erosion risk where vegetation is removed exposing topsoil. A management plan will be prepared for the site that details measures to minimise soil erosion during construction. This will include detailed erosion and sediment control strategies including stabilising exposed soil surfaces to prevent erosion.

It is not considered that the proposal is likely to result in any increases in local salinity or impacts from acid sulphate soils.

### **Threats to Groundwater**

The proposal is not likely to have any impacts upon groundwater. No groundwater will be removed or polluted as a result of the proposal. No groundwater dependent ecosystems have been identified within the subject site. The groundwater hydrology will not be altered as a result of the proposal.

### **Threats to Rivers**

The proposal area is part of the Hunter River catchment. Middlebrook Station drains into the Kingdon Ponds sub-catchment which flows to the Hunter River. Mountain Station drains through a series of gullies into the Middle Brook sub-catchment which flows into the Hunter River. The proposal does not require the removal of any riparian vegetation, construction of barriers to fish movement, damage to fish habitats or changes to river flows.

There is some low level pollution risk in the form of sedimentation of creek and drainage lines as the result of erosion upstream due to vegetation removal. However the construction and operational phases of the proposal include erosion and sediment control management actions that will minimise the risk of sedimentation of downstream catchment areas.

### **Threats to Estuaries and Lakes**

There are no estuaries or lakes located within the subject site or local area. The potential threats to estuaries and lakes listed within the Catchment Action Plan are therefore not applicable to this proposal.

### **Threats to Coastal and Marine Areas**

The subject site is not located in or near a coastal or marine area. The proposal therefore will not result in dune erosion, impact on rocky shelves, or enhance weed and pest incursion in coastal or marine areas.

### **Threats to Biodiversity**

#### *Vegetation removal*

The proposal will require the removal of approximately 5.9 hectares (0.8%) of the EEC White Box - Yellow Box - Blakely's Red Gum Woodland. The majority of the vegetation to be removed is degraded as a result of past clearing, grazing and weed invasion. Considering the small proportion of vegetation to be removed and its degraded nature, impacts on local biodiversity are expected to be negligible. The removal of 5.9 hectares of vegetation will not affect the viability of the EEC, nor will it result in a loss of habitat substantial enough to impact the viability of local fauna populations. There are opportunities within this proposal to

offset vegetation losses by improving, through vegetation management, the quality of retained vegetation or regenerating currently cleared areas.

#### *Limited capacity of landholders to protect and improve biodiversity on their land*

The proposal will not result in a significant change in the way that the land within the subject site will be managed. The primary impact associated with construction phase activities is the removal of 5.9 hectares of vegetation. Impacts relating to this have been addressed in the previous paragraph. All other activities will be carried out using the most ecologically sensitive methods possible. Land management during the operational phase, is expected to be much the same as it was prior to the development. The proposal is not expected to introduce any new threats to biodiversity.

#### *Pests or feral animals*

Several pest fauna species were observed within the subject site including the goat, rabbit, brown hare, red fox, dog, common myna and common starling. The proposal is not expected to increase the amount of pest fauna species within the subject site.

#### *Weeds*

A variety of weed species, particularly common pasture weeds, were observed within the subject site. The removal of vegetation will encourage the spread of weeds by disturbing soil and allowing more sunlight to reach the ground layer. Enhanced incursion of pasture weeds into the 5.9 hectare area proposed for clearing will have a negligible impact on local biodiversity. There is the potential for weed control programs to be implemented at this site, particularly within and adjacent to areas disturbed as part of the proposal.

## SECTION 6

### PART 3A THREATENED SPECIES ASSESSMENT CONSIDERATIONS

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#### 6.1 BACKGROUND

The following threatened flora and fauna species and endangered ecological communities assessment relies on the flora and fauna survey and assessment information contained within the Flora and Fauna Assessment Report attached as Appendix I. The assessment has been prepared in accordance with the *DRAFT Guidelines for Threatened Species Assessment* (DEC & DPI 2005).

The following information is provided to address the impacts of the proposed development upon threatened flora and fauna species, endangered populations and endangered ecological communities. Assessments have been prepared for those threatened species recorded within the subject site during surveys and those recorded recently within local area studies and considered to have potential to occur within the subject due to the presence of suitable habitat.

#### 6.2 HOW IS THE PROPOSAL LIKELY TO AFFECT THE LIFECYCLE OR HABITAT OF A THREATENED SPECIES, POPULATION OR ENDANGERED ECOLOGICAL COMMUNITY

##### 6.2.1 Threatened Flora Species

No threatened flora species were observed within the subject site during surveys.

##### 6.2.2 Threatened Fauna Species

The following threatened fauna species have been assessed due to their known occurrence in the subject site:

- Glossy Black-Cockatoo;
- Grey-crowned Babbler;
- Speckled Warbler;
- Grey-headed Flying-fox;
- Yellow-bellied Sheath-tail-bat;
- Eastern Bentwing-bat;
- Eastern Cave Bat.

These threatened species have been assessed individually below.



### **Glossy Black-Cockatoo (*Calyptrorhynchus lathami*)**

The Glossy Black-Cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of *Allocasuarina* feed trees. They choose feed trees with larger cone crops but show no sign of selecting trees on the basis of cone size - concentrating foraging in trees with a high ratio of total seed weight to cone weight (Clout 1989). They breed in hollow trees or stumps usually in *Eucalypts*.

The subject site provides suitable foraging and roosting habitat for this species. This species was observed foraging within *Allocasuarina* trees on the Glen Ridge on Middlebrook Station during surveys conducted on the 9<sup>th</sup> May 2007 with chewed cones observed during surveys conducted on the 2<sup>nd</sup> August 2007. This species would utilise the large areas of suitable habitat available within the local area including those habitats within Towarri National Park.

The proposal will require the removal of a relatively small area of potential habitat for the Glossy Black-Cockatoo for the construction of turbines and related infrastructure. Large areas of habitat will be retained within the site and are available within the local area. Key habitats such as hollow-bearing trees will be retained as part of the proposal.

Site specific offset strategies will be developed as part of the later stages of this proposal. The proposal will also include an Environmental Management Plan for the construction and operational phases of the development. The Environmental Management Plan will include full details of the site offset strategies.

It is not considered likely that the construction of transmission lines would significantly impact upon this species. The impacts of the construction of the turbines are addressed in Appendix 3.

### **Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)**

The Grey-crowned Babbler occupies open woodlands dominated by mature *eucalypts*, with regenerating trees, tall shrubs and an intact groundcover of grass and forbs. This species forages in leaf litter and on the bark of trees (Garnett & Crowley 2000). Birds forage in a group, staying within fifteen metres of each other, but occasionally spreading out to thirty metres (Boles 1988). All members of a group cooperate in (nest) building and caring of the young but only the breeding female incubates and broods (King 1980). The whole group roosts each night in a roosting nest (dormitory), and many of these are built and maintained throughout the year (Schodde & Tidemann 1986).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. A small group of two (2) birds were observed in the foothills of the Glen Ridge at Middlebrook Station on all survey days. A larger group of approximately five (5) birds were observed at the gate to the haul road at Middlebrook Station during surveys conducted on the 13<sup>th</sup> June 2007 and again during surveys conducted on the 1<sup>st</sup> and 2<sup>nd</sup> August 2007.

This species would utilise the large areas of suitable habitat available within the local area including those habitats within Towarri National Park.

The proposal will require the removal of a relatively small area of potential habitat for the Grey-crowned Babbler for the construction of turbines and related infrastructure. Large areas of habitat will be retained within the site and are available within the local area. The proposal is not likely to significantly impact upon the lifecycle or habitat of a local population of this species.

Site specific offset strategies will be developed as part of the later stages of this proposal. The proposal will also include an environmental management plan for the construction and operational phases of the development.

It is not considered likely that the construction of transmission lines would significantly impact upon this species. The impacts of the construction of the turbines are addressed in Appendix 3.

### **Speckled Warbler (*Pyrrholaemus saggitata*)**

Speckled Warblers inhabit mainly grassy ground layer of dry sclerophyll forests and woodlands, often with scattered shrubs in the understorey. This species is mainly insectivorous but will also take seeds and other plant material (Higgins & Peters 2002). They are sedentary with no migratory or seasonal movements known. They nest solitary with large exclusive breeding territories, the boundaries of which change little over successive years. They breed most of the year round with a peak from September to November (Higgins & Peters 2002).

The subject site provides suitable foraging and roosting habitat for this species. The proposed development is unlikely to impact with this species or its habitat. This species was observed in two separate locations upon the Glen Ridge on Middlebrook Station during surveys conducted on the 8<sup>th</sup> & 9<sup>th</sup> May 2007 and re-observed in the same locations during surveys conducted on the 1<sup>st</sup> and 2<sup>nd</sup> August 2007.

This species would utilise the large areas of suitable habitat available within the local area including those habitats within Towarri National Park.

The proposal will require the removal of a relatively small area of potential habitat for the Speckled Warbler for the construction of turbines and related infrastructure. Large areas of habitat will be retained within the site and are available within the local area. The proposal is not likely to significantly impact upon the lifecycle or habitat of a local population of this species.

Site specific offset strategies will be developed as part of the later stages of this proposal. The proposal will also include an environmental management plan for the construction and operational phases of the development.

It is not considered likely that the construction of transmission lines would significantly impact upon this species. The impacts of the construction of the turbines are addressed in Appendix 3.

### **Grey-headed Flying-fox (*Pteropus poliocephalus*)**

These bats eat the fruit or blossoms of more than 80 species of plants. Their major food source is eucalypt blossom and native fruits from a variety of tree species. Native figs (*Ficus spp*) account for a large percentage of the fruit eaten. They are also known to raid orchards of cultivated fruit. The Grey-headed Flying-fox has a nightly feeding range of 20 to 50km from their camp (Churchill, 1998).

Grey-headed Flying-foxes congregate in large camps of up to 200,000 individuals, depending on availability of surrounding blossoming plants, from early until late summer (Churchill 1998). Camps are commonly formed in gullies, typically not far from water and in vegetation with a dense canopy. Roost sites are an important resource where mating, birth and rearing of young occur as well as providing refuge (Strahan 1995).

Two Grey-headed Flying-foxes were observed flying over the Glen Ridge on Middlebrook Station during nocturnal surveys conducted on the evening of the 9<sup>th</sup> May 2007. No roost or camp sites were observed within the subject site or are known from the immediate area. This species would utilise the large areas of suitable habitat available within the local area including those habitats within Towarri National Park.

The proposal will require the removal of a relatively small area of potential foraging habitat for the Grey-headed Flying-fox for the construction of turbines and related infrastructure. Large areas of habitat will be retained within the site and are available within the local area. The proposal is not likely to significantly impact upon the lifecycle or habitat of a local population of this species.

Site specific offset strategies will be developed as part of the later stages of this proposal. The proposal will also include an environmental management plan for the construction and operational phases of the development.

It is not considered likely that the construction of transmission lines would significantly impact upon this species. The impacts of the construction of the turbines are addressed in Appendix 3.

**Microchiropteran Bat Species: Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Eastern Bentwing-Bat (*Miniopterus schreibersii*) & Eastern Cave Bat (*Vespadelus troughtoni*)**

The Yellow-bellied Sheathtail-bat inhabits a wide variety of Eucalypt forests, foraging above the canopy in fast flight movements. This species roosts in tree hollows and occasional old buildings (Hoye & Richards 1995). This species was detected foraging near the southern end of Glen Ridge during Anabat II surveys conducted on the evening of the 26 April 2007.

The Eastern Bentwing-bat forages above and below the canopy within open forests and woodlands, feeding on small insects (Dwyer 1995a). This species was detected foraging near the southern end of Glen Ridge during Anabat II surveys conducted on the evening of 26 April 2007.

The Eastern Cave Bat is a poorly known species, but is believed to dwell predominantly in caves, overhangs and occasionally buildings. It has been found roosting in small groups in sandstone overhang caves, boulder piles, mine tunnels and occasionally in buildings. These bats roost sites are near the entrance in generally well lit areas. They roost in small avons or domes in the roofs of the caves as well as in cracks or crevices (Churchill 1998). The Eastern Cave Bat inhabits tropical mixed woodland and wet sclerophyll forest on the coast and the dividing range but extends into the drier forests of the western slopes and inland areas (Churchill 1998). It forages mainly beneath the canopy in a range of forest types over its range (SFNSW 1995). This species was detected via Anabat II detection surveys conducted on the 8 May 2007, foraging within the vicinity of the proposed maintenance shed on Mountain Station, Owens Gap and at the north-western spur area near a communications tower also on Mountain Station.

These species would utilise the large areas of suitable habitat available within the local area including those habitats within Towarri National Park.

The proposal will require the removal of a relatively small area of potential foraging habitat for these microchiropteran bat species for the construction of turbines and related infrastructure. Large areas of habitat will be retained within the site and are available within the local area. The proposal includes the retention of key habitat areas such as hollow-bearing trees, caves and outcrop areas that may be used as roost or maternity sites. It is

considered that the proposal is not likely to significantly impact upon the lifecycle or habitat of a local population of these species.

Site specific offset strategies will be developed as part of the later stages of this proposal. The proposal will also include an environmental management plan for the construction and operational phases of the development.

It is not considered likely that the construction of transmission lines would significantly impact upon this species. The impacts of the construction of the turbines are addressed in Appendix 3.

### **6.2.3 Endangered Ecological Communities**

One Endangered Ecological Community, White Box - Yellow Box - Blakely's Red Gum Woodland was observed within the subject site.

#### **WHITE BOX - YELLOW BOX – BLAKELY'S RED GUM WOODLAND (WBYYBRW)**

There is one Endangered Ecological Community (EEC) known as White Box Yellow Box, Blakely's Red Gum Woodland (WBYYBRW) present within the subject site. This community occupies approximately 761.9ha within the subject site. This community also corresponds in part with the Upper Hunter White Box-Ironbark Grassy Woodland vegetation community mapped by Peak (2006) as occupying approximately 5687ha within the Upper Hunter region. This EEC is also known to be securely conserved, albeit poorly represented within the Goulbourn River and Towarri NP upper hunter reserve system.

Based on preliminary site layout plans the proposal is likely to require the removal of a maximum of approximately 5.9ha (3.6 ha Middlebrook Station, 2.3 ha Mountain Station) or 0.8% within the site for the upgrading of the vehicle access tracks and construction of the wind turbines envelopes, however this final figure is likely to be less. The majority of the Box Woodland vegetation required for removal within the subject site is highly disturbed by current intensive grazing practices, exotic weed invasion and clearing.

It is considered that the proposal is not likely to significantly impact upon the status, viability or habitat of this endangered ecological community within the local area or region.

### **6.2.4 ENDANGERED POPULATIONS**

#### ***Cymbidium canaliculatum***

*Cymbidium canaliculatum* is listed as an endangered population within the Hunter Catchment. There are currently 8 records of this species within the Hunter Central Rivers CMA region (BioNet 2007). The number of plants of *C. canaliculatum* in the Hunter Catchment is currently estimated to be very low, as few as 90. There could be as many as 300 to 500 individuals in the population, assuming an average density of about one plant per 30 square kilometres of estimated habitat for *C. canaliculatum* population in the Hunter Catchment (NSW Scientific Committee 2006). Seven (7) clumps of this species were observed in the subject site within the Box Woodland vegetation community. Clumps are defined as single clusters which may contain multiple individual bulbs. Each of these populations will be retained as part of the proposal. One of these clumps is isolated within a paddock tree by more than 5km from the nearest other known specimen. It is questionable whether the species at this location will remain viable in the long term.

Despite the proposal requiring the removal of a small area of disturbed habitats for this species, large areas of suitable habitat will be retained within the subject site. Furthermore,

large areas of habitat for this species are retained within the local conservation network of the upper hunter, including the adjoining Towarri NP. All individuals of this species will be retained as part of the proposal.

It is considered that the proposal is not likely to significantly impact upon the lifecycle or habitat of a local population of the endangered population.

It is therefore considered that the action proposed is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

### **6.3 DOES THE PROPOSAL AFFECT ANY THREATENED SPECIES OR POPULATIONS AT THE LIMIT OF THEIR KNOWN DISTRIBUTION**

No threatened species or endangered ecological communities are at the limit of their known distribution in the locality of the subject site. As such the proposal is not likely to affect any threatened species or endangered ecological communities at the limits of their known distribution.

### **6.4 HOW IS THE PROPOSAL LIKELY TO AFFECT CURRENT DISTURBANCE REGIMES**

The site has been historically cleared for grazing and consists of a mosaic of cleared highly disturbed lands and large areas of intact native vegetation. The development footprint will be limited to those areas required for the turbines, access tracks and other related infrastructure. It is expected that approximately 8 hectares of vegetation will be required for clearing.

Edge effects are likely to occur at the interface between the development and retained vegetation. Strict vegetation management strategies and protocols will be established to control and minimise any potential edge effect. The establishment of Asset Protection Zones and buffers will aid in buffering the effects of development upon adjacent retained vegetation.

It is not considered that the proposal will alter fire frequencies within the site. The implementation of best practice erosion and sediment controls during construction and occupation will control impacts associated with runoff to lower lying areas.

Given the large size of the site, currently disturbed nature of the landscape and relatively low amount of vegetation to be disturbed (removed/modified) it is not expected that the proposal is likely to increase or exacerbate current disturbance regimes.

### **6.5 HOW IS THE PROPOSAL LIKELY TO AFFECT HABITAT CONNECTIVITY**

The proposed development is likely to remove approximately 5.9 hectares of vegetation (3.6 ha Middlebrook Station, 2.3 ha Mountain Station). The site is bound to the north and east by similar native vegetation communities with high level vegetative connectivity to Towarri National Park and surrounding native vegetation. As the proposed development is situated along the southern escarpment part of the remnant bushland within Middlebrook station and the predominately cleared areas of Mountain Station it will not disconnect any corridors or isolate any patch of vegetation.

The subject site does not form part of any identified regional corridor or area of key habitat.

It is considered that the vegetation removal required as part of the proposal is low and will not occur in areas that will fragment or isolate currently connected areas of vegetation and habitats within the local landscape.

#### **6.6 HOW IS THE PROPOSAL LIKELY TO AFFECT CRITICAL HABITAT**

No critical habitat relevant to these endangered ecological communities is declared under the *TSC Act 1995* within the subject site.

## SECTION 7

### ENVIRONMENTAL MANAGEMENT

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#### 7.1 MANAGEMENT PROGRAM OVERVIEW

*Adaptive management* is a management style that allows actions to be responsive to monitoring outcomes. An adaptive management program will be implemented for the Kyoto Energy Park. This section provides a general outline of the management program for the subject site. The management program for the subject site is briefly outlined in this section, and will be described in detail in the Environmental Management Plan to be prepared for the site. Ecological management for the proposed development will occur in two stages:

1. Pre-operational
2. Operational

Pre-operational and operational phases of the development must meet Best Practice Guidelines for wind Energy projects (AusWEA 2002).

##### **7.1.1 Pre-operational Phase Management**

Ecological management during the pre-operational phase involved a Level 3 assessment of direct and indirect bird impacts in accordance with Auswind guidelines (Auswind 2005). Level 3 risk assessment involved analysis of population viability for impacted species and provided:

- Estimates of the level of risk of significant bird impacts
- Baseline data for use in operational phase monitoring of impacts
- Information for use in the design of risk mitigation measures
- Vegetation management
- Site offset strategies

##### **7.1.2 Operational Phase Management**

Ecological management during the operational phase will aim to continually assess the impact of wind turbines on aerial fauna through monitoring as per Auswind guidelines (Auswind 2005). Species of Concern identified in the Pre-operational Management Phase will be targeted. Monitoring will involve dead bird and bat searches, indirect disturbance impact assessment and avoidance behaviour studies.

Operational phase assessment will be conducted in a BACI (Before-After-Control-Impact) experimental style. Assessment aims will be to:

- Determine the difference in bird and bat fauna abundance and diversity within the subject site before and after installation of wind turbines;
- Determine the difference in bird and bat fauna utilisation of the subject site before and after installation of wind turbines;
- Assess population viability of impacted species.
- Monitoring offset and vegetation management areas

Only a limited number of studies looking at the impact of wind turbines on aerial fauna have been completed. The collection of long-term data for the subject site therefore presents an

opportunity to contribute knowledge to an under-researched field, and will allow for better ecological management of future wind energy projects.



## SECTION 8

### CONCLUSION

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Based on the information contained within this report, the following conclusions are made.

In relation to the *Threatened Species Conservation Act* (1995):

- i) One threatened flora population, *Cymbidium canaliculatum*, was observed within the subject site.
- ii) Seven threatened fauna species, the Glossy Black-Cockatoo, Grey-crowned Babbler, Spectacled Warbler, Grey-headed Flying-fox, Yellow-bellied Sheath-tail-bat, Eastern Bentwing-bat and Eastern Cave Bat, were observed within the subject site.
- iii) One Endangered Ecological Community, White Box - Yellow Box - Blakely's Red Gum Woodland, was observed within the subject site.

In relation to the *Environment Protection and Biodiversity Conservation Act* (1999)

- i) One threatened fauna species, the Grey-headed Flying-fox, was observed within the subject site.
- ii) One Endangered Ecological Community, White Box-Yellow Box-Blakely's Redgum Grassy Woodlands and Derived Native Grasslands, was observed within the subject site.

The 7-part test completed for the proposal as part of the Flora and Fauna Assessment and in accordance with the *Threatened Species Conservation Act* (1995) and Section 5A of the *Environmental Planning and Assessment Act* (1979) concluded that the proposed development was not likely to have a significant impact upon threatened species, endangered populations or endangered ecological communities and a Species Impact Statement should not be required for the proposal.

The proposal was referred to the Department of Environment, Water, Heritage and the Arts in accordance with the *Environmental Planning and Assessment Act* (1999). The department deemed the proposal to not be a controlled action.

The proposal will include an Environmental Management Plan for the construction and operation phases of the development. A key feature of the Environmental Management Plan will be a monitoring program to determine the impacts of the construction of turbines upon bird and bat species. The Environmental Management Plan will also include information on site offset strategies developed as part of the finalisation of the site plans.

## **SECTION 9**

### **RECOMMENDATIONS**

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In summary of this Ecological Site Assessment, the following recommendations have been made to minimise and monitor any potential ecological impacts of the proposal:

- i) Construction and Operation phases of the proposal should be congruent with the Best Practice Guidelines for Wind Energy Projects (AusWEA 2002). This should include the implementation of an Environmental Management Plan.
- ii) The Environmental Management Plan should include ameliorative measures to minimise soil erosion and sedimentation risk.
- iii) A post-construction bird and bat monitoring program should be implemented to determine the impacts on bird and bat species. This should be detailed in the Environmental Management Plan and congruent with Best Practice Guidelines for Wind Energy Projects (AusWEA 2002).
- iv) A vegetation offset strategy will be developed as part of the Environmental Management Plan to compensate for the vegetation to be removed. This will include vegetation management planning strategies within offset areas and adjacent to site facilities and should focus on retaining and restoring areas of endangered ecological community White Box - Yellow Box - Blakely's Red Gum Woodland.
- v) Previously cleared and disturbed areas be used at all times possible for construction of site facilities.
- vi) Existing access tracks should be utilised at all times possible as part of the site design in accordance with minimising vegetation removal impacts.

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## **APPENDIX I**

### **SITE PLANS AND FLORA/FAUNA DETAILS**

## SITE PLANS AND FLORA/FAUNA DETAILS

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### FLORA

#### FLORA SURVEY METHODOLOGY

To determine the likely and actual occurrence of flora species and plant communities on the subject site field survey work was undertaken to supplement literature reviews and previous flora surveys of the area. The methods utilised for the flora survey are outlined below.

##### *Literature Review*

A review of available literature for the area was undertaken to obtain reference material and background information for this study. Two local vegetation survey and mapping projects, (Hill et al., 2001, Peak 2006) have been completed within parts of the Middlebrook Station and to a lesser extent Mountain Station properties. The vegetation mapping from these studies was used to represent the distribution of vegetation communities within the local area and those areas of the subject site not surveyed by this study.

A search of the Atlas of NSW Wildlife (DECC 2007) was undertaken to identify records of threatened flora species located within 10km of the site. This enabled the preparation of a predictive list of threatened flora species that could possibly occur within the habitats found on the site.

##### *Aerial Photograph Interpretation (API)*

The site's vegetation community boundaries were initially identified using API of vegetation within the subject site from an aerial photo. This is provided in Figures A3 and A4 of this report. Analysis of these photos identified past land use practices, disturbances, native vegetation regrowth, changes in vegetation structure and floristics throughout the subjects site represented by changes in colour, patterns and height of the vegetation. This analysis provided an initial split of the vegetation communities within the subject site into simple structural and disturbance classifications.

##### *Field Survey*

Detailed 'ground truthing' of the existing initial vegetation mapping (Hill et al 2001, Peak 2006) and the API was conducted on the 9th-11th May, 12th-14th June 2007 predominately within the areas of impact. 'Ground truthing' is a term given to the validation process of conducting a flora survey within vegetation communities that have been mapped and identified remotely (for example, by aerial photo interpretation or modeling). Additional flora surveys were undertaken on 12-14 August and 17 September 2007.

The field survey also consisted of a meandering transect survey (Cropper 1993), targeted threatened species searches and sampling of systematically placed 20 x 20 metre flora quadrats within vegetation communities identified by aerial photo interpretation or subsequently during the field validation to occur within the area of impact. The transect survey assisted in the ground truthing of the vegetation community boundaries and identification of the dominant floristic species observed

within each vegetation community. Full details of the number of quadrats completed within each vegetation community are contained within Figures A1 and A2.

### **Quadrat Survey**

The locations of the flora quadrats were generally restricted to the areas of direct or indirect impacts from the proposed development ('the study area') and gave consideration to important influencing environmental variables such as geographic location; geology, soil type and/or physiographic location. The quadrat survey was completed to assist in identifying the dominant floristic characteristics of each vegetation community and provided detailed information on community's structure and their complete floristic assemblage. The approximate locations of these surveys are provided in Figures A1 and A2.

A total of forty-one (41) 20 X 20 metre quadrat plots were completed within the subject site.

Each 20 x 20m plot survey recorded the presence of vascular plant taxa and assigned a cover abundance estimate for each species based on a modified Braun-Blanquet 1-6 scale. The cover abundance values for each 1 to 6 class is provided in Table A1.

<b>TABLE A1 COVER ABUNDANCE SCALE USED IN FLORISTIC SURVEY</b>		
<b>Class</b>	<b>Cover Abundance</b>	<b>Notes</b>
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: < 5 individuals Shrubs and small trees: < 5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 –20% cover	
4	20 –50% cover	
5	50 –70% cover	
6	70 – 100% cover	

Full details of the number of quadrats completed within each vegetation community are contained within Figures A1 and A2.

Specimens of plants not readily identified in the field were collected for identification.

Determination of species composition as well as structural descriptions of the vegetation on the site according to Specht et. al. (1995) was also carried out. All vascular plants were identified using keys and nomenclature in Harden (1990a, 1991, 1992 and 1993), Harden and Murray (2000) and Harden, G.J. (2002). Wherever they were known, changes to nomenclature and classification have been incorporated into the results.

### **EPBC Act Box Gum Woodland Condition Assessment**

Detailed condition sampling was completed on 31 July and 1 August 2007 in accordance with the guidelines for assessment identified within the EPBC Act Policy Statements – White Box, Yellow Box, Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands (DEH 2006).

This survey involved the systematic sampling of 15, 30 x 30 metre plots (approximately 0.09ha), within patches of highest quality remnant Box Gum Woodlands. Each plot recorded the presence of vascular plant taxa and assigned a cover abundance estimate for each species based on a modified Braun-Blanquet 1-6 scale.

Analysis of the results for each plot, was completed to identify the following questions;

Does the plot have a predominately native understorey, defined as an area where more than 50% of the perennial cover is comprised of native species. and;

Based on the list of species provided by the Department of Environment and Water Resources, are there at least 12 of the characteristic native species and one important species within the understorey?

### ***Vegetation Community Nomenclature***

The vegetation communities identified within the site by Conacher Travers were classified according to a modified Walker and Hopkins (1990) methodology, however within these descriptions the dominant canopy species are listed after the structural description. Vegetation communities identified within the subject site by Hill et al (2001) and Peak (2006) have generally been described as previously reported.

For each vegetation community identified within the subject site, corresponding vegetation communities identified within the local area by Hill et al (2001) and Peak (2006) are also provided. Corresponding Endangered Ecological Communities listed on both the TSC Act and EPBC Act are also provided.

### ***Seasonal Surveys***

A detailed search was carried out for terrestrial orchids during the flora survey of the site. However, as orchids generally only flower for short seasonal periods, and can sometimes erratically miss several seasons, their observation is difficult. In order to detect species that flower at other times of the year additional targeted searches may be required. Details of threatened cryptic flora known within the local area are provided in Table A2.

<b>TABLE A2 FLOWERING TIMES OF CRYPTIC FLORA</b>		
<b>Species</b>	<b>Flowering Period</b>	<b>Surveyed</b>
<i>Diuris pedunculata</i>	August - September	12-14 August 2007 17th September 2007
<i>Diuris tricolor</i>	September - November	17th September 2007
<i>Thesium australe</i>	September - February	17th September 2007

### ***Survey Limitations***

The floristic survey was affected by limitations in time, existing levels of disturbance and seasonal influences. Identification to the species level of several specimens recorded in the survey was also limited by the availability of flowering and/or fruiting material. As the surveys were carried out during autumn, winter and spring after a prolonged period of drought, the diversity of annual herbs and grasses was expected



to be under-represented within the recorded ground flora. These layers were likely to have been further under represented in sampling due to the intensive sheep grazing regime that coincided with the prolonged drought within the majority of the subject site.

Field validation of the previous local area vegetation mapping by Hill *et al.*, (2001) and Peak (2006) was restricted to those areas immediately surrounding the proposal.

## VEGETATION COMMUNITY DESCRIPTIONS

The flora species observed during surveys are listed in Table A3.

A total of seventeen (17) vegetation communities have been identified within the subject site by *Conacher Travers* or previous surveys (Hill *et al.*, 2001 and Peak, 2006). The community descriptions for those vegetation types mapped by the previous surveys and not sampled in this study have been adapted from their corresponding reports (Hill *et al.*, 2001 and Peak, 2006).

The communities identified and mapped are:

1. Dry Rainforest Closed Forest
2. Ironbark - Box Open Forest
3. Ironbark Open Forest
4. Ironbark-Stringybark Open Forest
5. Grey Gum -Ironbark Open Forest
6. Grey Gum – Stringybark Open Forest
7. Grey Gum – Apple Open Forest
8. Slaty Gum Open Forest
9. Box Woodland
10. Box – Ironbark Grassy Woodland
11. Box Ironbark Red Gum Woodland
12. Exposed Ironbark Woodland
13. Exposed Ironbark Cyperus Woodland
14. Red Gum Woodland
15. Exposed Acacia Low Open Woodland
16. Rocky Heathland on Sandstone Benches
17. Grassland with Scattered Trees

A flora species list of the subject site is provided in Table A3 while a general description of the vegetation communities is provided below. Figures A3 and A4 show the distribution of the vegetation on the site.

### 1) DRY RAINFOREST CLOSED FOREST – (*Backhousia myrtifolia* - *Ficus rubiginosa*)

#### **Previous Vegetation Studies:**

**Hill *et al.*, (2001)** – RF3 Dry Rainforest in Sandstone Gorges

**Peak (2006)** – Map Unit 3 Depauperate Dry Rainforest

**EEC on the TSC Act - NA**

**EEC on the EPBC Act - NA**

#### **Structure:**

**Emergent Trees:** To 20 metres high with a Projected Foliage Cover (PFC) of <10%

<b>Trees:</b>	To 18 metres high with a 60-90% PFC.
<b>Low Trees:</b>	To 6 metres high with a variable 5-40% PFC.
<b>Shrubs:</b>	To 1 metre high with a <5% PFC.
<b>Ground:</b>	To 0.5m with a variable 30-100% PFC.

**Species:**

**Emergent Trees:** *Allocasuarina torulosa* (Forest Oak), *Angophora floribunda* (Rough-barked Apple) and *Eucalyptus punctata* (Grey Gum).

**Trees:** *Backhousia myrtifolia* (Grey Myrtle) and *Ficus rubiginosa* (Port Jackson Fig).

**Low Trees:** *Cassinia australis* var. *australis* (Red Olive Plum), *Ficus coronata* (Sandpaper Fig), *Notelaea microcarpa* var. *macrocarpa* (Native Olive), *Pittosporum undulatum* (Sweet Pittosporum), *Rapanea variabilis* (Muttonwood), and *Trema tomentosa* var. *viridis* (Native Peach).

**Shrubs:** *Breynia oblongifolia* (Coffee Bush), *Clerodendrum tomentosum* (Hairy Clerodendrum) and *Hymenanthera dentata* (Tree Violet).

**Sub-shrubs:** *Nyssanthes diffusa* (Barbwire Weed), *Sigesbeckia orientalis* var. *orientalis* and *Solanum stelligerum* (Devil's Needles)

**Herbs:** *Urtica incisa* (Stinging Nettle), *Dendrobium speciosum* (Rock Orchid), *Commelina cyanea* (Scurvy Weed)

**Grasses:** *Oplismenus aemulus* (Basket Grass), *Oplismenus imbecillis* and *Poa seiberiana* (Tussock Grass).

**Ferns:** *Adiantum aethiopicum* (Common Maidenhair), *Doodia aspera* (Rasp fern), *Pyrrosia rupestris* (Rock Felt Fern), *Adiantum hispidulum* (Rough Maidenhair), *Asplenium flabellifolium* (Necklace Fern), *Pellaea falcata* (Sickle Fern).

**Vines:** *Cayratia clematidea*, *Cissus antarctica*, *Clematis glycinoides* var. *glycinoides*, *Dichondra repens*, *Eustrephus latifolius*, *Morinda jasminoides* and *Pandorea pandorana* ssp. *pandorana*.

**Sedges:** *Cyperus imbecillis*.

**Location and Distribution:**

This community develops in sheltered gullies and slopes on Narrabeen Sandstone that have deeper, more fertile soils than surrounding sandstone areas. These sheltered sites are provided protection from desiccation by adjacent cliffs and steep slopes (Hill *et al.*, 2001). It also occurs in a small number of pockets on exposed and steep slopes derive from Basalt. Within the subject site this community was restricted to isolated occurrences along steeper sheltered slopes of Middlebrook Station and a number of deep valleys in the east of Mountain Station.

**Disturbance:**

With the exception of bushfires, this community is subject to very few disturbances.

**Weed Invasion:**

This community exhibits very little weed invasion.

**2) IRONBARK - BOX OPEN FOREST (*Eucalyptus crebra*)****Previous Vegetation Studies:**

**Hill et al., (2001)** - Narrow Leaved Ironbark Open Forest on Basalt

**Peak (2006)** - Upper Hunter White Box - Ironbark Grassy Woodland

**EEC on the TSC Act - NA**

**EEC on the EPBC Act - NA**

**Structure:**

**Trees:** To 25 metres high with a Projected Foliage Cover (PFC) of 15-40%.

**Shrubs:** To 4 metres high with a variable 30-75% PFC.

**Groundlayer:** To 1.5 metres high with variable 20 - 45% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Angophora floribunda* (Rough-barked Apple), *Eucalyptus albens* – *molacanna* (White Box/Grey Box intergrade) and *Eucalyptus crebra* (Narrow leaved Ironbark).

**Shrubs:** *Acacia paradoxa* (Kangaroo Thorn), *Cassinia quinquefaria*, *Beyeria viscosa*, *Dodonaea viscosa* subsp. *angustifolia* (Hop Bush), *Notelaea microcarpa* var. *macrocarpa* (Native Olive) and *Olearia elliptica* (Sticky Daisy-bush).

**Sub-Shrubs:** *Abutilon oxycarpum* (Flannel Weed), *Hibbertia acicularis* (Prickly Guinea Flower) *Sigesbeckia orientalis* var. *orientalis* (Indian Weed) and *Spartothamnella juncea*.

**Groundlayer:** *Aristida ramosa* var. *speciosa* (Wire Grass), *Asperula conferta* (Woodruff) *Calotis lappulacea*, *Cyperus gracilis*, *Daucus glochidiatus* (Native Carrot), *Einadia hastata* (Berry Saltbush), *Einadia polygonoides*, *Eragrostis brownii* (Brown's Lovegrass), *Lomandra filiformis* ssp. *coriacea* (Wattle Mat-rush), *Microlaena stipoides* var. *stipoides* (Weeping Rice Grass), *Pratia purpurascens* (Whiteroot), *Rostellularia adscendens* ssp. *adscendens* var. *pogonantha*, and *Vittadinia sulcata*.

**Vines:** *Desmodium varians* and *Dichondra repens*, *Glycine tabacina* species complex

**Ferns:** *Cheilanthes austrotenuifolia*, *Cheilanthes distans*

**Location and Distribution:**

This vegetation community occupies the steeper mid and lower slopes of Middlebrook Station on basalt soils.

**Variation:**

There are a number of minor variations within this community's canopy, particularly in regards to variations in the structure and dominant species.

**Disturbance:**

This community has been disturbed by low levels of weed invasion in the shrub and ground layers, a history of rural activities, grazing and selective clearing.

**Weed Invasion:**

This community exhibits low weed levels of invasion in both the shrub and ground layers. Areas of *Opuntia stricta* var. *stricta* are scattered throughout the community, while a variety of exotic herbs and pasture grasses occur within the ground layer.

**3) IRONBARK OPEN FOREST (*Eucalyptus crebra*)****Previous Vegetation Studies:**

**Hill et al., (2001)** - Narrow Leaved Ironbark Open Forest on Basalt

**Peak (2006)** - Upper Hunter White Box - Ironbark Grassy Woodland

**EEC on the TSC Act - NA**

**EEC on the EPBC Act - NA**

**Structure:**

**Trees:** To 25 metres high with a Projected Foliage Cover (PFC) of 25-40%.

**Shrubs:** To 4 metres high with a 50% PFC.

**Groundlayer:** To 1.5 metres high with variable 30 - 65% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Angophora floribunda* (Rough-barked Apple), *Allocasuarina luehmannii* (Bull Oak), *Callitris endlicheri* (Black Cyperus Pine), *Eucalyptus punctata*, *Eucalyptus crebra* (Narrow-leaved Ironbark).

**Shrubs:** *Acacia paradoxa* (Kangaroo Thorn), *Bursaria spinosa* var. *spinosa* (Blackthorn), *Cassinia aculeata*, *Dodonaea viscosa* subsp. *angustifolia* (Hop Bush), *Leucopogon muticus*, *Myoporum montanum* (Western Boobialla), *Spartothamnella juncea* and *Xanthorrhoea johnsonii* (Grass Tree).

**Sub-Shrubs:** *Hibbertia obtusifolia* (Grey Guinea Flower), *Melichrus urceolatus* (Urn Heath), *\*Opuntia stricta* var. *stricta* (Prickly Pear) and *Solanum prinophyllum* (Forest Nightshade).

**Groundlayer:** *Aristida ramosa* var. *peciosa* (Wire Grass), *Einadia polygonoides*, *Eragrostis brownii* (Brown's Lovegrass), *Lepidosperma laterale* (Variable Sword Sege) *Lomandra multiflora* (Many-flowered Mat-rush) and *Pratia purpurascens* (White Root).

**Vines:** *Dichondra repens* (Kidney Weed) and *Glycine clandestina* species complex.

**Ferns:** *Cheilanthes sieberi* subsp. *sieberi*

**Location and Distribution:**

This vegetation community is located on the mid-slopes of the southern ridge of Middlebrook Station downslope of the Box Ironbark Community. It generally appears to be associated with those areas where the basalt capping has been eroded leaving a relatively high sandstone influence.

**Variation:**

There are a number of minor variations within this community's canopy, particularly in regards to variations in the structure and dominant species. Both *Allocasuarina luehmannii* (Bull Oak) and *Callitris endlicheri* dominate a sub tree layer in the southern portion of this community. In generally there appears to be broad transition zone between this and the adjoining Box- Ironbark and Grey Gum- Ironbark communities.

**Disturbance:**

This community has been disturbed by extensive grazing, minor track construction and selective clearing, weed invasion in the shrub and ground layers and a history of rural activities.

**Weed Invasion:**

This community exhibits low levels of weed invasion in both the shrub and ground layers.

**4) IRONBARK-STRINGYBARK OPEN FOREST (*Eucalyptus nubila*, *Eucalyptus sparsifolia*)**

**Previous Vegetation Studies:**

**Hill et al., (2001)** – OF 7 Ironbark-Stringybark Open Forest on Sandstone

**Peak (2006)** – Map Unit 6 Upper Hunter Hills Exposed Ironbark Woodland

**EEC on the TSC Act - NA**

**EEC on the EPBC Act - NA**

**Structure:**

**Emergent Trees:** To 15-25 metres high with a Projected Foliage Cover (PFC) of 5-10%

**Trees:** To 8-20 metres high with a 20-45% PFC.

**Low Trees:** To 4-8 metres high with a variable <5-15% PFC.

**Shrubs:** To 0.5-4 metre high with a 5-45% PFC.

**Ground:** To <1m with a variable 5-50% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Eucalyptus nubila*, *Eucalyptus sparsifolia*, *Callitris endlicheri*, *Acacia implexa* and *Eucalyptus punctata*

**Low Trees:** *Persoonia linearis*, *Acacia crassa* ssp. *crassa* and *Xanthorrhoea johnsonii*

- Shrubs:** *Leucopogon muticus*, *Hibbertia circumdans*, *Podolobium ilicifolium*, *Calytrix tetragona*, *Leptospermum polyanthum*, *Dodonaea triangularis*, *Acacia piligera*
- Herbs:** *Pomax umbellata*, *Goodenia hederacea* ssp. *hederacea*, *Dianella revoluta* var. *revoluta*, *Platysace ericoides*, \**Hypochaeris radicata* and *Acianthus collinus*
- Grasses:** *Cleistochloa rigida*, *Microlaena stipoides* var. *stipoides*, *Paspalidium distans* and *Entolasia stricta*
- Ferns:** *Cheilanthes sieberi* ssp. *sieberi*
- Vines:** *Billardiera scandens*
- Sedges:** *Lepidosperma laterale*, *Lomandra glauca*, *Lomandra multiflora* ssp. *multiflora* and *Lomandra confertifolia*

**Location and Distribution:**

This vegetation community is restricted to the western escarpment of the northern portion of Middlebrook Station.

**Disturbance:**

This community has been disturbed by low levels of weed invasion in the shrub and ground layers, grazing and selective clearing.

**5) GREY GUM - IRONBARK OPEN FOREST (*Eucalyptus punctata* - *Eucalyptus crebra*)**

**Previous Vegetation Studies:**

**Hill et al., (2001)** - Grey Gum - Stringybark Sheltered Open Forest/ Narrow Leaved Ironbark Open Forest on Basalt

**Peak (2006)** - Upper Hunter Hills Sheltered Moist Forest/Upper Hunter White Box - Ironbark Grassy Woodland

**EEC on the TSC Act - NA**

**EEC on the EPBC Act - NA**

**Structure:**

**Trees:** To 30 metres high with a Projected Foliage Cover (PFC) of 25-40%.

**Shrubs:** To 4 metres high with a <10% PFC.

**Groundlayer:** To 1.5 metres high with variable 40 - 75% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Angophora floribunda* (Rough-barked Apple), *Eucalyptus punctata*, *Eucalyptus crebra* (Narrow-leaved Ironbark).

**Shrubs:** *Acacia verniciflua* (Varnish Wattle), *Acacia paradoxa* (Kangaroo Thorn), *Cassinia aculeata*, *Indigofera australis* (Native Indigo), *Leucopogon muticus*, *Podolobium ilicifolium* (Prickly Shaggy Pea) and *Xanthorrhoea johnsonii* (Grass Tree).

**Sub-Shrubs:** *Hibbertia obtusifolia* (Grey Guinea Flower), *Melichrus urceolatus* (Urn Heath), *\*Opuntia stricta var. stricta* (Prickly Pear), *Phyllanthus hirtellus* (Thyme Spurge), *Solanum prinophyllum* (Forest Nightshade).

**Groundlayer:** *Aristida ramosa var. peciosa* (Wire Grass), *Einadia hastata* (Berry Saltbush), *Eragrostis brownii* (Brown's Lovegrass), *Lepidosperma laterale* (Variable Sword Sege) *Lomandra multiflora* (Many-flowered Mat-rush) and *Pratia purpurascens* (White Root).

**Vines:** *Dichondra repens* (Kidney Weed) and *Glycine clandestina* species complex.

**Ferns:** *Cheilanthes sieberi subsp. seeberi*

**Location and Distribution:**

This vegetation community occurs downslope of the Narrow-leaved Ironbark - Box Open Forest community and is associated with more sheltered slopes with a minor basalt influence within the soil. It is located within the central portion of Middlebrook Station surrounding the quarried areas of the site.

**Disturbance:**

This community has been disturbed by low levels of weed invasion in the shrub and ground layers, a history of rural activities, grazing and selective clearing.

**Weed Invasion:**

This community exhibits low weed invasion in both the shrub and ground layers. Areas of *Opuntia stricta var. stricta* are scattered throughout the community, while a variety of exotic herbs and pasture grasses occur within the ground layer.

**6) GREY GUM- STRINGYBARK OPEN FOREST (*Eucalyptus punctata*, *Eucalyptus sparsifolia*)**

**Previous Vegetation Studies:**

*Hill et al., (2001)* – OF6 Grey Gum- Stringybark Sheltered Forest

**Peak (2006)** – Map Unit 29 Upper Hunter Hill Sheltered Moist Forest

**EEC on the TSC Act - NA**

**EEC on the EPBC Act - NA**

**Structure:**

**Trees:** To 12-30 metres high with a 35-60% PFC.

**Low Trees:** To 2-5 metres high with a variable 10-25% PFC.

**Shrubs:** To 0.5-3 metre high with a 5-30% PFC.

**Ground:** To <0.5m with a variable 30-90% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Eucalyptus punctata*, *Eucalyptus sparsifolia*, *Eucalyptus crebra*, (*Eucalyptus nubila*)

**Low Trees:** *Persoonia linearis*, *Pittosporum undulatum*, *Choretrum* species

- Shrubs:** *Leucopogon muticus*, *Acacia verniciflua*, *Indigofera australis*, *Podolobium ilicifolium*, *Leptospermum polyanthum*, *Dodonaea triangularis*, *Acacia filicifolia*, *Acacia piligera*, *Bursaria spinosa* ssp. *spinosa*, *Canthium buxifolium*, *Cassinia aculeata*, *Cassinia laevis* and *Cassinia quinquefaria*
- Herbs:** *Pomax umbellata*, \**Senecio madagascariensis*, *Pratia purpurascens*, \**Hypochaeris radicata*, *Einadia hastata* and *Gonocarpus elatus*
- Grasses:** *Cleistochloa rigida*, *Digitaria ramularis* and *Microlaena stipoides* var. *stipoides*
- Ferns:** *Cheilanthes sieberi* ssp. *sieberi*
- Vines:** *Desmodium varians*, *Glycine clandestina* species complex, *Dichondra repens*, *Billardiera scandens*, *Cassytha glabella*
- Sedges:** *Lepidosperma laterale* and *Gahnia aspera*

**Location and Distribution:**

This vegetation community is restricted to south facing upper slopes above the escarpment in the north-west of Middlebrook Station.

**Disturbance:**

This community exhibits very little disturbances with the exception of an isolated fire trail and past bushfires.

**7) GREY GUM – APPLE OPEN FOREST (*Eucalyptus punctata*, *Angophora floribunda* and *E. crebra*)**

**Previous Vegetation Studies:**

Hill *et al.*, (2001) - AOF1 Grey Gum – Alluvial Open Forest

Peak (2006) - Map Unit 29 Upper Hunter Hill Sheltered Moist Forest

EEC on the TSC Act - NA

EEC on the EPBC Act - NA

**Structure:**

**Trees:** To 20-30 metres high with a 30-40% PFC.

**Low Trees:** To 4-15 metres high with a variable 10-60% PFC.

**Shrubs:** To 0.5-3 metre high with a 15-50% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Eucalyptus punctata*, *Angophora floribunda*, *Allocasuarina torulosa*, *E. blakelyi*, *E. tereticornis* and *E. crebra*.

**Low Trees:** *Notelaea microcarpa* var. *microcarpa*, *Pittosporum undulatum*, *Rapanea variabilis* and *Persoonia linearis*.

**Shrubs:** *Breynia oblongifolia*, *Clerodendrum tomentosum*, *Maytenus silvestris*, *Spartothamnella juncea*, *Acacia filicifolia*, *Leptospermum polyanthum*, *Indigofera australis*, *Leptospermum polygalifolium*, *Bursaria spinosa* ssp. *spinosa*, *Hymenanthera dentata* and *Olearia elliptica*.



- Herbs:** *Pratia purpurascens*, \**Bidens pilosa*, \**Conyza albida*, *Plectranthus parviflorus*, *Galium propinquum*, *Hydrocotyle laxiflora*, \**Hypochaeris radicata*, *Einadia hastata*, *Viola hederacea*, *Rostellularia adscendens* ssp. *adscendens* var. *pogonantha*, *Lagenifera stipitata* and \**Stellaria media*.
- Grasses:** *Microlaena stipoides* var. *stipoides*, *Oplismenus aemulus*, *Oplismenus imbecillis*, *Echinopogon intermedius* and *Echinopogon ovatus*.
- Ferns:** *Asplenium flabellifolium*, *Pyrrosia rupestris*, *Cheilanthes sieberi* ssp. *sieberi*, *Adiantum aethiopicum*, *Adiantum hispidulum*, *Pellaea falcata* and *Pellaea paradoxa*.
- Vines:** *Desmodium varians*, *Glycine clandestina* species complex, *Glycine tabacina* species complex, *Dichondra repens*, *Dichondra species A*, *Clematis glycinoides*, *Pandorea pandorana* ssp. *pandorana*, *Eustrephus latifolius*, *Billardiera scandens*, *Clematis glycinoides* var. *glycinoides*, *Passiflora herbertiana* ssp. *herbertiana* and *Tylophora barbata*.
- Sedges:** *Gahnia aspera*, *Lepidosperma laterale*, *Lomandra confertifolia* ssp. *pallida* and *Cyperus gracilis*.

**Location and Distribution:**

This vegetation community dominates sheltered alluvial drainage lines and lower slopes throughout Middlebrook Station.

**Disturbance:**

This community has been moderately disturbed by weed invasion, clearing, intensive grazing, construction of roads and alterations to the natural drainage.

**8) SLATY GUM OPEN FOREST (*Eucalyptus dawsonii*)**

**Previous Vegetation Studies:**

*Hill et al., (2001)* - NA

*Peak (2006)* - In part Upper Hunter White Box - Ironbark Grassy Woodland

*EEC on the TSC Act* - NA

*EEC on the EPBC Act* - NA

**Structure:**

**Trees:** To 30 metres high with a Projected Foliage Cover (PFC) of 25-40%.

**Shrubs:** To 4 metres high with a 50% PFC.

**Groundlayer:** To 1.5 metres high with variable 30 - 65% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Eucalyptus dawsonii* (Slaty Gum).

**Shrubs:** *Notelaea microcarpa* var. *macrocarpa* (Native Olive), *Spartothamnella juncea* and *Xanthorrhoea johnsonii* (Grass Tree).

**Sub-Shrubs:** *Phyllanthus hirtellus* (Thyme Spurge), and *Spartothamnella juncea*.

**Groundlayer:** *Aristida ramosa* var. *peciosa* (Wire Grass), *Cyperus gracilis*, *Einadia hastata* (Berry Saltbush), *Eragrostis brownii* (Brown's Lovegrass), *Gahnia aspera* (Saw Sedge), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush) and *Vittadinia sulcata*.

**Vines:** *Dichondra repens* (Kidney Weed) and *Glycine clandestina* species complex

**Ferns:** *Cheilanthes distans* (Bristly Cloak Fern)

**Location and Distribution:**

This vegetation community is located on the east facing lower slope of a single valley within Mountain Station.

**Disturbance:**

This community has been disturbed by extensive grazing and selective clearing, weed invasion in the shrub and ground layers and a history of rural activities.

**Weed Invasion:**

This community exhibits low levels of weed invasion in both the shrub and ground layers.

**9) BOX WOODLAND - (*Eucalyptus albens* – *molacanna* and *Eucalyptus blakelyi*)**

**Previous Vegetation Studies:**

**Hill et al., (2001)** – OF9 Box Open Forest on Basalt

**Peak (2006)** – In part Map Unit 11 Upper Hunter White Box - Ironbark Grassy Woodland

**EEC on the TSC Act** – In Part, White Box Yellow Box Blakely's Red Gum Woodland

**CEEC on the EPBC Act** - In Part, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

**Structure:**

**Trees:** To 25 metres high with a Projected Foliage Cover (PFC) of 5-30%.

**Shrubs:** To 4 metres high with a variable <5- 60% PFC.

**Groundlayer:** To 1.5 metres high with variable 20 - 75% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Angophora floribunda* (Rough-barked Apple), *Brachychiton populneus* (Kurrajong), *Eucalyptus albens* – *molacanna* (White

Box/Grey Box intergrade), *Eucalyptus blakelyi* (Blakely's Red Gum) and *Ficus rubiginosa* (Port Jackson Fig).

**Shrubs:** *Dodonaea viscosa subsp. angustifolia* (Hop Bush), *Indigofera australis* (Native Indigo), *Notelaea microcarpa* (Native Olive), *Olearia elliptica* (Sticky Daisy-bush), *Pittosporum undulatum* (Sweet Pittosporum).

**Sub-Shrubs:** *Hibbertia acicularis* (Prickly Guinea Flower), *Swainsona galegifolia* (Smooth Darling Pea), *Spartothamnella juncea* and *Urtica incisa* (Stinging Nettle)

**Groundlayer:** *Acaena novae-zelandiae* (Bidgee-Widgee), *Aristida ramosa* var. *peciosa* (Wire Grass), *Aristida calycina* (Wire Grass), *Asperula conferta* (Woodruff) *Austrodanthonia bipartita* (Wallaby Grass), *Austrostipa ramosissima* (Stout Bamboo Grass), *Bothriochloa decipiens* (Redleg Grass), *Chrysocephalum apiculatum* (Common Everlasting), *Cyperus gracilis*, *Daucus glochidiatus* (Native Carrot), *Einadia hastata* (Berry Saltbush), *Einadia polygonoides*, *Galium migrans* (Bedstraw), *Geranium potentilloides* var. *potentilloides*, *Lomandra longifolia* (Spiky-headed Mat-rush), *Microlaena stipoides* var. *stipoides* (Weeping Rice Grass), *Plectranthus parviflorus* (Cockspur Flower), *Plantago debilis* (Slender Plantain), *Rostellularia adscendens* ssp. *adscendens* var. *pogonantha*, *Rumex brownie* (Swamp Dock) and *Vittadinia sulcata*.

**Vines:** *Desmodium brachypodum*, *Glycine tabacina* species complex, *Dichondra repens* and *Pandorea pandorana* (Wonga Vine).

**Ferns:** *Cheilanthes sieberi subsp. sieberi* and *Cheilanthes distans*

#### **Location and Distribution:**

At higher elevations this community develops on the basalt capping of the upper ridges of Middlebrook Station and most of the uncleared areas of basalt capping within Mountain Station.

#### **Variation:**

There are a number of variations within this community's canopy, particularly in regards to variations in the structure and dominant species. Many of the exposed ridge and upper slope areas of Mountain Station and to a lesser extent Middlebrook Station are dominated by almost pure stands of *Eucalyptus blakelyi* with a similar floristic assemblage within the understorey to those adjoining areas with a canopy dominated by *Eucalyptus albens* (White Box).

A significant structural variation of this community has been mapped separately within the subject site as Shrubby Box Woodland. This variation occupies the steeper upper slopes of both Mountain and Middlebrook Stations and contains a dense (>50%) shrub layer. Shrubby Box Woodland has been mapped separately for assessment purposes as it does not meet the specific criteria of the listed Endangered Ecological Community, White Box – Yellow Box – Blakeley's Redgum Woodland.

**Disturbance:**

This community has been extensively cleared and disturbed by a history of weed invasion and grazing in the shrub and ground layers. Large parts of this community, particularly on Mountain Station have also been subjected to exotic pasture improvement activities. Clearing for fence lines and access roads has also occurred throughout these communities.

**Weed Invasion:**

This community exhibits extensive weed invasion in both the shrub and ground layers. Large areas of this community have been subjected to exotic pasture improvement activities while the existing grazing pressures have also contributed significantly to the spread of a variety of exotic and native grasses and herbs within the understorey.

**10) BOX- IRONBARK GRASSY WOODLAND****Previous Vegetation Studies:**

**Hill et al., (2001)** – OF 10 Narrow-leaved Ironbark Open Forest on basalt slopes/OF9 Box Open Forest on Basalt

**Peak (2006)** - Map Unit 11 Upper Hunter White Box- Ironbark Grassy Woodland

**EEC on the TSC Act** - In Part White Box Yellow Box Blakely's Red Gum Woodland

**CEEC on the EPBC Act** – In Part White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

**Structure**

**Trees:** To 10-20 metres high with a 10-30% PFC.

**Shrubs:** To 2-5 metre high with a 10-40% PFC.

**Ground:** To <0.5 metre high with a 50-90% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Eucalyptus crebra*, *Eucalyptus albens* – *molucana*, *Brachychiton populneus* subsp. *populneus*.

**Shrubs:** *Notelaea microcarpa* var. *microcarpa*, *Acacia paradoxa*, *Olearia elliptica* subsp. *Elliptica*.

**Sub-Shrubs:** *Myoporum montanum*, *Acacia decora*, *Maireana microphylla* and *Bursaria spinosa* subsp. *spinosa*

**Herbs:** *Calotis lappulacea*, *Einadia hastata*, *Einadia nutans* and *Eremophila debilis*

**Grasses:** *Aristida ramosa*, *Austrostipa verticillata*, *Chloris ventricosa*, *Eragrostis leptostachya*, *Cynodon dactylon*, *Sporobolus creber*, *Cymbopogon refractus* and *Dichanthium sericeum* subsp. *sericeum*.

**Ferns:** *Cheilanthes sieberi* subsp. *sieberi*

**Vines:** *Clematis glycinoides* and *Eustrephus latifolius*

**Sedges:** *Cyperus fulvus*

**Location and Distribution:**

This vegetation community occurs throughout the south and east of Middlebrook Station on the more fertile lower slopes often associated with highly disturbed grazing areas.

**Disturbance:**

This community has been highly disturbed in areas by extensive weed invasion, clearing, grazing and the construction of roads.

**11) BOX- IRONBARK- RED GUM WOODLAND (*Eucalyptus albens* *x* *molucana*, *E. crebra* & *E. blakelyi*)**

**Previous Vegetation Studies:**

**Hill et al., (2001)** – OF 10 Narrow-leaved Ironbark Open Forest on basalt slopes

**Peak (2006)** - Map Unit 9 Upper Hunter Hills Box- Ironbark- Red Gum Woodland

**EEC on the TSC Act** - NA

**EEC on the EPBC Act** - NA

**Structure**

**Trees:** To 12-20 metres high with a 15-25% PFC.

**Shrubs:** To 0.5 metre high with a 35-50% PFC.

**Ground:** To <0.5 metre high with a 40-85% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Eucalyptus albens* – *molucana*, *E. crebra*, *E. canaliculata*, *E. laevopinea*, *E. blakelyi* and *Brachychiton populneus* subsp. *populneus*.

**Low Trees:** *Pittosporum undulatum*

**Shrubs:** *Notelaea microcarpa* var. *microcarpa* and *Olearia elliptica* subsp. *elliptica*

**Sub-Shrubs:** *Myoporum montanum*, *Sigesbeckia orientalis* subsp. *orientalis* and *Spartothamnella juncea*.

**Herbs:** *Pratia purpurascens*, *Dichondra repens*, *Lomandra multiflora* subsp. *multiflora* and *Scutellaria humilis*

**Grasses:** *Microlaena stipoides* var. *stipoides*, *Aristida ramosa*, *Austrodanthonia fulva* and *Cymbopogon refractus*

**Ferns:** *Cheilanthes sieberi* subsp. *sieberi*, *Pellaea paradoxa* and *Cheilanthes distans*.

**Vines:** *Cayratia clematidea*, *Clematis glycinoides*, *Pandorea pandorana* ssp. *pandorana*, *Eustrephus latifolius* and *Cissus opaca*.

**Sedges:** *Carex inomitata*, *Lepidosperma laterale*, *Cyperus imbecillis*, *Cyperus gracilis*, *Carex inversa* and *Carex appressa*

**Location and Distribution:**

This vegetation community occupies upper slopes and ridges of both Middlebrook and Mountain Stations often associated with colluviums adjoining basalt capping.

**Disturbance:**

This community has been highly disturbed by low to moderate weed invasion, clearing, and in some areas intensive grazing.

**12) EXPOSED IRONBARK WOODLAND (*Eucalyptus crebra*)****Previous Vegetation Studies:**

**Hill et al., (2001)** – OF 7 Ironbark - Stringybark Open Forest on Sandstone

**Peak (2006)** - Map Unit 6 Upper Hunter Hills Exposed Ironbark Woodland

**EEC on the TSC Act** - NA

**EEC on the EPBC Act** - NA

**Structure**

<b>Trees:</b>	To 12-20 metres high with a 20-30% PFC.
<b>Low Trees:</b>	To 5-8 metres high with a variable 20% PFC.
<b>Shrubs:</b>	To 1-3 metre high with a 15-40% PFC.
<b>Ground:</b>	To <1 metre high with a 40-70% PFC.

**Floristics:**

(Main Species Present)

<b>Trees:</b>	<i>Eucalyptus crebra</i> , <i>Angophora floribunda</i> , <i>Brachychiton populneus</i> subsp. <i>populneus</i> , <i>E. blakelyi</i> and <i>Eucalyptus albens</i> – <i>molucana</i> .
<b>Low Trees:</b>	<i>Pittosporum undulatum</i> , <i>Rapanea variabilis</i> and <i>Acacia implexa</i>
<b>Shrubs:</b>	<i>Notelaea macrocarpa</i> var. <i>macrocarpa</i> , <i>Olearia elliptica</i> subsp. <i>elliptica</i> , <i>Breynia oblongifolia</i> and <i>Acacia paradoxa</i>
<b>Sub-Shrubs:</b>	<i>Myoporum montanum</i> , <i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i> and <i>Spartothamnella juncea</i> .
<b>Herbs:</b>	<i>Dichondra repens</i> , <i>Senecio quadridentatus</i> , <i>Daucus glochidiatus</i> , <i>Plantago debilis</i> , <i>Cynoglossum australe</i> and <i>Rumex brownii</i>
<b>Grasses:</b>	<i>Dichelachne micrantha</i> and <i>Microlaena stipoides</i>
<b>Ferns:</b>	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> and <i>Cheilanthes distans</i>
<b>Vines:</b>	<i>Desmodium brachypodum</i> , <i>Glycine clandestina</i> , <i>Glycine tabacina</i> species complex, <i>Clematis glycinoides</i> , <i>Pandorea pandorana</i> ssp. <i>pandorana</i> , <i>Eustrephus latifolius</i> and <i>Rubus parvifolius</i> .
<b>Sedges:</b>	<i>Scleria mackaviensis</i> , <i>Lepidosperma laterale</i> , <i>Gahnia aspera</i> , <i>Cyperus gracilis</i> and <i>Carex appressa</i>

**Location and Distribution:**

This vegetation community occurs throughout the subject site associated with highly exposed slopes, ridges and escarpments.

**Disturbance:**

This community exhibits only slight disturbance by weed invasion, clearing and grazing.

**13) EXPOSED IRONBARK CYPERUS WOODLAND (*Eucalyptus crebra* and *Callitris endlicheri*)****Previous Vegetation Studies:**

**Hill et al., (2001)** – OF 7 Ironbark - Stringybark Open Forest on Sandstone

**Peak (2006)** - Map Unit 6 Upper Hunter Hills Exposed Ironbark Woodland

**EEC on the TSC Act** - NA

**EEC on the EPBC Act** - NA

**Structure:**

**Trees:** To 12-20 metres high with a 20-30% PFC.

**Low Trees:** To 5-8 metres high with a variable 20% PFC.

**Shrubs:** To 1-3 metre high with a 15-40% PFC.

**Ground:** To <1 metre high with a 40-70% PFC.

**Floristics:**

(Main Species Present)

**Trees:** *Eucalyptus crebra*, *Eucalyptus albens* – *molucana* and *Angophora floribunda*.

**Low Trees:** *Callitris endlicheri* and *Persoonia linearis*

**Shrubs:** *Notelaea microcarpa* var. *microcarpa*, *Olearia elliptica* subsp. *elliptica* and *Leucopogon muticus* *Podolobium ilicifolium*

**Sub-Shrubs:** *Melichrus urceolatus*.

**Herbs:** *Pomax umbellata*, *Dianella revoluta* var. *revoluta* and *Dichondra repens*.

**Grasses:** *Cleistochloa rigida*, *Microlaena stipoides* var. *stipoides*, *Paspalidium distans* and *Entolasia stricta*

**Ferns:** *Cheilanthes sieberi* subsp. *sieberi*

**Vines:** *Desmodium brachypodum*, *Glycine clandestina*, *Glycine tabacina* species complex and *Pandorea pandorana* ssp. *pandorana*.

**Sedges:** *Lepidosperma laterale* and *Gahnia aspera*.

**Location and Distribution:**

This vegetation community occurs throughout the subject site associated with highly exposed slopes ridges and escarpments on Narrabeen sediments.

**Disturbance:**

This community exhibits only slight disturbance by weed invasion, clearing and grazing.

#### 14) RED GUM WOODLAND (*E. tereticornis*)

##### **Previous Vegetation Studies:**

*Hill et al., (2001)* – NA

*Peak (2006)* - Map Unit 13 Hunter Floodplain Red Gum Woodland Complex

*EEC on the TSC Act* - NA

*EEC on the EPBC Act* - NA

##### **Structure**

**Trees:** To 18-35 metres high with a 5-25% PFC.

**Ground:** To <1 metre high with a 60-90% PFC.

##### **Floristics:**

##### **(Main Species Present)**

**Trees:** *E. tereticornis*, *E. melliodora*, *Angophora floribunda* and *Casuarina cunninghamiana* subsp. *cunninghamiana*.

**Shrubs:** *Bursaria spinosa*, *Exocarpus strictus*

**Sub-Shrubs:** *Solanum cinereum*

**Herbs:** *Dichondra repens*, *Einadia hastata*, *Pratia purpurascens*, *Alternanthera denticulata*, *Calotis lappulacea*, *Commelina cyanea*, *Einadia trigonos* and *Rumex brownii*.

**Grasses:** *Austrostipa verticillata*, *Cynodon dactylon*, *Arisitida ramosa*, *Microlaena stipoides* var *stipoides*, *Austrodanthonia fulva* and *Sporobolus creber*.

**Ferns:** *Cheilanthes sieberi* subsp. *sieberi* and *Cheilanthes austrotenuifolia*

**Vines:** *Glycine tabacina*, *Desmodium varians* and *Glycine clandestina*

**Sedges:** *Carex* sp, *Cyperus fulvus* and *Cyperus gracillius*

##### **Location and Distribution:**

This vegetation community is restricted to the southern portion of Middlebrook Station on the deep alluvial soils associated with the floodplain.

##### **Disturbance:**

This community has been highly disturbed by extensive weed invasion, clearing intensive grazing, construction of roads and alterations to the natural drainage.

#### 15) Exposed Acacia Low Open Forest

##### **Previous Vegetation Studies:**

*Hill et al., (2001)* – Map Unit OF5 Acacia Exposed Low Open Forest

*Peak (2006)* - Map Unit 16 Upper Hunter Narrabeen Escarpment Acacia Woodland

*EEC on the TSC Act* - NA

*EEC on the EPBC Act* - NA



**Structure:**

**Emergent Trees:** To 15 metres high with a Projected Foliage Cover (PFC) of <10%

**Trees:** To 10 metres high with a 25-45% PFC

**Shrubs:** To 2 metres high with a 20-60% PFC

**Ground:** To <1 metres high with a 10-30% PFC

**Floristics:**

(Main Species Present)

**Emergent**

**Trees:** *Eucalyptus crebra* and *Eucalyptus sparsifolia*

**Trees:** *Acacia crassa* ssp. *crassa*, *Acacia maidenii*, *Persoonia linearis*, *Choretrum* species A,

**Shrubs:** *Hibbertia circumdans*, *Leucopogon muticus*, *Hovea lanceolata*, *Goodenia ovata*, *Leptospermum polyanthum*, *Phebalium squamulosum* ssp. *lineare*, *Cassinia uncata*, *Olearia elliptica*, *Calytrix tetragona*, *Leptospermum parvifolium*.

**Herbs:** *Pomax umbellata*, *Gonocarpus tetragynus* and *Goodenia hederacea* ssp. *hederacea*

**Grasses:** *Cleistochloa rigida*, *Entolasia stricta* and *Digitaria ramularis*

**Ferns:** *Cheilanthes sieberi* ssp. *sieberi* and *Cheilanthes austrotenuifolia*

**Vines:** *Cassytha glabella*

**Sedges:** *Lepidosperma laterale* and *Lomandra confertifolia* ssp. *pallida*

**Location and Distribution:**

This community develops on Narrabeen Sandstone in exposed sites with a northern aspect and containing skeletal soils and steep slopes (Hill and Peak 2000). Within the subject site this community is restricted to isolated occurrences along the north facing pagodas of the escarpments in Middlebrook Station.

**Disturbance:**

With the exception of bushfires, this community is subject to very few disturbances.

**Weed Invasion:**

This community exhibits very little weed invasion.

**16) ROCKY HEATHLAND ON SANDSTONE BENCHES****Previous Vegetation Studies:**

**Hill et al., (2001)** – Map Unit HL2 Rocky Heathland on Sandstone Benches

**Peak (2006)** - Mu 6 Upper Hunter Hills Exposed Ironbark Woodland

**EEC on the TSC Act - NA**

**EEC on the EPBC Act - NA**

**Structure:**

**Emergent Trees:** To 15 metres high with a Projected Foliage Cover (PFC) of <10%

**Trees:** To 10 metres high with a 25-45% PFC

**Shrubs:** To 2 metres high with a 20-60% PFC

**Ground:** To <1 metres high with a 10-30% PFC

**Floristics:****(Main Species Present)**

**Trees:** *Eucalyptus crebra* and *Eucalyptus sparsifolia*

**Trees:** *Acacia crassa* ssp. *crassa*, *Acacia doratoxylon*, *Acacia maidenii*, *Persoonia linearis*

**Shrubs:** *Dodonaea boroniifolia*, *Phebalium squamulosum* subsp. *lineare*, *Calytrix tetragona*, *Hovea lanceolata*, *Leptospermum parvifolium*, *Zieria cytisoides* and *Xanthorrhoea johnsonii*

**Herbs:** *Pomax umbellata*, *Goodenia hederacea* ssp. *hederacea*, *Stylidium laricifolium*, *Cleistochloa rigida*, *Poranthera microphylla*, *Lomandra glauca* and *L. confertifolia* ssp. *pallida*

**Grasses:** *Cleistochloa rigida*, *Entolasia stricta* and *Digitaria ramularis*

**Ferns:** *Cheilanthes sieberi* ssp. *sieberi* and *Cheilanthes austrotenuifolia*

**Vines:** *Cassytha glabella*

**Sedges:** *Lepidosperma laterale* and *Lomandra confertifolia* ssp. *pallida*

**Location and Distribution:**

This community develops on Narrabeen Sandstone in exposed sites with a northern aspect and containing skeletal soils and steep slopes (Hill and Peak 2000). Within the subject site this community was restricted to isolated occurrences along the escarpments in Middlebrook and Mountain Stations.

**Disturbance:**

With the exception of bushfires, this community is subject to very few disturbances.

**Weed Invasion:**

This community exhibits very little weed invasion.

**17) GRASSLAND WITH SCATTERED TREES****Structure:**

**Trees:** To 25 metres high with a Projected Foliage Cover (PFC) of <5%.

**Shrubs:** To 5 metres high with a <5% PFC.

**Groundlayer:** To 1.5 metres high with variable 20 - 95% PFC.

**Floristics:****(Main Species Present)**

**Trees:** *Angophora floribunda* (Rough-barked Apple), *Brachychiton populneus* (Kurrajong), *Eucalyptus albens* – *molacanna* (White Box/Grey Box intergrade), *Eucalyptus blakelyi* (Blakely's Red Gum) and *Eucalyptus tereticornis* (Red gum).

**Shrubs:** *Acacia* spp. *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) and *Opuntia stricta* (Prickly Pear).

**Groundlayer:** *Acaena novae-zelandiae* (Bidgee-Widgee), *Aristida ramosa* var. *peciosa* (Wire Grass), *Aristida calycina* (Wire Grass), *Austrodanthonia bipartita* (Wallaby Grass), *Austrostipa ramosissima* (Stout Bamboo Grass), *Bidens pilosa* (Cobbler's Pegs), *Bothriochloa decipiens* (Redleg Grass), *Chrysocephalum apiculatum* (Common Everlasting), *Cyperus gracilis*, *Einadia hastata* (Berry Saltbush), *Einadia polygonoides*, *Echium plantagineum* (Paterson's Curse), *Lomandra longifolia* (Spiky-headed Mat-rush), *Microlaena stipoides* var. *stipoides* (Weeping Rice Grass), *Plantago debilis* (Slender Plantain), *Plantago lanceolata* (Ribwort), *Rostellularia adscendens* ssp. *adscendens* var. *pogonantha*, *Rumex brownie* (Swamp Dock), *Senecio madagascariensis* (Fireweed), *Sida rhombifolia* (Paddy's Lucerne), *Urtica urens* (Small Stinging Nettle) and *Vittadinia sulcata*.

***Location and Distribution:***

This vegetation community occurs throughout the subject site and is associated with highly disturbed areas of pasture and grazing.

***Variation:***

This community contains a number of considerable variations largely associated with the degree of disturbance and topographic location. Scattered along the western portion of the subject site are a number of artificial dams. These water bodies contain a variety of aquatic and semi aquatic herbs around their perimeters.

***Disturbance:***

This community has been highly disturbed by extensive weed invasion, clearing, grazing, construction of roads and alterations to the natural drainage.

***Weed Invasion:***

This community exhibits extensive weed invasion in both the shrub and ground layers.

Table A3 lists the flora species found on-site.

TABLE A3 FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
TREES		
Casuarinaceae	<i>Allocasuarina luehmannii</i>	Bulloak
Casuarinaceae	<i>Allocasuarina torulosa</i>	Forest Oak
Casuarinaceae	<i>Casuarina cunninghamiana</i>	River Oak
Cupressaceae	<i>Callitris endlicheri</i>	Black Cyperus Pine
Cupressaceae	<i>Callitris glaucophylla</i>	White Cyperus Pine
Meliaceae	<i>Melia azedarach</i> var. <i>australasica</i>	White Cedar
Mimosaceae	<i>Acacia irrorata</i> subsp. <i>irrorata</i>	Green Wattle
Mimosaceae	<i>Acacia maidenii</i>	Maiden's Wattle
Mimosaceae	<i>Acacia parvipinnula</i>	Silver-stemmed Wattle
Mimosaceae	<i>Acacia salicina</i>	Native Willow
Mimosaceae	<i>Acacia stenophylla</i>	River Cooba
Moraceae	<i>Ficus coronata</i>	Sandpaper Fig
Moraceae	<i>Ficus rubiginosa</i>	Port Jackson Fig
Myrsinaceae	<i>Rapanea howittiana</i>	Brush Muttonwood
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple
Myrtaceae	<i>Backhousia myrtifolia</i>	Grey Myrtle
Myrtaceae	<i>Eucalyptus albens</i>	White Box
Myrtaceae	<i>Eucalyptus albens</i> x <i>molacanna</i>	White Box/Grey Box intergrade
Myrtaceae	<i>Eucalyptus blakelyi</i>	Blakelys Red Gum
Myrtaceae	<i>Eucalyptus canaliculata</i>	Large Fruited Grey Gum
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
Myrtaceae	<i>Eucalyptus dalrympleana</i>	Mountain Gum
Myrtaceae	<i>Eucalyptus dawsonii</i>	Slaty Gum
Myrtaceae	<i>Eucalyptus laevopinea</i>	Silver-top Stringybark
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box
Myrtaceae	<i>Eucalyptus punctata</i>	Grey Gum
Myrtaceae	<i>Eucalyptus sideroxylon</i>	Red Ironbark
Myrtaceae	<i>Eucalyptus sparsifolia</i>	Narrow-leaved Stringybark
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	Native Olive
Oleaceae	<i>Notelaea microcarpa</i> var. <i>velutina</i>	Native Olive
Oleaceae	<i>Olea europaea</i> subsp. <i>africana</i> *	Common Olive
Pittosporaceae	<i>Pittosporaceae undulatum</i>	Sweet Pittosporum
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash
Rutaceae	<i>Melicope micrococca</i>	White Euodia
Santalaceae	<i>Exocarpos cupressiformis</i>	Native Cherry
Santalaceae	<i>Exocarpos strictus</i>	Pale Ballart
Sterculiaceae	<i>Brachychiton populneus</i> ssp. <i>populneus</i>	Kurrajong

TABLE A3 (cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
SHRUBS		
Amaranthaceae	<i>Nyssanthus diffusa</i>	Barbwire Weed
Asclepidaceae	<i>Gomphocarpus fruiticosus</i> *	Narrow Leaf Cotton Bush
Asteraceae	<i>Cassinia aculeata</i>	Dolly Bush
Asteraceae	<i>Cassinia cunninghamii</i>	-
Asteraceae	<i>Cassinia quinquefaria</i>	-
Asteraceae	<i>Olearia elliptica</i>	Sticky Daisy-bush
Asteraceae	<i>Ozothamnus diosmifolius</i>	Ball Everlasting
Asteraceae	<i>Xanthium spinosum</i> *	Bathurst Burr
Cactaceae	<i>Opuntia stricta</i> var. <i>stricta</i> *	Common Prickly Pear
Celastraceae	<i>Cassine australis</i> var. <i>australis</i>	Red Olive Plum
Celastraceae	<i>Maytenus silvestris</i>	-
Cesalpinioideae	<i>Senna aciphylla</i>	-
Dilleniaceae	<i>Hibbertia acicularis</i>	Prickly Guinea Flower
Ericaceae - styphelioideae	<i>Leucopogon lanceolatus</i> var. <i>lanceolatus</i>	Lance Bearded Heath
Ericaceae - styphelioideae	<i>Leucopogon muticus</i>	-
Ericaceae - styphelioideae	<i>Leucopogon</i> sp.	
Ericaceae - styphelioideae	<i>Lissanthe strigosa</i> subsp. <i>strigosa</i>	Peach Heath
Ericaceae - styphelioideae	<i>Melichrus procumbens</i>	Jam Tarts
Ericaceae - styphelioideae	<i>Melichrus urceolatus</i>	Urn Heath
Ericaceae - styphelioideae	<i>Styphelia triflora</i>	Five Corners
Euphorbiaceae	<i>Beyeria viscosa</i>	-
Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush
Euphorbiaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge
Fabaceae	<i>Daviesia genistifolia</i>	-
Fabaceae	<i>Hovea lanceolata</i>	-
Fabaceae	<i>Hovea linearis</i>	-
Fabaceae	<i>Indigofera australis</i>	Native Indigo
Fabaceae	<i>Swainsona galegifolia</i>	Smooth Darling Pea
Faboideae	<i>Podolobium ilicifolium</i>	Prickly Shaggy Pea
Lamiaceae	<i>Prostanthera ovalifolia</i>	-
Lamiaceae	<i>Spartothamnella juncea</i>	-
Mimosaceae	<i>Acacia crassa</i> ssp. <i>crassa</i>	-
Mimosaceae	<i>Acacia cremiflora</i>	-
Mimosaceae	<i>Acacia cultriformis</i>	Knife-leaved Wattle
Mimosaceae	<i>Acacia decora</i>	Western Golden Wattle
Mimosaceae	<i>Acacia falcata</i>	Sickle Wattle
Mimosaceae	<i>Acacia implexa</i>	Hickory
Mimosaceae	<i>Acacia paradoxa</i>	Kangaroo Thorn

TABLE A3 (cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
Mimosaceae	<i>Acacia piligera</i>	-
Mimosaceae	<i>Acacia terminalis</i>	Sunshine Wattle
Mimosaceae	<i>Acacia ulicifolia</i>	Prickly Moses
Mimosaceae	<i>Acacia verniciflua</i>	Varnish Wattle
Myoporaceae	<i>Eremophila debilis</i>	Winter Apple
Myoporaceae	<i>Myoporum montanum</i>	Western Boobialla
Myrtaceae	<i>Calytrix tetragona</i>	-
Myrtaceae	<i>Leptospermum parvifolium</i>	Small-leaved Tea-tree
Myrtaceae	<i>Leptospermum polygalifolium</i>	Lemon-scented Tea-tree
Myrtaceae	<i>Melaleuca nodosa</i>	Ball Honey Myrtle
Pittosporaceae	<i>Bursaria spinosa</i> var. <i>spinosa</i>	Blackthorn
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung
Rhamnaceae	<i>Cryptandra amara</i> var. <i>amara</i>	-
Rhamnaceae	<i>Cryptandra spinescens</i>	-
Rhamnaceae	<i>Spyridium buxifolium</i>	-
Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry
Rubiaceae	<i>Canthium buxifolium</i>	-
Rubiaceae	<i>Opercularia aspera</i>	Common Stinkweed
Rubiaceae	<i>Opercularia diphylla</i>	-
Rubiaceae	<i>Psychotria loniceroides</i>	-
Rutaceae	<i>Boronia angustisepala</i>	-
Rutaceae	<i>Geijera parviflora</i>	-
Rutaceae	<i>Phebalium squamulosum</i> subsp. <i>lineare</i>	Scaly Phebalium
Rutaceae	<i>Zieria cytisoides</i>	Downy Zieria
Santalaceae	<i>Choretrum candollei</i>	-
Sapindaceae	<i>Alectryon subcinereus</i>	Native Quince
Sapindaceae	<i>Dodonaea triquetra</i>	Hop Bush
Sapindaceae	<i>Dodonaea boroniifolia</i>	-
Sapindaceae	<i>Dodonaea viscosa</i> subsp. <i>angustifolia</i>	-
Sapindaceae	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	-
Solanaceae	<i>Solanum aviculare</i>	Kangaroo Apple
Solanaceae	<i>Solanum elegans</i>	Spiny Kangaroo Apple
Solanaceae	<i>Solanum nigrum</i> *	Black-berry Nightshade
Solanaceae	<i>Solanum radicans</i> *	-
Solanaceae	<i>Solanum stelligerum</i>	Devil's Needles
Thymelaeaceae	<i>Pimelea linifolia</i>	Rice Flower
Ulmaceae	<i>Trema tomentosa</i> var. <i>viridis</i>	Native Peach
Verbenaceae	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum

TABLE A3 (cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
Violaceae	<i>Hymenanchera dentata</i>	Tree Violet
GROUNDCOVERS		
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet
Acanthaceae	<i>Rostellularia adscendens</i> var. <i>pogonantha</i>	-
Adiantaceae	<i>Adiantum aethiopicum</i>	Common Maidenhair
Adiantaceae	<i>Adiantum hispidulum</i>	Rough Maidenhair
Adiantaceae	<i>Pellaea falcate</i>	Sickle Fern
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed
Anthericaceae	<i>Arthropodium milleflorum</i>	Pale Vanilla Lily
Apiaceae	<i>Centella asiatica</i>	Pennywort
Apiaceae	<i>Conium maculatum</i> *	Hemlock
Apiaceae	<i>Cyclospermum leptophyllum</i> *	Slender Celery
Apiaceae	<i>Daucus glochidiatus</i>	Native Carrot
Apiaceae	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort
Aspleniaceae	<i>Asplenium flabellifolium</i>	Necklace Fern
Asteraceae	<i>Arctotheca calendula</i> *	Capeweed
Asteraceae	<i>Bidens pilosa</i> *	Cobbler's Pegs
Asteraceae	<i>Calotis cuneifolia</i>	Purple Burr Daisy
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr Daisy
Asteraceae	<i>Chondrilla juncea</i> *	Skeleton Weed
Asteraceae	<i>Chryscephalum apiculatum</i>	Common Everlasting
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle
Asteraceae	<i>Conyza albida</i> *	Tall Fleabane
Asteraceae	<i>Conyza bonariensis</i> *	Flax-leaf Fleabane
Asteraceae	<i>Cotula australis</i>	Common Cotula
Asteraceae	<i>Cymbonotus lawsonianus</i>	Bears-ear
Asteraceae	<i>Euchiton</i> sp.	-
Asteraceae	<i>Gamochaeta</i> sp.*	-
Asteraceae	<i>Glossogyne tannensis</i>	Cobbler's Tack
Asteraceae	<i>Hypochaeris radicata</i> *	Catsear
Asteraceae	<i>Lactuca serriola</i> *	Prickly Lettuce
Asteraceae	<i>Lagenifera stipitata</i>	-
Asteraceae	<i>Pseudognaphalium luteoalbum</i>	Cudweed
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed
Asteraceae	<i>Senecio quadridentatus</i>	Cotton Fireweed
Asteraceae	<i>Sigesbeckia orientalis</i> var. <i>orientalis</i>	Indian Weed
Asteraceae	<i>Silybum marianum</i> *	Variegated Thistle
Asteraceae	<i>Soliva</i> sp.*	Bindii
Asteraceae	<i>Sonchus asper</i> subsp. <i>glaucescens</i> *	Rough Sowthistle
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sow-thistle

TABLE A3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
GROUNDCOVERS (Cont.)		
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion
Asteraceae	<i>Vernonia cinerea</i> var. <i>cinerea</i>	-
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	Fuzzweed
Asteraceae	<i>Vittadinia sulcata</i>	-
Boraginaceae	<i>Cynoglossum latifolium</i>	-
Boraginaceae	<i>Echium plantagineum</i> *	Patterson's Curse
Brassicaceae	<i>Capsella bursa-pastoris</i> *	Shepherds Purse
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell
Campanulaceae	<i>Wahlenbergia luteola</i>	Bluebell
Campanulaceae	<i>Wahlenbergia</i> sp.	Native Bluebell
Campanulaceae	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	Austral Bluebell
Carophyllaceae	<i>Cerastium glomeratum</i> *	Mouse-ear Chickweed
Caryophyllaceae	<i>Stellaria media</i> *	Common Chickweed
Chenopodiaceae	<i>Chenopodium christatum</i>	Crested Goosefoot
Chenopodiaceae	<i>Chenopodium pumilo</i>	-
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush
Chenopodiaceae	<i>Einadia polygonoides</i>	Saltbush
Colchicaceae	<i>Burchardia umbellata</i>	Milkmaids
Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed
Convolvulaceae	<i>Dichondra</i> species A	Hairy Kidney Weed
Crassulaceae	<i>Crassula sieberiana</i>	Australian Stonecrop
Cucurbitaceae	<i>Citrullus lanatus</i> var. <i>lanatus</i> *	Bitter Melon
Cyperaceae	<i>Carex appressa</i>	Tall Sedge
Cyperaceae	<i>Carex inversa</i>	Knob Sedge
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge
Cyperaceae	<i>Cyperus gracilis</i>	-
Cyperaceae	<i>Cyperus imbecilis</i>	-
Cyperaceae	<i>Gahnia aspera</i>	Saw Sedge
Cyperaceae	<i>Lepidosperma laterale</i>	Variable Sword-sedge
Cyperaceae	<i>Lepidosperma</i> sp.	-
Cyperaceae	<i>Scleria mackaviensis</i>	-
Dilleniaceae	<i>Hibbertia linearis</i>	-
Dilleniaceae	<i>Hibbertia obtusifolia</i>	Grey Guinea Flower
Euphorbiaceae	<i>Chamaesyce drummondii</i>	Caustic Weed
Euphorbiaceae	<i>Euphorbia planiticola</i>	-
Euphorbiaceae	<i>Poranthera microphylla</i>	-
Fabaceae	<i>Melilotus indicus</i> *	-



TABLE A3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
GROUNDCOVERS (Cont.)		
Fabaceae	<i>Medicago arabica</i> *	-
Fabaceae	<i>Trifolium repens</i> *	White Clover
Fabaceae	<i>Trifolium</i> sp.*	Clover
Gentianaceae	<i>Centaurium erythraea</i> *	Common Centaury
Geraniaceae	<i>Erodium</i> sp.*	Storksbills
Geraniaceae	<i>Geranium homeanum</i>	Northern Cranesbill
Geraniaceae	<i>Geranium potentilloides</i> var. <i>potentilloides</i>	-
Geraniaceae	<i>Geranium solanderi</i> var. <i>solanderi</i>	Cutleaf Cranesbill
Goodeniaceae	<i>Goodenia bellidifolia</i>	Daisy-leaved Goodenia
Goodeniaceae	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	Ivy-leaved Goodenia
Goodeniaceae	<i>Goodenia ovata</i>	-
Goodeniaceae	<i>Goodenia</i> sp.	-
Haloragaceae	<i>Gonocarpus tetragynus</i>	Poverty Raspwort
Iridaceae	<i>Romulea rosea</i> *	Onion Grass
Lamiaceae	<i>Marrubium vulgare</i> *	Horehound
Lamiaceae	<i>Plectranthus parviflorus</i>	Cockspur Flower
Lamiaceae	<i>Scutellaria humilis</i>	Dwarf Skull Cap
Lamiaceae	<i>Stachys arvensis</i> *	Stagger Weed
Liliaceae	<i>Caesia parviflora</i> var. <i>parviflora</i>	Pale Grass Lily
Liliaceae	<i>Dianella revoluta</i>	Mauve Flax Lily
Lobeliaceae	<i>Isotoma axillaris</i>	Showy Isotoma
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot
Loliaceae	<i>Dianella longifolia</i>	-
Lomandraceae	<i>Lomandra confertifolia</i>	-
Lomandraceae	<i>Lomandra confertifolia</i> subsp. <i>pallida</i>	-
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush
Lomandraceae	<i>Lomandra glauca</i> subsp. <i>glauca</i>	-
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat-rush
Malvaceae	<i>Abutilon oxycarpum</i>	Flannel Weed
Malvaceae	<i>Malva parviflora</i> *	Paddy Melon
Malvaceae	<i>Sida corrugata</i>	-
Malvaceae	<i>Sida cunninghamii</i>	-
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne
Orchidaceae	<i>Acianthus fornicatus</i>	Pixie Caps
Orchidaceae	<i>Corybas</i> sp.	Helmet Orchid
Orchidaceae	<i>Pterostylis concinna</i>	Trim Greenhord

TABLE A3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
GROUNDCOVERS (Cont.)		
Orchidaceae	<i>Pterostylis</i> sp.	Greenhood
Oxalidaceae	<i>Oxalis corniculata</i> *	Yellow Wood Sorrel
Oxalidaceae	<i>Oxalis exilis</i>	-
Oxalidaceae	<i>Oxalis latifolia</i>	Fish-tail Oxalis
Oxalidaceae	<i>Oxalis perrenans</i>	-
Oxalidaceae	<i>Oxalis pes caprae</i>	Soursob
Phormiaceae	<i>Dianella caerulea</i> var. <i>cinerascens</i>	Blue Flax Lily
Phormiaceae	<i>Stypandra glauca</i>	Nodding Blue Lily
Plantaginaceae	<i>Plantago debilis</i>	Slender Plantain
Plantaginaceae	<i>Plantago gaudichaudii</i>	-
Plantaginaceae	<i>Plantago lanceolata</i> *	Ribwort
Poaceae	<i>Aristida calycina</i>	Wire Grass
Poaceae	<i>Aristida ramosa</i>	Wire Grass
Poaceae	<i>Aristida ramosa</i> var. <i>speciosa</i>	Wire Grass
Poaceae	<i>Aristida vagans</i>	Three-awn Speargrass
Poaceae	<i>Aristida warburgii</i>	Wire Grass
Poaceae	<i>Austrodanthonia bipartita</i>	Wallaby Grass
Poaceae	<i>Austrodanthonia linkii</i> var. <i>fulva</i>	Wallaby Grass
Poaceae	<i>Austrodanthonia</i> sp.	Wallaby Grass
Poaceae	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass
Poaceae	<i>Austrostipa setacea</i>	Corkscrew Grass
Poaceae	<i>Austrostipa verticillata</i>	-
Poaceae	<i>Bothriochloa decipiens</i>	Redleg Grass
Poaceae	<i>Cenchrus caliculatus</i>	Hillside Burr-grass
Poaceae	<i>Cenchrus incertus</i> *	Spiny Burr-grass
Poaceae	<i>Chloris truncata</i>	Windmill Grass
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris
Poaceae	<i>Cleistochloa rigida</i>	-
Poaceae	<i>Cleistochloa rigida</i>	-
Poaceae	<i>Cymbopogon refractus</i>	Barbwire Grass
Poaceae	<i>Cynodon dactylon</i>	Common Couch
Poaceae	<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	Queensland Bluegrass
Poaceae	<i>Dichelachne micrantha</i>	Short-hair Plume Grass
Poaceae	<i>Digitaria ramularis</i>	-
Poaceae	<i>Echinopogon caespitosus</i>	Tufted Hedgehog Grass
Poaceae	<i>Echinopogon intermedius</i>	Erect Hedgehog Grass
Poaceae	<i>Entolasia marginata</i>	Bordered Panic
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass

TABLE A3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
GROUNDCOVERS (Cont.)		
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Rice Grass
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass
Poaceae	<i>Oplismenus imbecillis</i>	-
Poaceae	<i>Panicum effusum</i>	Hairy Panic
Poaceae	<i>Panicum simile</i>	Two Colour Panic
Poaceae	<i>Poa seiberiana</i>	Tussock Grass
Poaceae	<i>Themeda australis</i>	Kangaroo Grass
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass
Polygonaceae	<i>Acetosella vulgaris</i> *	Sheep Sorrel
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock
Polygonaceae	<i>Rumex pulcher</i> *	Fiddle Dock
Polygoniaceae	<i>Polygonum ariculare</i> *	Wireweed
Primulaceae	<i>Anagallis arvensis</i> *	Scarlet Pimpernel
Primulaceae	<i>Anagallis</i> sp.*	Pimpernel
Rosaceae	<i>Acaena novae-zelandiae</i>	Bidgee-widgee
Rosaceae	<i>Acaena ovina</i>	Biddy Biddy
Rubiaceae	<i>Asperula conferta</i>	Common Woodruff
Rubiaceae	<i>Galium migrans</i>	Bedstraw
Rubiaceae	<i>Pomax umbellata</i>	Whiteroot
Scrophulariaceae	<i>Verbascum</i> □ <i>hypsus</i> ssp. □ <i>hypsus</i> *	Aaron's Rod
Scrophulariaceae	<i>Veronica plebia</i>	Creeping Speedwell
Sinopteridaceae	<i>Cheilanthes austrotenuifolia</i>	-
Sinopteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern
Sinopteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Poison Rock Fern
Sinopteridaceae	<i>Pellaea paradoxa</i>	-
Solanaceae	<i>Solanum americanum</i> *	Glossy Nightshade
Solanaceae	<i>Solanum campanulatum</i>	-
Solanaceae	<i>Solanum cinereum</i>	Narrawa Burr
Solanaceae	<i>Solanum parvifolium</i>	-
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade
Solanaceae	<i>Solanum</i> sp.	-
Stackhousiae	<i>Stackhousia monogyna</i>	Creamy Candles
Stylidiaceae	<i>Stylidium</i> sp.	Trigger Plant
Thymelaeaceae	<i>Pimelea curviflora</i>	
Urticaceae	<i>Urtica incisa</i>	Stinging Nettle
Urticaceae	<i>Urtica urens</i> *	Small Stinging Nettle
Xanthorrhoeaceae	<i>Xanthorrhoea glauca</i> subsp. <i>glauca</i>	-
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	-
Zamiaceae	<i>Macrozamia concinna</i>	-

TABLE A3 (Cont.) FLORA SPECIES OBSERVED ON THE SUBJECT SITE		
Family	Scientific Name	Common Name
GROUNDCOVERS (Cont.)		
Epiphytes		
Loranthaceae	<i>Amyema pendulum</i> ssp. <i>pendulum</i>	Drooping Mistletoe
Orchidaceae	<i>Cymbidium canaliculatum</i>	Tiger Orchid
Orchidaceae	<i>Cymbidium suave</i>	Native Cymbidium
Orchidaceae	<i>Dendrobium liguiforme</i> var. <i>liguiforme</i>	Rock Lily
Orchidaceae	<i>Dendrobium speciosum</i>	Rock Lily
Polypodiaceae	<i>Pyrrosia rupestris</i>	Rock Felt Fern
VINES		
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod
Bignoniaceae	<i>Pandorea pandorana</i> ssp. <i>pandorana</i>	Wonga Vine
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>nutans</i>	Climbing Saltbush
Fabaceae	<i>Desmodium brachypodum</i>	Large Tick-trefoil
Fabaceae	<i>Desmodium varians</i>	-
Fabaceae	<i>Glycine clandestina</i>	Twining Glycine
Fabaceae	<i>Glycine latifolia</i>	-
Fabaceae	<i>Glycine tabacina</i>	Twining Glycine
Fabaceae	<i>Hardenbergia violacea</i>	False Sarsparilla
Fabaceae	<i>Glycine tabacina</i> species complex	Glycine
Lauraceae	<i>Cassytha glabella</i> forma <i>glabella</i>	Slender Devil's Twine
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily
Pittosporaceae	<i>Billardiera scandens</i> var. <i>scandens</i>	Apple Dumplings
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard
Ranunculaceae	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	Clematis
Vitaceae	<i>Cayratia clematidea</i>	Slender Grape
Vitaceae	<i>Cissus antarctica</i>	Native Grape
Species name <sup>TS</sup> = Threatened Species      * = Introduced Species		

## **FAUNA**

### **FAUNA HABITATS**

The subject site is divided into two separate sections, Middlebrook Station and the Mountain Station in the Owens Gap area. Both these areas have similar available habitats for locally occurring fauna species. Owens Gap has incurred higher levels of disturbance through clearing for stock grazing. The vegetation of these two areas consists mainly of dry open forest, woodland and cleared areas. Within the vegetation communities identified a range of fauna habitats are present and include:

- Flower, nectar and seed producing tree and shrub species of the dry open forest, and woodland.
- Hollow bearing trees and stags
- Sparse to dense shrub layer and understorey
- Sparse to dense grassy layer
- Moderately dense to sparse leaf litter layer
- Fallen timber and hollow logs
- Rocky outcrops and caves
- Farm dams

A range of habitat types and values exist across the subject site. The subject site consists mainly of dry open forest, woodland and cleared areas. The flower, nectar and seed producing tree and shrub species of these communities provide a foraging resource for bird and arboreal mammal species. Scattered hollow bearing trees and stags, and fallen timber and hollow logs provide breeding and shelter habitat for arboreal mammal, bird and reptile species. The grassy groundcover may provide foraging habitat for a range of small mammals such as rodents, large mammals such as macropods, granivorous birds such as parrots and foraging areas for raptors.

The rocky outcrops and associated rock caves and crevices provide suitable shelter and foraging habitat for reptiles, small mammals, some amphibians and some microbat species.

The small farm dams scattered throughout the two areas provide foraging and water nourishment for a range of mammal, bird, reptile and amphibian species.

Middlebrook Station adjoins Towarri National Park to the north and displays similar habitats types and values to that of Middlebrook Station. Owens Gap is surrounded by similar habitat types associated with the adjoining grazing properties.

### **FAUNA SURVEY METHODOLOGY**

In order to detect the possible occurrence of threatened fauna species specific methods targeting these species were employed in addition to the standard fauna survey methods of nocturnal spotlighting and habitat searches. Details on the fauna survey methods are provided below:

#### ***Literature Review:***

- Review of local resource documents
- A search of the Atlas of NSW Wildlife (DECC 2007) database of threatened fauna records was undertaken to identify records of threatened species located within 10km of the subject site

### ***Fauna Survey (to date)***

Fauna survey of the site incorporating the following fauna survey methods was utilised:

- Arboreal & terrestrial mammal trapping (Type A (20) & B (10) Elliott traps for 3 nights)
- Large cage trapping for larger terrestrial fauna.
- Nocturnal spotlighting for birds, arboreal and terrestrial mammals, reptiles and frogs
- Call playback and listening for forest owl and arboreal mammal responses
- Anabat II recording for microchiropteran bat species
- Diurnal habitat searches for frogs, reptiles and mammals
- Bird census

The fauna survey details are provided in Table A4 and locations shown in Figures A1 and A2. The results of surveys are provided in Table A5. After examination of the Director Generals Requirements for this development, further surveys across varying seasons are required. The fauna survey completed has been an autumn / winter and a spring / summer survey. Weather conditions causing difficult site access conditions have resulted in some limitations to the fauna surveys particularly the spring / summer survey. It is considered that to provide a more complete spring / summer survey data set further surveys conducted in more favourable weather will be necessary.

Given the large size of the site and difficulties in gaining access to many areas fauna surveys were completed within those areas likely to be impacted, that is, areas proposed for turbines and other facilities. The locations of each of the fauna surveys completed within each of the various vegetation communities likely to be impacted by the proposal are shown on Figures A1 and A2.

**TABLE A4**  
**FAUNA SURVEY DETAILS**

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time per day
Diurnal Birds	27/4/07	8/8 cloud, no wind, light rain/ foggy, 180C	Opportunistic observation	2hrs 0700 – 0900
	8/5/07	1/8 cloud, no wind, no rain, 270C	Census / opportunistic observation	5hrs 1100 – 1600
	9/5/07	5/8 cloud, no wind, no rain, 160C	Census / opportunistic observation	6hrs 0700-1300
	11/5/07	8/8 - 2/8 cloud, light SE wind, no rain, early fog, 200C.	Opportunistic observation	5hrs 0700-1200
	13/6/07	0/8 cloud, light SW wind, 100C.	Opportunistic observation	5hrs 0745-1245
	1/8/07	0/8 cloud, strong NW wind, 200C.	Opportunistic observation	2.5hrs 1030-1300
	1/8/07	0/8 cloud, mod NW wind, 250C.	Opportunistic observation	2hrs 1400-1600
	2/8/07	6/8 cloud, mod NW wind, 180C.	Opportunistic observation	4hrs 0800-1200
	2/8/07	7/8 cloud, mod NW wind, 220C.	Opportunistic observation	1hr 1300-1400
	10/12/07	0/8 cloud, light / nil wind, 220C.	Census / opportunistic observation	6hrs 0700- 1100/ 1500-1700
	11/12/07	7/8 cloud, mod S wind, 180C, rain.	Census / opportunistic observation	5hrs 0700- 1000/ 1600-1800
	12/12/07	8/8 cloud, strong S wind, 120C, rain.	Census / opportunistic observation	2hrs 0800- 1000
	26/02/08	6/8 cloud, mod SW wind, 28°C, no rain	Census / opportunistic observation	3hrs 1500- 1800
	27/02/08	2/8 cloud, mod SW wind, 26°C, no rain	Census / opportunistic observation	9hrs 0730-1230/ 1330-1730
	28/02/08	8/8 cloud, mod SW wind, 17°C variable showers	Census / opportunistic observation	3.5hrs 0800-1030/ 1800-1900
	29/02/08	6/8 cloud, no wind, 24°C, no rain	Census / opportunistic observation	2hrs 0800- 1000
Nocturnal Birds	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 200C	Call playback & spotlighting	2hrs 1745 - 1945
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 160C	Call playback & spotlighting	1hr 45min 1745 -1930
	10/5/07	8/8 cloud, no wind, no moon, no rain, 120C	Call playback & spotlighting	1hr 30min 1800 -1930
	1/8/07	5/8 cloud, no wind, moon, no rain, 150C	Call playback & spotlighting	2hrs 1800 - 2000
Arboreal Mammals	8/5/07	8/8-0/8 cloud, light SE wind, no rain, no moon 20-150C	Type A (20) Elliott Traps	20trap nights
	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 200C	Spotlighting, Call playback	1hr 15min 1730-1945
	9/5/07	8/8 cloud, mod SE wind, no rain, foggy, no moon, 140C	Type A (20) Elliott Traps	20 trap nights
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 160C	Spotlighting, Call playback	1hr 30min 1745 -1915
	10/5/07	8/8 cloud, no wind, no moon, light rain, foggy, 100C	Type A (20) Elliott Traps	20 trap nights
	10/5/07	8/8 cloud, no wind, no moon, no rain, 120C	Spotlighting, Call playback	1hr 45min 1745 -1930
	1/8/07	5/8 cloud, no wind, moon, no rain, 150C	Spotlighting	2hrs 1800 - 2000
				Total 60 trap nights

TABLE A4 (Cont.) FAUNA SURVEY DETAILS				
Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time per day
Terrestrial Mammals	8/5/07	8/8-0/8 cloud, light SE wind, no rain, no moon 20-150C	Type B (10) Elliott Traps/ 2 large cages	1hr 15min 1730-1945  1hr 30min 1745 -1915  1hr 45min 1745 -1930 2hrs 1800 - 2000 Total: 30 Elliott trap nights 6 large cage trap nights
	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 200C	Spotlighting	
	9/5/07	8/8 cloud, mod SE wind, no rain, foggy, no moon, 140C	Type B (10) Elliott Traps/ 2 large cages	
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 160C	Spotlighting	
	10/5/07	8/8 cloud, no wind, no moon, light rain, foggy, 100C	Type B (10) Elliott Traps/ 2 large cages	
	10/5/07	8/8 cloud, no wind, no moon, no rain, 120C	Spotlighting	
	1/8/07	5/8 cloud, no wind, moon, no rain, 150C	Spotlighting, opportunistic observation	
Bats	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 200C	Anabat II x 4/ Spotlight	5hrs 1730-1945
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 160C	Anabat II x 4/ Spotlight	9hrs 1745 -1915
	10/5/07	8/8 cloud, no wind, no moon, no rain, 120C.	Anabat II x 4/ Spotlight	7hrs 1745 -1930
	1/8/07	5/8 cloud, no wind, no moon, no rain, 150C.	Anabat II x 2/ Spotlight	4hrs 1800 -2000
	26/02/08	6/8 cloud, no wind, Late 3/4 moon no rain, 20°C	Anabat II x 2	
	27/02/08	5/8 cloud, no wind, Late ¾ moon, no rain, 18°C	Anabat II x 1	
Reptiles	27/4/07	8/8 cloud, no wind, light rain/ foggy, 180C	Habitat search, Opportunistic observation	2hrs 0700 – 0900
	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 200C	Spotlight	1hr 15min 1730-1945
	8/5/07	1/8 cloud, no wind, no rain, 270C	Habitat search, Opportunistic observation	5hrs 1100 – 1600
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 160C	Spotlight	1hr 30min 1745 -1915
	9/5/07	5/8 cloud, no wind, no rain, 160C	Habitat search, Opportunistic observation	6hrs 0700-1300
	10/5/07	8/8 cloud, no wind, no moon, no rain, 120C	Spotlight	1hr 45min 1745 -1930
	11/5/07	8/8 - 2/8 cloud, light SE wind, no rain, early fog, 200C	Habitat search, Opportunistic observation	5hrs 0700-1200
	1/8/07	0/8 cloud, strong NW wind, 200C.	Habitat search, Opportunistic observation	2.5hrs 1030-1300
	1/8/07	0/8 cloud, mod NW wind, 250C.	Habitat search, Opportunistic observation	2hrs 1400-1600
	2/8/07	6/8 cloud, mod NW wind, 180C.	Habitat search, Opportunistic observation	4hrs 0800-1200
	2/8/07	7/8 cloud, mod NW wind, 220C	Habitat search, Opportunistic observation	1hr 1300-1400
	10/12/07	0/8 cloud, light / nil wind, 220C.	Habitat search, Opportunistic observation	6hrs 0700-1100/1500-1700
	11/12/07	7/8 cloud, mod S wind, 180C, rain.	Habitat search, Opportunistic observation	5hrs 0700-1000/1600-1800
	12/12/07	8/8 cloud, strong S wind, 120C, rain.	Habitat search, Opportunistic observation	2hrs 0800- 1000



TABLE A4 (Cont.) FAUNA SURVEY DETAILS				
Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time per day
Reptiles (cont.)	26/02/08	6/8 cloud, mod SW wind, 28°C, no rain	Habitat search, Opportunistic observation	3hrs 1500- 1800
	26/02/08	6/8 cloud, no wind, 20°C, approaching storm	Spotlight	1.5hrs 2000-2130
	27/02/08	2/8 cloud, mod SW wind, 26°C, no rain	Habitat search, Opportunistic observation	9hrs 0730-1230/ 1330-1730
	27/02/08	8/8 cloud, no wind, 15°C, light rain	Spotlight	1.5hrs 2000-2130
	28/02/08	8/8 cloud, mod SW wind, 17°C variable showers	Habitat search, Opportunistic observation	3.5hrs 0800-1030/ 1800-1900
	29/02/08	6/8 cloud, no wind, 24°C, no rain	Habitat search, Opportunistic observation	2hrs 0800- 1000
Amphibians	27/4/07	8/8 cloud, no wind, light rain/ foggy, 180C	Habitat search, Call identification	2hrs 0700 – 0900
	8/5/07	0/8 cloud, light SE wind, no moon, no rain, 200C	Spotlight, Call identification	1hr 15min 1730-1945
	8/5/07	1/8 cloud, no wind, no rain, 270C	Habitat search, Call identification	5hrs 1100 – 1600
	9/5/07	8/8 cloud, light/ mod SE wind, no moon, no rain, 160C	Spotlight, Call identification	1hr 30min 1745 -1915
	9/5/07	5/8 cloud, no wind, no rain, 160C	Habitat search, Call identification	6hrs 0700-1300
	10/5/07	8/8 cloud, no wind, no moon, no rain, 120C	Spotlight, Call identification	1hr 45min 1745 -1930
	11/5/07	8/8 - 2/8 cloud, light SE wind, no rain, early fog, 200	Habitat search, Call identification	5hrs 0700-1200
	1/8/07	5/8 cloud, no wind, moon, no rain, 150C	Spotlight, Call identification	2hrs 1800 – 2000
	26/02/08	6/8 cloud, mod SW wind, 28°C, no rain	Habitat search, Opportunistic observation	3hrs 1500- 1800
	26/02/08	6/8 cloud, no wind, 20°C, approaching storm	Spotlight	1.5hrs 2000-2130
	27/02/08	2/8 cloud, mod SW wind, 26°C, no rain	Habitat search, Opportunistic observation	9hrs 0730-1230/ 1330-1730
	27/02/08	8/8 cloud, no wind, 15°C, light rain	Spotlight	1.5hrs 2000-2130
	28/02/08	8/8 cloud, mod SW wind, 17°C variable showers	Habitat search, Opportunistic observation	3.5hrs 0800-1030/ 1800-1900
	29/02/08	6/8 cloud, no wind, 24°C, no rain	Habitat search, Opportunistic observation	2hrs 0800- 1000

Table A5 lists the fauna species found on-site.

TABLE A5 FAUNA OBSERVED DURING SURVEYS				
Common Name	Scientific Name	Method May 07	Method Aug 07	Method Dec 07
Birds				
Pacific Black Duck	<i>Anas superciliosa</i>	OC		OC
Grey Teal	<i>Anas gracilis</i>	OC	OC	OC
Australian Wood Duck	<i>Chenonetta jubata</i>	OC	OC	OC
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	OC	OC	OC
Black-fronted Dotterel	<i>Elseya melanops</i>	O		O
Masked Lapwing	<i>Vanellus miles</i>	OC		OC
Wedge-tailed Eagle	<i>Aquila audax</i>	O	O	O
Little Eagle	<i>Hieraaetus morphnoides</i>	O		O
Whistling Kite	<i>Haliastur sphenurus</i>			O
Brown Falcon	<i>Falco berigora</i>	O		
Nankeen Kestrel	<i>Falco cenchroides</i>	O		OC
Black-shouldered Kite	<i>Elanus axillaris</i>	O		
Wonga Pigeon	<i>Leucosarcia melanoleuca</i>	C		
Common Bronzewing	<i>Phaps chalcoptera</i>	O	O	O
Crested Pigeon	<i>Ocyphaps lophotes</i>	O	O	
Glossy Black-Cockatoo <sup>TS</sup>	<i>Calyptorhynchus lathami</i>	OC	Sc	
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	OC	OC	OC
Little Corella	<i>Cacatua sanguinea</i>	OC	OC	
Galah	<i>Cacatua roseicapilla</i>	OC	OC	OC
Australian King-Parrot	<i>Alisterus scapularis</i>	OC	OC	OC
Crimson Rosella	<i>Platycercus elegans</i>	OC	OC	OC
Eastern Rosella	<i>Platycercus eximius</i>	OC	OC	OC
Red-rumped Parrot	<i>Psephotus haematonotus</i>	OC	OC	
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>			OC
Southern Boobook	<i>Ninox novaeseelandiae</i>	C		
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	OC	OC	OC
Sacred Kingfisher	<i>Todiramphus sanctus</i>			OC
Dollarbird	<i>Eurystomus orientalis</i>			OC
White-throated Treecreeper	<i>Cormobates leucophaeus</i>		OC	OC
Superb Fairy-wren	<i>Malurus cyaneus</i>	OC		
Spotted Pardalote	<i>Pardalotus punctatus</i>	OC	OC	
Striated Pardalote	<i>Pardalotus striatus</i>	OC	OC	OC
White-browed Scrubwren	<i>Sericornis frontalis</i>	OC	OC	
Speckled Warbler <sup>TS</sup>	<i>Pyrrholaemus saggitata</i>	OC	OC	
Brown Gerygone	<i>Gerygone mouki</i>	OC		
Brown Thornbill	<i>Acanthiza pusilla</i>	O C	OC	
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	OC	OC	OC
Yellow Thornbill	<i>Acanthiza nana</i>	OC	OC	
Noisy Friarbird	<i>Philemon corniculatus</i>	O C		OC
Red Wattlebird	<i>Anthochaera carunculata</i>	OC	OC	OC
Noisy Miner	<i>Manorina melanocephala</i>	O C	OC	OC
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>		OC	OC
White-eared Honeyeater	<i>Lichenostomus leucotis</i>	OC		
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	O C		
Eastern Yellow Robin	<i>Eopsaltria australis</i>	O	O	
Scarlet Robin	<i>Petroica multicolor</i>	OC		

TABLE A5 FAUNA OBSERVED DURING SURVEYS				
Common Name	Scientific Name	Method May 07	Method Aug 07	Method Dec 07
Jacky Winter	<i>Microeca fascians</i>		OC	
Rufous Whistler	<i>Pachycephala rufiventris</i>			OC
Grey-crowned Babbler <sup>TS</sup>	<i>Pomatostomus temporalis</i>	OC	OC	OC
Golden Whistler	<i>Pachycephala pectoralis</i>	OC		
Willie Wagtail	<i>Rhipidura leucophrys</i>	OC		
Grey Fantail	<i>Rhipidura fuliginosa</i>	OC	OC	
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	OC	OC	OC
Olive-backed Oriole	<i>Oriolus sagittatus</i>	OC		
Pied Butcherbird	<i>Cracticus nigrogularis</i>	OC		OC
Grey Butcherbird	<i>Cracticus torquatus</i>	OC		
Australian Magpie	<i>Gymnorhina tibicen</i>	O C	OC	OC
Magpie-lark	<i>Grallina cyanoleuca</i>	O C	OC	
Pied Currawong	<i>Strepera gracula</i>	O C	OC	OC
White-winged Chough	<i>Corcorax melanorhamphos</i>	OC	OC	OC
Australian Raven	<i>Corvus coronoides</i>	OC	OC	
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>	OC	OC	
Rufous Songlark	<i>Cincloramphus mathewsi</i>			OC
Zebra Finch	<i>Taeniopygia guttata</i>			OC
Fairy Martin	<i>Hirundo ariel</i>	OC	OC	
Welcome Swallow	<i>Hirundo neoxena</i>	OC	OC	
Common Myna *	<i>Acridotheres tristis</i>	OC	OC	
Common Starling *	<i>Sturnus vulgaris</i>	OC	OC	
Mammals				
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	Sp	Sp	
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	Sp	Sp	
Common Wombat	<i>Vombatus ursinus</i>	Sc	Sc	
Swamp Wallaby	<i>Wallabia bicolor</i>	O	Sp	O
Euro	<i>Macropus robustus</i>	O Sp	O	
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	O	O	O
Grey-headed Flying-fox <sup>TS</sup>	<i>Pteropus poliocephalus</i>	Sp		
Freetail Bat	<i>Mormopterus sp. 2</i>	A		
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	A	A	
Eastern Bentwing-bat <sup>TS</sup>	<i>Miniopterus schreibersii oceansis</i>	A		
White-striped Freetail-bat	<i>Nyctinomus australis</i>	A		
Long-eared Bat	<i>Nyctophilus spp</i>		A	
Yellow-bellied Sheath-tail-bat <sup>TS</sup>	<i>Saccolaimus flaviventris</i>	A		
Mammals				
Eastern Cave Bat <sup>TS</sup>	<i>Vespadelus troughtoni</i>	A		
Little Forest Bat	<i>Vespadelus vulturnus</i>	A		
Eastern Horseshoe-bat	<i>Rhinolophus megaphyllus</i>	A	A	
Horse *	<i>Equus caballus</i>	O	O	O
Sheep*	<i>Ovis aries</i>	O	O	O
Goat *	<i>Capra hircus</i>	O Sc		
Cow *	<i>Bos taurus</i>	O	O	O
Rabbit *	<i>Oryctolagus cuniculus</i>	Sc O	Sc O	
European Red Fox *	<i>Vulpes vulpes</i>	O Sc		
Dog *	<i>Canis familiaris</i>	OC		
Reptiles				
Punctate Worm-skink	<i>Anomalopus swainsoni</i>	S		

TABLE A5 FAUNA OBSERVED DURING SURVEYS				
Common Name	Scientific Name	Method May 07	Method Aug 07	Method Dec 07
South-eastern Morethia Skink	<i>Morethia boulengeri</i>	S	S	
White's Rock-skink	<i>Egernia whitii</i>	S		
Copper Tailed Ctenotus	<i>Ctenotus taeniolatus</i>		S	
Lesueur's Velvet Gecko	<i>Oedura lesueurii</i>		S	
Key to Methods of Observation				
O	- Observation	S	- Search	
C	- Call identification	A	- Anabat II	
Sp	- Spotlight	Sc	- Scat, Track or Sign	
E	- Elliott or Cage Trap			
* = Exotic species <sup>TS</sup> = Threatened species				