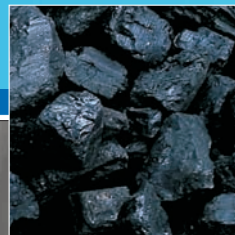
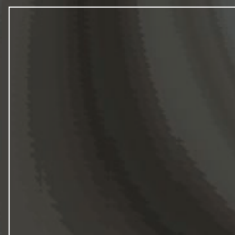


Modifications to Mangoola Coal Mine Plans and Relocation of 500kV Electricity Transmission Line

environmental



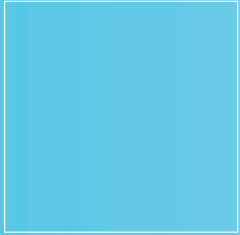
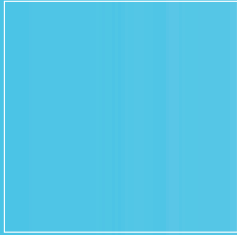
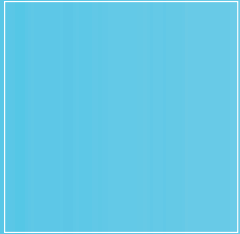
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DECEMBER 2010

VOLUME 2

Appendices B1-B5



VOLUME 1

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Appendix A2	Schedule of Lands
Appendix A3	Community Consultation
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Appendix B1	Ecological Assessment
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VOLUME 3

Appendix C1	Ecological Assessment
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Appendix C5	Visual Assessment

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Appendix C7	Noise and Blasting Assessment
Appendix C8	Greenhouse Gas and Energy Assessment

Appendix B1

Ecological Assessment

Xstrata Mangoola Pty Limited and
TransGrid

Ecological Assessment – Proposed Relocation of 500 kV Electricity Transmission Line, Mangoola Coal

December 2010

Ecological Assessment – Proposed Relocation of 500 kV Electricity Transmission Line, Mangoola Coal

Prepared by

Umwelt (Australia) Pty Limited

on behalf of

Xstrata Mangoola Pty Limited and TransGrid

Project Director:	Barbara Crossley	
Project Manager:	Travis Peake	
Report No.	2497/R11/Final	Date: December 2010



2/20 The Boulevard
PO Box 838
Toronto NSW 2283

Ph: 02 4950 5322
Fax: 02 4950 5737
Email: mail@umwelt.com.au
Website: www.umwelt.com.au

Executive Summary

This Ecological Assessment documents the ecological impacts associated with the proposed relocation of a 500 kilovolt (kV) electricity transmission line (ETL) for the Mangoola Coal Project, located in the Wybong area, 20 kilometres west of Muswellbrook and approximately 10 kilometres north of the township of Denman.

Mangoola Coal is seeking to modify its mine plans approved under the current Project Approval 06_0014 (PA 06_0014). Following detailed feasibility investigations, Mangoola Coal has resolved that the improved operational efficiency warrants the relocation of a 9 kilometre section of the Bayswater to Mount Piper 500 kV ETL that currently bisects the site.

This Ecological Assessment forms part of a larger Environmental Assessment prepared for the proposed relocation. This Environmental Assessment will form a new project application under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to be submitted for the 500 kV ETL relocation. TransGrid is the proponent for the ETL relocation project. The Minister for Planning is the consent authority.

Project Area

This report provides an assessment of the impacts of the proposed relocation of the 500 kV ETL on the ecological values of the Assessment Areas. For the purposes of this assessment, the Assessment Areas, which total approximately 36 hectares, are defined as those parts of the proposed easement that fall outside of the existing approved project disturbance area for the Mangoola Coal Project. The Assessment Areas encompass approximately 3.4 kilometres of relocated ETL to the south of the approved project disturbance boundary (Assessment Area A) and 1.9 kilometres of relocated ETL to the north of the approved project disturbance boundary (Assessment Area B).

Methods

A detailed survey methodology was designed and implemented in order to gain a thorough understanding of the ecological features of the Assessment Areas. The methods used as part of the current project built on the extensive amount of existing knowledge of the area, gained from the Ecological Assessment completed for the Anvil Hill Project EA (Umwelt 2006), as well as various other studies undertaken at Mangoola Coal.

Field surveys completed for the current project focussed on those parts of the proposed easement falling outside of the approved project disturbance area, being the areas to the north of Wybong Road, and the area to the south-east, running through the Habitat Enhancement and Sustainable Agriculture Offset Areas. Five proposed access tracks, occurring outside of the easement, and an Additional Biodiversity Offset Area were also subject to ecological survey.

The methods used comprised a detailed literature review as well as searches of a variety of relevant ecological databases. Information gathered from this stage was then used to design a field survey program to map and survey vegetation communities, and to identify threatened flora and fauna species, endangered populations, Threatened Ecological Communities (TECs), or their habitats across the Assessment Areas.

The flora surveys incorporated both semi-quantitative plot-based methods at a number of locations within the Assessment Areas and the Additional Biodiversity Offset Area, as well as seven non-quantitative transects that were traversed in the Assessment Areas. The flora

surveys were undertaken in accordance with the DEC *Draft Threatened Species Survey and Assessment Guidelines* (DEC 2004).

The fauna survey included: hair tube sampling; diurnal bird and herpetofauna surveys; nocturnal spotlighting; anabat echolocation detection; and opportunistic observations. The surveys were undertaken at a number of broad fauna survey locations concentrated in areas within the Assessment Areas and the Additional Biodiversity Offset Area.

Flora Results

A total of 185 flora species were recorded within the Assessment Areas, of which 129 (70 per cent) are native and 56 (30 per cent) are introduced species. The majority of the flora species identified were from the class Magnoliopsida (flowering plants), which accounted for 179 of the species identified.

One species was from the Class Coniferopsida (conifers), 4 species were from the Class Filicopsida (ferns), and 179 from Magnoliopsida (flowering plants). Flora species were recorded from 58 plant families, the most speciose being Poaceae (24 species), Asteraceae (23 species) and Fabaceae (16 species).

One threatened flora species, listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), was recorded in the Assessment Areas, being lobed bluegrass (*Bothriochloa biloba*). One threatened flora species, listed under the *Threatened Species Conservation Act 1995* (TSC Act) was recorded in the Assessment Areas, being Tricolour diuris (*Diuris tricolor*), which is also listed as an endangered population under the TSC Act. The tiger orchid (*Cymbidium canaliculatum*), listed under the TSC Act, was also recorded within the Assessment Areas. This species comprises an endangered population within the Hunter catchment. Three Threatened Ecological Communities (TEC) were also mapped as occurring within the Assessment Areas, including: Ironbark Woodland Complex, which is consistent with a listed Endangered Ecological Community (EEC) under the TSC Act (Central Hunter Grey Box – Ironbark Woodland); the Slaty Box Woodland, which is consistent with a listed Vulnerable Ecological Community (VEC) under the TSC Act (Hunter Valley Footslopes Slaty Gum Woodland); and the Rough-barked Apple Woodland, which is consistent with a listed EEC under the TSC Act (Hunter Floodplain Red Gum Woodland).

Fauna Results

A total of 96 fauna species were identified during surveys undertaken for this assessment. The total species count comprised 58 bird species, 8 reptile species, 8 amphibian species and 22 mammal species.

The identified bird species included 2 listed as vulnerable under the TSC Act, 9 species listed as migratory under the EPBC Act and 14 species listed as marine/migratory under the EPBC Act.

The identified vulnerable species were the grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) and speckled warbler (*Chthonicola sagittata*). The preliminary-listed scarlet robin (*Petroica boodang*) was also recorded in the Assessment Areas. The migratory listed bird species included the masked lapwing (*Vanellus miles*), rainbow bee-eater (*Merops ornatus*), Australian reed-warbler (*Acrocephalus australis*) and nankeen kestrel (*Falco cenchroides*). The marine listed bird species identified occurring in the Assessment Areas included the Australian pelican (*Pelecanus conspicillatus*), fan-tailed cuckoo (*Cacomantis flabelliformis*), dollarbird (*Eurystomus orientalis*) and welcome swallow (*Hirundo neoxena*). Four threatened mammal species were identified in the Assessment Areas, all of which were micro-bats: the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large-eared pied bat (*Chalinolobus dwyeri*), large-footed myotis (*Myotis*

adversus) and eastern cave bat (*Vespadelus troughtoni*). All of these bats are listed as vulnerable under the TSC Act, with the large-eared pied bat also listed as vulnerable under the EPBC Act.

The Assessment Areas encompass approximately 25.7 hectares of Grassland habitat, 9.8 hectares of Woodland habitat and 0.5 hectares of Riparian habitat. The habitat assessment showed that the woodland and riparian/floodplain habitat formations provided a range of fauna habitats, suitable for a number of threatened fauna species known to occur within the Project area. Of the three habitat formations, the Woodland habitats provide the highest diversity of habitat niches for fauna species.

Impacts

The ETL relocation Project will result in permanent impact to 14.9 hectares (comprising 10.3 hectares of woodland and 4.6 hectares of grassland) associated with the establishment of the various areas necessary to construct the towers (e.g. the tower footprints, tower assembly areas, laydown areas and access tracks). Of the 10.3 hectares of woodland proposed to be permanently disturbed, approximately 8.8 hectares is the Ironbark Woodland Complex, approximately 1.0 hectare is the Slaty Box Woodland and approximately 0.5 hectares is the Rough-barked Apple Woodland. All of these communities are of conservation significance, as they are consistent with listed TECs under the TSC Act.

The two threatened flora species recorded in the Assessment Areas are low-growing species (both <1 metre in height). It is unlikely that they would be impacted by ongoing maintenance works within the easement, and therefore potential habitats for these species will not be significantly reduced as part of the maintenance works required for the ETL. However, the permanent impacts from the construction of the ETL will remove habitat for these species. It is likely this will result in the loss of individuals of lobed bluegrass (*Bothriochloa biloba*), and it is also likely that the two recorded individuals of tricolour diuris (*Diuris tricolor*) will be impacted as a result of construction activities. Two examples of the tiger orchid (*Cymbidium canaliculatum*) (being an endangered population) were recorded within the Assessment Areas. The project will result in the disturbance of 14.9 hectares of known and potential habitat for this species.

The fauna habitat values of the Assessment Areas are relatively limited, as a result of the highly modified and fragmented nature of the vegetation. Despite this, the Assessment Areas support foraging and nesting resources for a wide range of fauna species, particularly within natural woodland remnants where they adjoin open grassland areas. The project is also likely to require the removal of hollow-bearing trees where they occur at the proposed tower locations, and in parts along the easement.

An assessment of significance, undertaken for the threatened species, endangered populations and TECs with the potential to occur in the Assessment Areas, concluded that the project is not likely to result in a significant impact on any of these features within the Assessment Areas. This is particularly so, when considering that 31 per cent of the vegetation to be impacted is Disturbed Grassland that has been heavily cleared and modified in the past.

Impact Mitigation Strategy

The project has been designed and revised to avoid impacts to ecological values where possible. This has included the selection of an ETL route where a large portion of the relocated ETL runs through the approved project disturbance boundary, despite sterilising coal resources. The permanent impact to 14.9 hectares of vegetation within the Assessment Areas is not likely to result in significant impacts on the biodiversity of the local area. Despite this, it is appropriate to implement mitigation measures for those impacts that have not been

able to be avoided and will occur as a result of the project. These will include pre-clearing surveys, installation of nest boxes and the retention of hollow-bearing trees, where possible.

Biodiversity Offset Strategy

In order to address residual impacts of the project on threatened species, endangered populations, TECs and their habitats, a Biodiversity Offset Strategy has been developed. This Strategy focuses on the provision of a formal offset area within the former 'Nipol' property (referred to as the Additional Biodiversity Offset Area), which lies to the south of and adjoins the existing Biodiversity Offset Area. The Biodiversity Offset Strategy provides for the protection of this Additional Biodiversity Offset Area, as well as ongoing management actions to ensure its ecological integrity in the long term.

The Additional Biodiversity Offset Area covers 30 hectares, which run along the western boundary of the former 'Nipol' property, thus providing a valuable corridor function within a generally fragmented landscape. The Additional Biodiversity Offset Area is primarily vegetated, and its protection will ensure existing vegetated connectivity from the heavily vegetated existing Conservation Offset Area in the north to the vegetated habitats of the Myambat Military Area. This will provide additional security to the existing corridor function of this area, which will assist in preserving movement corridors for flora and fauna in the local area. This improved security will in turn assist in securing this connectivity on a regional basis.

Summary and Conclusion

The permanent impact to 14.9 hectares of vegetation (comprising 10.3 hectares of woodland and 4.6 hectares of grassland) associated with the ETL relocation Project is not likely to result in significant impacts on the biodiversity of the local area. This is particularly so, when considering that 31 per cent of the vegetation to be removed is Disturbed Grassland that has been heavily cleared and modified in the past. It is also considered not likely that the project will result in the loss of a significant amount of fauna habitat in the local area.

A Biodiversity Offset Strategy has been designed to address residual ecological impacts. In combination, the impact mitigation and biodiversity offsetting proposed as part of this project seeks to achieve the overall goal to maintain or improve the biodiversity values of the local area.

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- A Flora Species List**
- B Fauna Species List**
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- D Assessment of Significance – Part 3A of the EP&A Act**
- E Assessment of Significance – EPBC Act**

1.0 Introduction

This report documents an impact assessment prepared for the proposed relocation of a 500 kV electricity transmission line (ETL) for the Mangoola Coal Project, located in the Wybong area, 20 kilometres west of Muswellbrook and approximately 10 kilometres north of the township of Denman (**Figure 1.1**).

1.1 Background to Project

Planning approval was granted to construct an open cut coal mine for the (then) Anvil Hill Project in June 2007. The mine, then owned by Centennial Coal, was approved to extract up to 10.5 million tonnes per annum (Mtpa) of run of mine (ROM) coal for 21 years. The approved project disturbance area is provided in **Figure 1.2**. In October 2007, the mine was purchased by Xstrata Mangoola Pty Limited, a wholly owned subsidiary of Xstrata Coal (NSW) Pty Limited, trading as Mangoola Coal.

Mangoola Coal has commenced construction of the mine, and mining is scheduled to commence in September 2010. Mangoola Coal is seeking to modify its approved mine plans to relocate the 9 kilometre section of the Bayswater to Mount Piper 500 kiloVolt (kV) ETL that currently bisects the site (see **Figure 1.2**). The Mangoola Coal Project, as currently approved, assumes that the existing 500 kV ETL will remain in place and that mining would occur on either side of the ETL. Mangoola Coal has determined that in order to achieve improved efficiencies in operations, it is necessary to relocate the existing 500 kV ETL with consequent changes to the mine plans.

This Ecological Assessment forms part of a larger Environmental Assessment prepared for the proposed relocation. This Environmental Assessment will form a new project application under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to be submitted for the 500 kV ETL relocation. TransGrid is the proponent for the ETL relocation project. The Minister for Planning is responsible for approving projects under Part 3A.

1.2 Project Description

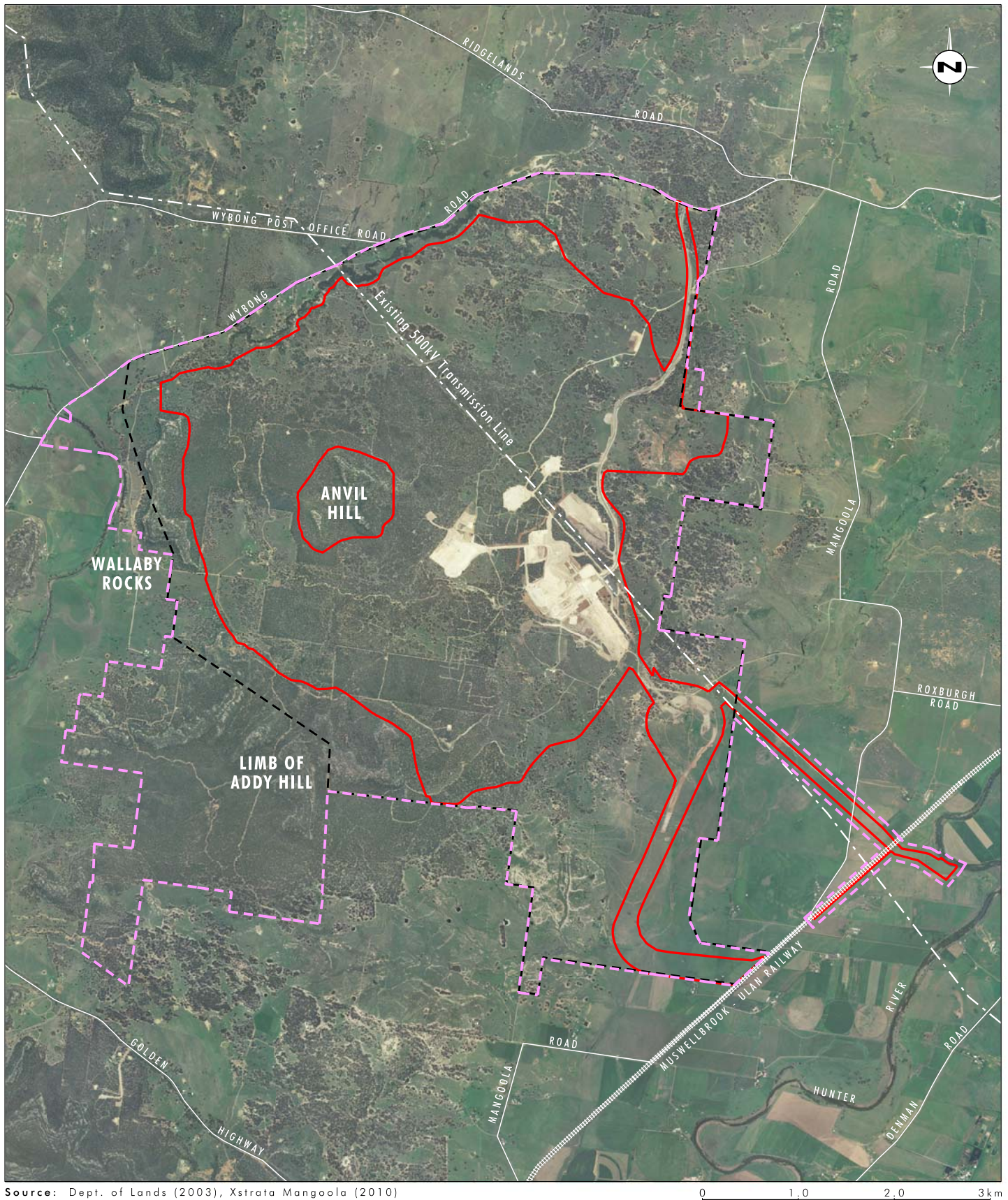
The route chosen for the relocated 500 kV ETL has been designed to ensure that the majority of the line is located within the approved project disturbance boundary, thereby minimising environmental impacts outside of this area as much as possible. Similarly, access to the relocated 500 kV ETL route will be gained (as far as possible) through the approved project disturbance area, along designated access tracks or along the proposed easement for the relocated 500 kV ETL to minimise environmental impacts.

The proposed relocation of the 500 kV ETL will require the construction of 32 new transmission towers along a 70 metre wide easement running the length of the 11 kilometre route. Following construction of the new 500 kV ETL, the 25 towers comprising the existing 500 kV ETL will be decommissioned, dismantled and removed. A 70 metre wide easement and five off-easement access tracks will be established for the relocated 500 kV ETL, and the easement over the section of the existing ETL will be relinquished.

The proposed route for the relocated 500 kV ETL easement and the locations of the off-easement access tracks are shown in **Figure 1.3**. The location of the existing 500 kV ETL is also provided in this figure.



FIGURE 1.1
Locality Plan

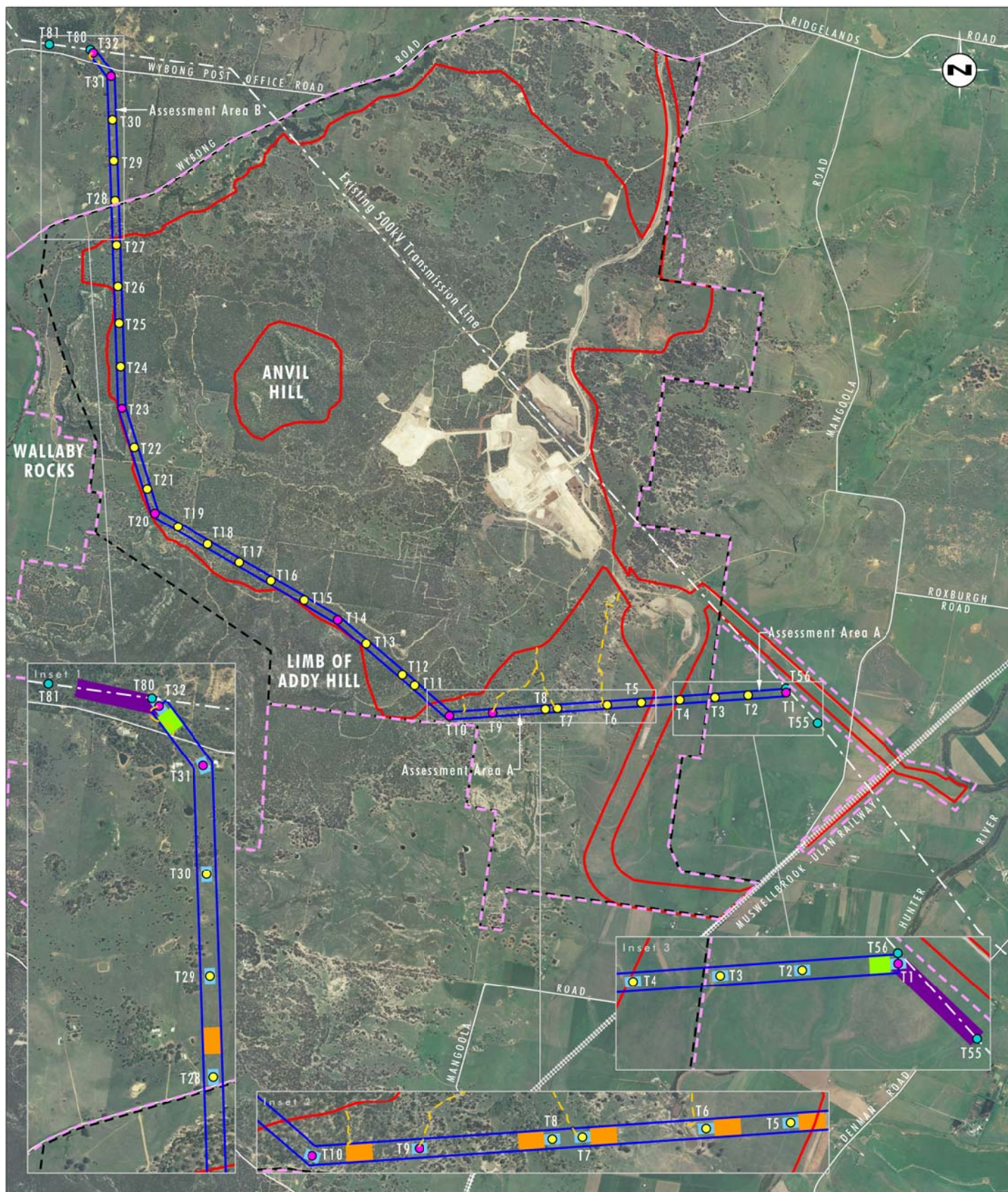


Legend

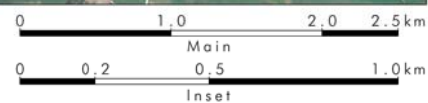
- Approved Project Disturbance Boundary
- - - Mining Lease 1626 Boundary
- - - Project Area

FIGURE 1.2

Approved Project Disturbance Area



Source: Dept. of Lands (2003), Xstrata Mangoola (2010)



Legend

- | | |
|---|---|
| — Approved Project Disturbance Boundary | — Proposed 500kV Transmission Line Easement |
| - - - Mining Lease 1626 Boundary | — Existing 500kV Transmission Line |
| — Project Area | ● Existing Tower Location |
| — Indicative Location of ETL Connection | ● Proposed Suspension Tower Location |
| — Indicative Location of Tower Assembly Area | ● Proposed Tension Tower Location |
| — Indicative Location of Laydown Area | — Proposed Access Tracks |
| — Indicative Location of Brake and Winch Site | |

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FIGURE 1.3

Proposed 500kV
Electricity Transmission Line Route
and Access Tracks

1.3 Definition of Impact

In order to define the likely impact of the ETL construction and operation (including ongoing access for maintenance purposes) on the ecological values of the area, impact calculations have been made that consider the different phases of ETL construction and operation. This has allowed impacts to be divided into permanent or temporary impacts. The definition of permanent or temporary impacts is contingent on two factors:

- the nature of the activity and its permanence; and
- the nature of the vegetation community occurring at the location that an activity will occur.

In terms of impacts on vegetation, the following activities are considered to result in a permanent impact:

- the 25 x 25 metre tower footprint, whether it occurs in an existing grassland or woodland vegetation community;
- clearance of woodland communities (comprising lopping of trees that have the potential to grow more than 4 metres in height) within the area defined for safety requirement for conductor parabolic sag. That is, the area of woodland that occurs directly below the conductors, and within a defined safety margin. This clearing will occur during the construction phase, and will be ongoing during routine maintenance activities for the ETL;
- tower assembly where it occurs in woodland areas due to the requirement to clear trees before tower assembly can occur;
- laydown areas where there is an existing woodland community due to the need to clear trees and clear the ground before laydown activities can occur;
- brake and winch sites in existing woodland areas due to the need to clear trees and clear the ground before an area can be used for placement of brake and winch machinery;
- connection areas that occur in existing woodland vegetation communities due to the need to clear vegetation prior to placing equipment required for connection activities;
- designated access areas whether they occur in existing grassland or woodland vegetation communities due to the need to provide an ongoing 4WD standard track for maintenance purposes; and
- easement access track whether located in an existing grassland or woodland community due to the need to provide an ongoing 4WD standard track for maintenance purposes.

The following activities occurring within designated vegetation community types are considered to have a temporary impact from an ecological perspective:

- establishment of tower assembly areas, laydown areas, brake and winch sites and connection areas within existing grassland areas due to the temporary nature of the use of the site and the ability of grassland communities to recover from these laydown activities.

Table 1.1 provides details on the estimated impact (both temporary and permanent) on each vegetation community, as a result of the ETL construction and operation.

Table 1.1 – Construction Impacts of Proposed ETL Relocation Project

	Vegetation Formation	Vegetation Community	Impact Type	Impact Area (ha)
Permanent Impacts	Grassland	Disturbed Grassland	Construction	4.6
	Woodland	Ironbark Woodland Complex	Construction	3.7
	Woodland	Ironbark Woodland Complex	Maintenance	5.1
	Woodland	Slaty Box Woodland	Maintenance	1.0
	Woodland	Rough-barked Apple Woodland	Maintenance	0.5
Total				14.9
Temporary Impacts	Grassland	Disturbed Grassland	Construction	4.6
Total				4.6

The northern section of the line outside the approved project disturbance area spans a distance of 400 metres across Big Flat Creek, which falls within the approved Conservation Offset Area. In this area, cables will be strung across the area from each end (i.e. completed aerially), meaning that there will be no need for heavy equipment to cross the ground at these locations during the stringing process. The draw wire will be walked through this section of the line to minimise ground disturbance within the Conservation Offset Area. Pulling the draw wire along the easement in all spans is expected to result in minimal disturbance to this area.

1.3.1 Decommissioning and Removal of Existing Electricity Transmission Line

Once the relocated 500 kV ETL is connected and operational, the towers and conductors that form the existing 500 kV ETL will be decommissioned and removed. The length of the existing 500 kV ETL is 9 kilometres.

Dismantling the existing 500 kV ETL initially involves accessing each tower location with a crane and associated support vehicles in order to remove the conductor and earthwire from the towers. The crane will be used to lower the conductor to the ground along the length of the existing easement, stripping the fittings and recoiling the conductor slowly along the ground for safety reasons. The eleven existing towers located outside of the approved project disturbance boundary, the towers located in the Biodiversity Offset Areas (across Big Flat Creek in the Conservation Offset Area, and within the Habitat Enhancement and Sustainable Agriculture Offset Areas), and any areas required for disturbance (including designated vehicle access tracks) will be defined and assessed via a due diligence process, and all disturbance will be confined to these designated areas. Such due diligence works will need to consider seasonality issues, particularly in relation to spring-flowering terrestrial orchids. This is considered appropriate because any disturbance will occur in areas that form part of an existing TransGrid easement where access tracks exist from past construction and maintenance activities.

Following this, the towers are dismantled on at each tower site, with a 100 tonne crane used to lower the tower to the ground for deconstruction at each tower site. At sensitive locations, such as within offsets areas, towers will be cut off above the ground surface and the tower foundations will remain in the ground. The deconstructed remains of the towers within the sensitive locations will be confined to deconstruction areas within the existing easement and

will be removed using designated access tracks, with this process being undertaken to avoid all potential vegetation disturbance outside these designated areas.

1.3.2 Operation and Maintenance

Following construction, the responsibility for operation and maintenance of the 500 kV ETL and its easement revert to TransGrid. This will mean that all maintenance of the relocated 500 kV ETL and its easement will be undertaken in accordance with the TransGrid maintenance procedures (being *Easement and Access Track Maintenance Policy* (Revision 5, 2008) and *Line Maintenance Policy* (Revision 7, 2009)). A summary of the relevant sections of these policies is provided in the Environmental Assessment for this project.

Maintenance of ETLs is essential to ensure that there are safe clearances between conductors and vegetation to eliminate the risk of lines causing bushfires. This in turn ensures the safety of the public and assists in maintaining a high level of system reliability.

The preferred method of managing vegetation within the easement is via lopping or direct removal of trees that have a mature height of over 4 metres. Such trees, where they are considered to have potential to create safety concerns for the ETL, will be cut off at stump level. All vegetation removal will occur in accordance with the requirements of the Rehabilitation and Offsets Management Plan (ROMP) (Umwelt, in prep.), particularly the pre-clearing and tree-felling procedures. In cases where stumps cannot be removed, herbicides may be used to reduce resprouting. Removed vegetation will be mulched/chipped and will be re-used on site in designated rehabilitation areas. Any habitat trees (e.g. trees with hollows) will be managed in accordance with the requirements of the Draft ROMP (Umwelt, in prep.).

Easements and designated access tracks will be maintained such that access is available to all weather four wheel drive standard, whilst being mindful of minimising impacts on the land's existing use.

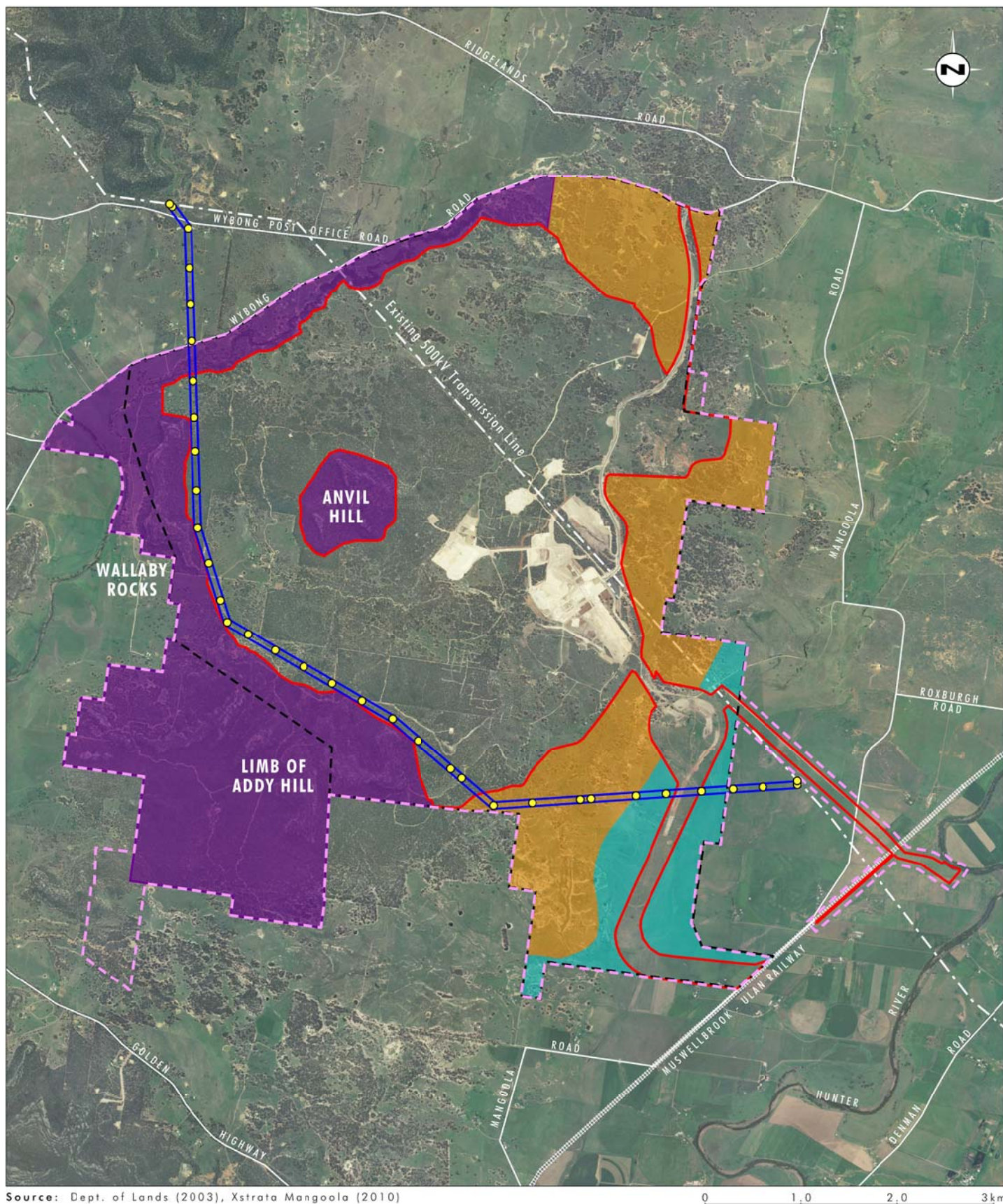
1.4 Assessment Areas

This report provides an assessment of the impacts of the proposed relocation of the 500 kV ETL on the ecological values of the Assessment Areas. For the purposes of this assessment, the Assessment Areas are defined as those parts of the proposed easement that fall outside of the existing approved project disturbance area for the mine (**Figure 1.3**). This equates to approximately 3.4 kilometres to the south of the approved project disturbance boundary (Assessment Area A) and 1.9 kilometres to the north of the approved project disturbance boundary (Assessment Area B).

Parts of the Assessment Areas fall within Biodiversity Offset Areas (**Figure 1.4**) defined by the Anvil Hill Project EA (Umwelt 2006), and these were subject to further ecological survey and assessment as part of the current project. Similarly, those parts of the Assessment Areas that were not assessed as part of the Anvil Hill Project EA (Umwelt 2006) were subject to ecological survey and assessment as part of the current project.

The approved project disturbance area and Biodiversity Offset Areas were extensively surveyed as part of the Anvil Hill Project EA (Umwelt 2006), and the information from that survey has informed this Ecological Assessment.

This Ecological Assessment considers the potential impacts arising from the construction of the 500 kV transmission easement in those areas lying outside of the approved project



Legend

- Approved Project Disturbance Boundary
- - - Mining Lease 1626 Boundary
- Project Area
- Proposed 500kV Transmission Line Easement
- Habitat Enhancement Offset Area
- Sustainable Agriculture Offset Area
- Conservation Offset Area
- Proposed Tower Location

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FIGURE 1.4

Approved Biodiversity Offset Areas

disturbance area (approximately 5 kilometres of the 11 kilometre easement), as well as the potential impacts of vegetation clearing and ongoing vegetation maintenance within the easement for maintenance purposes. Attention has been paid to the definition of permanent versus temporary impacts, in order to provide an accurate representation of the project. The potential impacts of the removal of the existing ETL have also been considered as part of this assessment. However these impacts are likely to be minor, as the works will be contained within the existing easement and will not create an increased disturbance area.

1.5 Objectives of Ecological Assessment

This Ecological Assessment has been prepared to assess the potential impact of the project on threatened flora and fauna species, endangered populations and threatened ecological communities (TECs), or their habitats, occurring within the Assessment Areas.

The objectives of the ecological assessment were to:

- document the flora and fauna assemblages of the Assessment Areas;
- document the fauna habitat types present within the Assessment Areas;
- identify any threatened species, endangered populations, TECs, or their habitats, listed under the *Threatened Species Conservation* (TSC) Act 1995 (NSW) (TSC Act), the *Environment Protection and Biodiversity Conservation* (EPBC) Act 1999 (Commonwealth) (EPBC Act) or the *Fisheries Management* (FM) Act 1994 (NSW) (FM Act);
- assess the potential impact of the project on any recorded or potentially occurring threatened species, endangered populations, TECs, or their habitats, in accordance with the requirements of the EP&A Act and the EPBC Act;
- provide management options to minimise ecological impacts associated with the Project, including modifications to the design or operation of the Project, and other on-site impact mitigation; and
- assess the requirements to offset residual ecological impact and assess the value of potential areas available for offsetting purposes.

2.0 Methods

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the ecological features of the Assessment Areas. The methods used as part of the current project built on the extensive amount of existing knowledge of the area, gained from the Ecological Assessment completed for the Anvil Hill Project EA (Umwelt 2006), as well as various ongoing post-approval projects including seasonal monitoring of flora and fauna.

Field surveys completed for the current project focussed on those parts of the proposed easement falling outside of the approved project disturbance area (**Figure 1.3**), being the areas to the north of Wybong Road, and the area to the south-east, running through the Habitat Enhancement and Sustainable Agriculture Offset Areas. The proposed designated off-easement access tracks were also subject to ecological survey.

The methods used comprised a detailed literature review as well as searches of a variety of relevant ecological databases. Information gathered from this stage was then used to design a field survey program to map and survey vegetation communities, and to identify threatened flora and fauna species, endangered populations, TECs, or their habitats across the Assessment Areas.

2.1 Literature Review

The completion of the Anvil Hill Project EA (Umwelt 2006) as well as ongoing post-approval works has provided Umwelt with extensive knowledge of the ecological issues pertaining to the Assessment Areas, and their surrounding environs. An in-depth literature review was undertaken for the Anvil Hill Project EA (Umwelt 2006), resulting in the collation of relevant information relating to significant ecological features of (or near) the Assessment Areas. The ecological information gained from that literature review has been drawn upon for this Ecological Assessment and supplemented by relevant literature which has become available since that time.

2.1.1 Ecological Database Searches

Searches of relevant ecological databases were also undertaken to identify threatened species, endangered populations and TECs recorded (or with potential to occur) within a 20 kilometre radius of the Assessment Areas. This included a search of the Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife and the Department of Environment, Water, Heritage and the Arts (DEWHA) Protected Matters Database. The results of these searches were compiled with the information gained from the literature review to provide a list of potential significant ecological features to be considered as part of this Ecological Assessment.

2.1.2 Relevant Local Literature

A number of documents were reviewed for background information and ecological information to contribute to this Ecological Assessment. Attention was paid to recent documents that focus on the ecological features of the area, and these are discussed further below.

2.1.2.1 Anvil Hill Project Ecological Assessment (Umwelt 2006)

This document was prepared to support the project application for the (then) Anvil Hill mine. A detailed field survey program was completed over two years (covering all seasons), and covering a study area of over 4000 hectares. The following significant ecological features (threatened or migratory species, populations and communities) were recorded:

- *Commersonia rosea*;
- *Diuris tricolor*;
- *Lasiopetalum longistamineum*;
- *Pomaderris queenslandica*;
- *Pomaderris reperta*;
- tiger orchid (*Cymbidium canaliculatum*) population;
- weeping myall (*Acacia pendula*) population;
- *Bothriochloa biloba*;
- Weeping Myall Woodland;
- glossy black-cockatoo (*Calyptorhynchus lathami*);
- turquoise parrot (*Neophema pulchella*);
- powerful owl (*Ninox strenua*);
- masked owl (*Tyto novaehollandiae*);
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- speckled warbler (*Chthonicola sagittata*);
- hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*);
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- diamond firetail (*Stagonopleura guttata*);
- koala (*Phascolarctos cinereus*);
- squirrel glider (*Petaurus norfolcensis*);
- brush-tailed rock-wallaby (*Petrogale penicillata*);
- eastern freetail-bat (*Mormopterus norfolkensis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- large-eared pied bat (*Chalinolobus dwyeri*);

- large-footed myotis (*Myotis adversus*);
- greater broad-nosed bat (*Scoteanax rueppellii*);
- eastern cave bat (*Vespadelus troughtoni*);
- rainbow bee-eater (*Merops ornatus*);
- white-bellied sea-eagle (*Haliaeetus leucogaster*);
- white-throated needletail (*Hirundapus caudacutus*); and
- satin flycatcher (*Myiagra cyanoleuca*).

Since the completion of this assessment, four species that were recorded as part of the Anvil Hill EA have been listed as Vulnerable under the TSC Act. These are:

- little eagle (*Hieraaetus morphnoides*);
- varied sittella (*Daphoenositta chrysoptera*);
- little lorikeet (*Glossopsitta pusilla*); and
- scarlet robin (*Petroica boodang*).

Each of these has been considered within the current Ecological Assessment.

2.1.2.2 Ecological Monitoring Reporting

Ecological monitoring at permanent monitoring points has been completed within the Project Area, with its initial baseline monitoring covering spring, summer, autumn and winter of 2007-2008 (Umwelt 2009). This monitoring has continued on a seasonal basis, and was reported on via seasonal briefing notes by Forest Fauna Surveys and Eastcoast Flora Survey (2008-9), being for:

- Spring 2008;
- Summer 2008-2009;
- Autumn 2009;
- Winter 2009; and
- Spring 2009.

From the monitoring completed by Umwelt and Forest Fauna Surveys/Eastcoast Flora Survey, the following significant ecological features have been recorded:

- Weeping Myall Woodland;
- glossy black-cockatoo (*Calyptorhynchus lathamii*);
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- speckled warbler (*Chthonicola sagittata*);

- hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*);
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- masked owl (*Tyto novaehollandiae*);
- squirrel glider (*Petaurus norfolcensis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- large-eared pied bat (*Chalinolobus dwyeri*);
- large-footed myotis (*Myotis adversus*); and
- eastern cave bat (*Vespadelus troughtoni*).

Each of these has been considered within the current Ecological Assessment.

2.1.2.3 Targeted Orchid Surveys

Targeted orchid surveys have also been completed within the approved project disturbance area (Eastcoast Flora Survey 2009a), as part of pre-clearing survey requirements. These surveys were completed during the appropriate flowering seasons to target:

- *Diuris tricolor*; and
- *Prasophyllum* sp. aff. *petilum* (undescribed) (now known as *Prasophyllum* sp. Wybong) (C. Phelps ORG 5269).

In total, 35 specimens of *Diuris tricolor* and 47 of *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) were detected in or adjacent to the target search areas, with an additional 34 and 12 specimens respectively recorded opportunistically elsewhere within the approved project disturbance area.

2.1.2.4 Targeted Orchid Surveys – Additional Biodiversity Offset Area

Targeted orchid surveys have also been completed within the Additional Biodiversity Offset Area (formerly known as the Nipol property) (Eastcoast Flora Survey 2009b) in order to investigate the status of significant orchid species in this property, as part of investigations into potential offset areas. These surveys were completed during the appropriate flowering seasons to target:

- *Diuris tricolor*;
- *Oligochaetochilus* sp. aff. *praetermissus* (Coonabarabran, undescribed); and
- *Prasophyllum* sp. aff. *petilum* (undescribed) (now known as *Prasophyllum* sp. Wybong) (C. Phelps ORG 5269).

No individuals of the target orchids were recorded, despite confirmation that these species were flowering nearby in the Mangoola Coal Project site at the time of survey. The report concluded that the Additional Biodiversity Offset Area does not support extensive areas of suitable habitat for any of the target orchid species, as these species are reported by the

author to favour derived native grassland within a narrow-leaved ironbark (*Eucalyptus crebra*) landscape. Only small areas of such habitat were recorded within the Additional Biodiversity Offset Area.

Despite the lack of significant terrestrial orchids present on the site, other significant features were recorded, being:

- Hunter Valley Footslopes Slaty Gum Woodland (Vulnerable Ecological Community);
- *Acacia homalophylla-pendula* (likely component of an Endangered Population in the Hunter); and
- *Bothriochloa biloba*.

Further details on the ecological values of this property and use of part of the area for the proposed Additional Biodiversity Offset Area, are provided in **Section 6.3.3**.

2.2 Flora Survey

The following sections document the methods employed for the flora surveys which were undertaken for the project on 13 and 14 November 2009. Additional surveys were completed for the proposed designated access tracks on 13 January 2010. A site visit was conducted on 10 June 2009 when opportunistic sightings were made. The 5 metre wide corridor for each proposed access track (as pegged by Mangoola Coal), with a total length of 2.8 kilometres, was surveyed to identify potentially occurring threatened flora species, populations and ecological communities, and significant habitat features for threatened fauna species.

The flora surveys incorporated both semi-quantitative plot-based methods, as well as non-quantitative methods such as walking transects. Flora surveys were undertaken in accordance with the DECCW Draft Threatened Species Survey and Assessment Guidelines (DEC 2004), where appropriate.

The aims of the flora field surveys were to:

- record the flora species diversity present within the Assessment Areas and access tracks;
- collect data for the identification, description and mapping of the vegetation communities present within the Assessment Areas and access tracks;
- describe the general health and condition of the vegetation of the Assessment Areas and access tracks;
- determine if any threatened flora species, endangered populations or TECs were present or have potential to occur within the Assessment Areas and access tracks; and
- gather sufficient information to enable an accurate assessment of the impacts of the project on the flora values of the Assessment Areas and access tracks.

2.2.1 Systematic Plot-based Survey

Four vegetation plots were sampled within the Assessment Areas (**Figure 2.1**). Each flora plot had dimensions of 20 metres by 20 metres (400 m²), which is a standard size used widely for systematic flora surveys throughout NSW and is recognised by the DECCW and the Royal Botanic Gardens Sydney. Within each plot, two ecologists spent approximately 45 minutes to 1 hour searching for species, walking along-side each other in parallel lines throughout the extent of the plot.

All species encountered within the plot were recorded, and a modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with modifications by Poore 1955 and Austin *et al.* 2001) was used to estimate the cover-abundances of each species (**Table 2.1**).

Table 2.1 - Modified Braun-Blanquet Crown Cover-abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Forbs, sedges and grasses: < 5 individuals Shrubs and small trees: < 5 individuals
2	Many individuals (less than 5% cover)	Forbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20% cover	N/A
4	20 – less than 50% cover	N/A
5	50 – less than 75% cover	N/A
6	75 – 100% cover	N/A

Note: * Modified Braun-Blanquet scale (Braun-Blanquet 1927; Poore 1955; Austin *et al.* 2001).

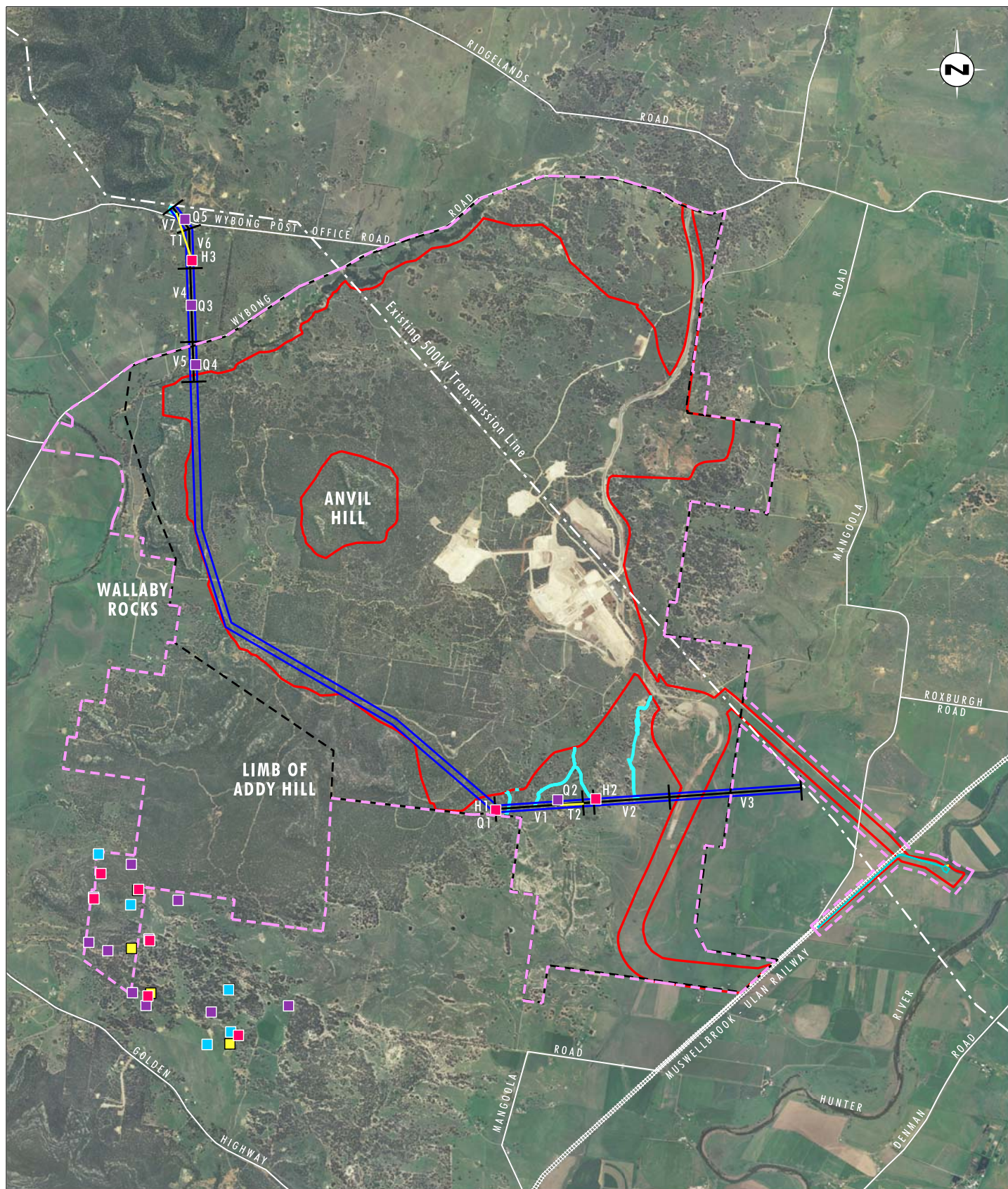
Information on the structural characteristics of the vegetation in each plot was also recorded, including the height range, canopy cover and the dominant species of each stratum. Information on the general health and condition of the vegetation within each plot was also recorded, including presence of weeds, disturbances such as fire and feral animals, and evidence of dieback or insect attack.

2.2.2 Vegetation Transects

Seven walking vegetation transects were traversed throughout the Assessment Areas, the locations of which are shown on **Figure 2.1**. This figure also identifies the combined vegetation and habitat assessment transects completed for the proposed designated access tracks. The objectives of these transects were to:

- search for threatened flora species and their habitats;
- assist in the delineation of vegetation communities, including TECs;
- enable greater coverage of the Assessment Areas than would be achieved by plot-based sampling; and
- contribute to floristic knowledge of the Assessment Areas.

The meander transects were variable in length and location, and were tailored to suit the environment in which they occurred. Their locations were selected to achieve broad coverage of the full range of environments across the Assessment Areas.



Base Source: Dept. of Lands (2003), Xstrata Mangoola (2010)

0 1.0 2.0 3 km

Legend

- Approved Project Disturbance Area
- Mining Lease 1626 Boundary
- Project Area
- Proposed 500kV Transmission Line Easment
- Existing 500kV Transmission Line
- Habitat Assessment Location

- Flora Quadrat Location
- Rapid Assessment Location
- Opportunistic Bird/Herpetological Survey
- Fauna Hair Funnel Line
- Vegetation Transect
- Vegetation and Habitat Transect

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FIGURE 2.1
Survey Effort

2.2.3 Plant Identification and Taxonomic Review

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2009), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide common names. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens, Sydney for formal identification.

2.3 Fauna Survey

As with the flora surveys, fauna surveys were concentrated in the areas outside of the approved project disturbance area. Two broad fauna survey locations were established around central hair funnel transects (**Figure 2.1**), and each area was subject to a variety of fauna survey methods. Trapping surveys were not completed for this project, as they were highly unlikely to result in the capture of species not already recorded from the local area, as part of previous surveys for the Anvil Hill Project EA (Umwelt 2006) and ongoing ecological monitoring (Forest Fauna Surveys/Eastcoast Flora Surveys 2008-2009). The aims of the fauna field surveys were to:

- record the fauna species diversity present within the Assessment Areas and access tracks;
- identify and characterise the different habitat types present within the Assessment Areas and access tracks, and determine the likely fauna assemblage present (based on extensive field-based knowledge of the assemblages of the broader area);
- determine if any threatened fauna species or endangered fauna populations are present or have potential to occur within the Assessment Areas and access tracks; and
- accrue sufficient information to enable an accurate assessment of the impacts of the project on the fauna values of the Assessment Areas and access tracks.

2.3.1 Diurnal Bird Surveys

Two diurnal bird surveys (each of one person hour) were undertaken at each of the fauna sites, on two separate days. Each survey consisted of a slow walking transect through various habitats, focusing on areas of high bird activity, where observed. Species were identified from characteristic calls and by observation, using 10 x 50 binoculars.

Opportunistic observations of bird species were also recorded during all other aspects of the field surveys.

2.3.2 Diurnal Herpetofauna Surveys

Two diurnal herpetological surveys (each of one person hour), were conducted in likely habitat areas at each of the fauna sites, on two separate days. During diurnal searches, likely micro-habitats were examined, such as under rocks, logs, tree bark, ground litter and dams. The diurnal searches were typically conducted between 11.00 am and 3.00 pm. Opportunistic observations of herpetofauna were also recorded during other aspects of the field survey.

2.3.3 Nocturnal Spotlighting

Spotlighting was conducted at the two fauna sites on foot using 30 watt Lightforce hand-held spotlights. All nocturnal fauna groups were targeted. A total of four person hours of spotlighting was completed over two nights (two person hours per fauna site). Spotlighting was undertaken generally between 9.00 pm and 12.00 am. Approximately 3 kilometres of driving spotlight survey was undertaken from a slow-moving vehicle within the Assessment Areas.

Two call playback sessions were conducted at each fauna site. At each site the recorded calls of the powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*), barking owl (*Ninox connivens*), squirrel glider (*Petaurus norfolcensis*) and koala (*Phascolarctos cinereus*) were played. Each call was played for a minimum of 4 minutes followed by a listening period of 2 minutes. Calls were broadcast using a 10 watt directional loud hailer. Mammal calls were played before bird calls to prevent the calls of predators from decreasing the likelihood of prey species responding to call playback.

2.3.4 Anabat Echolocation Detection

Micro-bat echolocation recordings were taken using an 'Anabat II Bat Detector', and 'Anabat CF Storage ZCAIM' (referred to as an 'Anabat detector').

Two all-night micro-bat echolocation recordings were undertaken at each of the fauna sites. Additional Anabat sites were established beneath (and in the vicinity of) the existing ETL. These sites were surveyed in order to gain information about micro-bat activity around the existing ETL, from which to inform the impact assessment. At each site, the Anabat detector was placed upon a small platform which was attached to a tree trunk at a height of approximately 6 metres. Each detector was positioned within likely micro-bat flyways. The Anabat detector was programmed to start recording 30 minutes before dusk and stop recording 30 minutes after dawn the following morning.

All Anabat detector recordings were analysed by Ray Williams (a recognised bat expert) of Ecotone Ecological Consultants. The echolocation calls of species were identified to one of three levels of confidence:

- confident;
- probable; and
- possible.

For the purposes of this assessment, all three levels of confidence were treated as positive identifications of species presence.

2.3.5 Hair Funnel Sampling

At each of the fauna sites, one terrestrial hair funnel transect comprising 20 large and 20 small funnels was set, along with one arboreal hair funnel transect comprising 10 large funnels. Terrestrial hair funnels were positioned amongst habitat features such as logs, fallen bark, rocks and ground cover. Arboreal hair funnels were positioned 3 to 4 metres above the ground on tree trunks or branches. Arboreal hair funnels were tilted to prevent rain entering.

The locations of these transects are shown on **Figure 2.1**. Each of the funnels was baited either with meat (chicken necks) or a bait mix of peanut butter, honey and oats. Each hair tube was then sprayed with a concentrated honey-water solution as an attractant to nectarivorous mammals.

All hair tubes were left in position for a minimum of ten nights and all hair samples were identified by Barbara Triggs (a recognised expert in this field) of Dead Finish, Victoria.

2.3.6 Habitat Assessment

Habitat assessments were undertaken at three locations within the Assessment Areas, as shown on **Figure 2.1**, as well as part of combined vegetation and habitat transects surveyed for the proposed designated access tracks. These assessments targeted the identification of potential habitat features and resources for threatened fauna species. Observations of the following habitat features were made:

- tree size class (trunk diameter);
- hollow-bearing trees and stags;
- fallen timber/logs;
- ground cover of rock outcrops;
- presence and condition of wet areas and water bodies;
- type and density of shrub and groundcover; and
- presence of faunal refugia.

In addition to these general habitat features, searches for specific habitat requirements of threatened fauna species considered to potentially occur within the locality were also made, including the presence of winter-flowering eucalypt species, which are important foraging resources for migratory species such as the regent honeyeater (*Anthochaera phrygia*) and the swift parrot (*Lathamus discolor*).

Habitat features such as tree hollows and fallen logs were observed for any evidence of fauna occupation such as scratches on the trunks of trees, chewed entrances to hollows, scratchings or diggings near logs and scats at the base of trees or near logs.

All habitat trees observed within the Assessment Areas were marked with a metal tree tag labelled with an identification number, and its location was recorded with a GPS.

Habitat features were considered when assessing the likely presence or absence of any threatened fauna species within the Assessment Areas. The known habitat requirements of each potentially occurring threatened species were compared with the habitat features recorded within the Assessment Areas.

2.3.7 Opportunistic Observations

All species observed opportunistically during other aspects of both flora and fauna surveys were also recorded, in particular opportunistic observations of threatened species.

2.3.8 State Environmental Planning Policy 44 - Koala Habitat Assessment

An application for project approval which relates to a site occurring within a Local Government Area (LGA) specified under State Environmental Planning Policy 44 (SEPP 44) – Koala Habitat Protection, affecting an area of 1 hectare or greater, must be assessed under SEPP 44. Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala (*Phascolarctos cinereus*) habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 of the policy constitute 15 per cent or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat.

The species listed in Schedule 2 of the policy are:

Scientific Name	Common Name
<i>Eucalyptus tereticornis</i>	forest red gum
<i>Eucalyptus microcorys</i>	tallowwood
<i>Eucalyptus punctata</i>	grey gum
<i>Eucalyptus viminalis</i>	ribbon or manna gum
<i>Eucalyptus camaldulensis</i>	river red gum
<i>Eucalyptus haemastoma</i>	broad-leaved scribbly gum
<i>Eucalyptus signata</i>	scribbly gum
<i>Eucalyptus albens</i>	white box
<i>Eucalyptus populnea</i>	bimble box or poplar box
<i>Eucalyptus robusta</i>	swamp mahogany

A SEPP 44 assessment was undertaken within each flora quadrat sampled within the Assessment Areas. All SEPP 44 listed canopy species were recorded, along with an estimate of the percentage of the total trees that comprise SEPP 44 species within the 400 m² plot.

3.0 Results

3.1 Flora

3.1.1 Floristics

A total of 185 flora species were recorded within the Assessment Areas, of which 129 (70 per cent) are native and 56 (30 per cent) are introduced species. A full list of the flora species recorded during surveys of the Assessment Areas is presented in **Appendix A**.

One species was from the Class Coniferopsida (conifers), 4 species were from the Class Filicopsida (ferns), and 179 from Magnoliopsida (flowering plants) (of which 43 were from sub-class Liliidae (monocots) and 136 from sub-class Magnoliidae (dicots)). Flora species were recorded from 58 plant families, the most speciose being Poaceae (24 species), Asteraceae (23 species) and Fabaceae (16 species).

3.1.2 Vegetation Communities

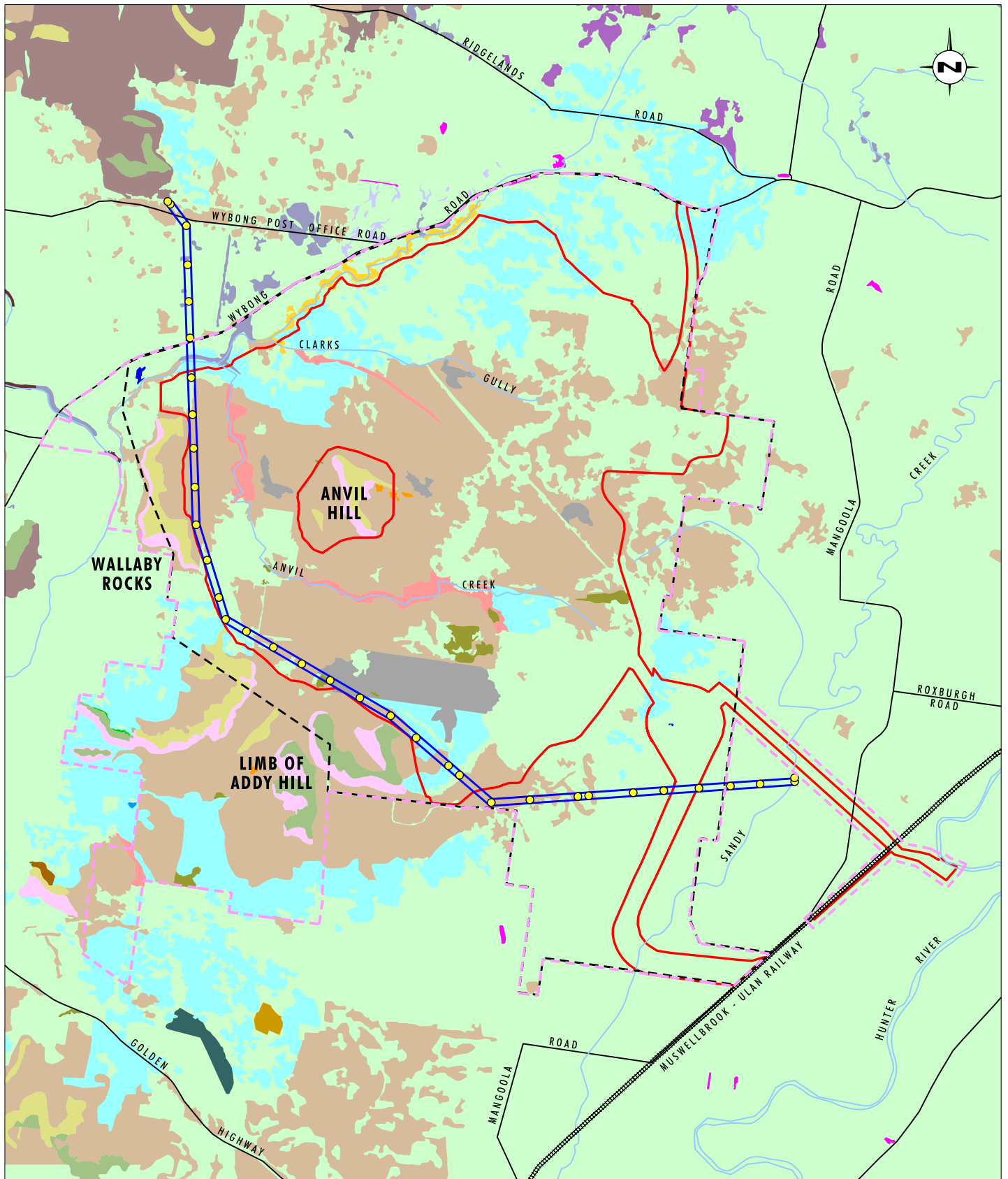
The majority of the Assessment Areas has been previously addressed in the vegetation mapping prepared for the Anvil Hill Project EA (Umwelt 2006). The field surveys undertaken for the current project resulted in update of the existing vegetation mapping, where further ground-truthing identified the need. The updated vegetation community mapping is provided in **Figure 3.1**. The primary revision to this mapping comprised the inclusion of some regenerating vegetation from the Disturbed Grassland category into the Ironbark Woodland Complex and Slaty Box Woodland vegetation communities. This has occurred in the Assessment Area A, near to towers T8, T9 and T10. No further revisions to the 2006 vegetation mapping were deemed necessary.

Four vegetation communities were mapped as occurring within the Assessment Areas (**Figure 3.1**). Each of these communities is listed in **Table 3.1**, along with their conservation significance and extent within the Assessment Areas.

Table 3.1 – Vegetation Communities Occurring within the Assessment Areas

Vegetation Community	Conservation Significance*	Amount within Assessment Areas (ha)
Ironbark Woodland Complex	Common and widespread in the local area and the central Hunter Valley. Moderate conservation significance. Consistent with an EEC under the TSC Act (Central Hunter Grey Box – Ironbark Woodland).	8.8
Slaty Box Woodland	Moderately widespread in the local area. Consistent with a VEC under the TSC Act (Hunter Valley Footslopes Slaty Gum Woodland).	1.0
Rough-barked Apple Woodland	Consistent with an EEC under the TSC Act (Hunter Floodplain Red Gum Woodland)	0.5
Disturbed Grassland	Moderate abundance in the local area. Not a naturally occurring community but still of some conservation significance due to diversity of native species.	25.7

Note: *Based on expert opinion, and drawing on Peake (2006) where equivalent vegetation communities exist.



Source: Peake (2006)

Legend

- | | | |
|---|---|---|
| Approved Project Disturbance Area | Vineyard | Disturbed/Modified Native Grassland |
| Mining Lease 1626 Boundary | Spotted Gum Open Forest | Red Ash Sheltered Forest |
| Project Area | Swamp Oak Riparian Forest | Cypress Pine Woodland |
| Proposed 500kV Transmission Line Easement | Paperbark Woodland | Slaty Box Woodland (VEC, TSC Act) |
| ● Proposed Tower Location | Tall Mixed Shrubland Complex | Ironbark Woodland Complex (EEC, TSC Act) |
| Ironbark-Wattle Low Exposed Woodland Complex | Drooping Sheoak Woodland | Weeping Myall Woodland (EEC, TSC and EPBC Acts) |
| Forest Red Gum Riparian Woodland | River Oak Riparian Forest | Rough-barked Apple Woodland (consistent with EEC, TSC Act) |
| Mixed Species Revegetation/Plantation | Exotic Rushland | |
| Coast Myall Exposed Woodland | Bullock Woodland | |
| Sheltered Grey Gum Woodland | Improved Pasture | |

File Name (A4): R11_V1/2497_079.dgn

FIGURE 3.1
Vegetation Communities

As can be seen from **Table 3.1** and **Figure 3.1**, the Disturbed Grassland community is the most widespread community within the Assessment Areas, with the Ironbark Woodland Complex being the next most common. One of these communities is consistent with a listed EEC, one with a preliminarily-listed EEC and one is consistent with a listed vulnerable ecological community (VEC).

3.1.2.1 Ironbark Woodland Complex

Several patches of Ironbark Woodland Complex occur throughout the Assessment Areas (**Figure 3.1**), with narrow-leaved ironbark (*Eucalyptus crebra*) typically forming a canopy that has 30 per cent cover and ranges between 10 and 25 metres in height. Other canopy species occurring sporadically include grey box (*Eucalyptus moluccana*), Blakelys red gum (*Eucalyptus blakelyi*) and rough-barked apple (*Angophora floribunda*).

A moderately sparse mid-stratum up to 3 metres in height is present, commonly occurring species being sticky daisy bush (*Olearia elliptica*), native olive (*Notelaea microcarpa* var. *microcarpa*), sticky hop bush (*Dodonaea viscosa*) and *Pultenaea cinerascens*.

The moderately dense groundcover is less than 0.5 metres in height, and comprise a large variety of forbs, many grasses, and a small number of sedges, ferns and twiners. The more abundant species include speargrass (*Austrostipa scabra* var. *scabra*), threeawn wiregrass (*Aristida vagans*), kidney weed (*Dichondra repens*), wallaby grass (*Austrodanthonia fulva*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), slender rats tail grass (*Sporobolus creber*), yellow burr-daisy (*Calotis lappulacea*) and common everlasting (*Chrysocephalum apiculatum*).

There is a recent final determination by the NSW Scientific Committee to list the Central Hunter Grey Box – Ironbark Woodland (which is broadly consistent with the Ironbark Woodland Complex of the Assessment Areas) as an EEC under the TSC Act.

3.1.2.2 Slaty Box Woodland

Several small patches of Slaty Box Woodland occur in the Assessment Areas (**Figure 3.1**). This community is characterised by the predominance of slaty box (*Eucalyptus dawsonii*), forming a woodland canopy of about 12-20 metres in height and 10-40 per cent cover.

Some or all of the following shrubs form a sparse low mid-stratum of up to 3 metres in height: bulloak (*Allocasuarina luehmannii*), native olive (*Notelaea microcarpa* var. *microcarpa*), shiny-leaved canthium (*Psydrax odorata*), coobah (*Acacia salicina*) and hickory wattle (*Acacia implexa*).

The groundcover is typically sparse at only 30 per cent cover, with a height of typically less than 0.4 metre. Often, large expanses of bare soil or leaf and bark litter are present, with only sparse clumps of groundcover plants. Common species include speargrass (*Austrostipa scabra* var. *scabra*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), kidney weed (*Dichondra repens*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*), threeawn wiregrass (*Aristida vagans*), blue trumpet (*Brunoniella australis*), common everlasting (*Chrysocephalum apiculatum*) and winter apple (*Eremophila debilis*). The introduced species, tiger pear (*Opuntia aurantiaca*) was also recorded.

There is a recent determination by the NSW Scientific Committee to list the Hunter Valley Footslopes Slaty Gum Woodland (which is consistent with the Slaty Box Woodland of the Assessment Areas) as a VEC under the TSC Act.

3.1.2.3 Rough-barked Apple Woodland

Rough-barked Apple Woodland occurs in a small section of the Assessment Areas, in the riparian vegetation along Big Flat Creek (**Figure 3.1**). The canopy of this community is dominated by rough-barked apple (*Angophora floribunda*) and swamp oak (*Casuarina glauca*) which occurs to 22 metres in height and has 30 per cent canopy cover.

The shrub stratum of this community is largely absent. However a very low density of native olive (*Notelaea microcarpa* var. *microcarpa*) and juvenile swamp oak (*Casuarina glauca*) was recorded in the remnant within the Assessment Areas.

The lower stratum supports a relatively low diversity of species. However it is typically dense to moderately dense. Commonly recorded species were weeping grass (*Microlaena stipoides* var. *stipoides*), kidney weed (*Dichondra repens*), poison pratia (*Pratia concolor*), climbing saltbush (*Einadia nutans* subsp. *nutans*) and sprawling bluebell (*Wahlenbergia gracilis*).

The introduced sharp rush (*Juncus acutus* subsp. *acutus*) was recorded with a cover of 20-40 per cent along the channel of Big Flat Creek within the Assessment Areas. A number of herbaceous introduced species were also recorded, such as fireweed (*Senecio madagascariensis*), scarlet pimpernel (*Anagallis arvensis*), plantain (*Plantago lanceolata*) and *Facelis retusa*.

This community forms part of MU 13 Hunter Floodplain Red Gum Woodland Complex of the Hunter Remnant Vegetation Project, which Peake (2006) indicated met the DEWHA (2006) criteria for listing as critically endangered, and it is regionally significant. This community is listed as the Hunter Floodplain Red Gum Woodland EEC under the TSC Act.

3.1.2.4 Disturbed Grassland

Disturbed Grassland is a widespread unnatural vegetation community that occurs as a result of extensive human modification of the natural woodland and open forest environments in the general locality. The structure and floristic composition of the community throughout the Assessment Areas is highly variable, being largely dependent on previous and current land use. In general, it is an open to closed grassland of 0.1-1 metre in height, dominated by a diverse range of native and introduced grasses and forbs, with fewer sedges and ferns.

The following species include the most frequent natives that are encountered: three-awned wiregrass (*Aristida vagans*), wiregrass (*Aristida ramosa*), wallaby grass (*Austrodanthonia fulva*), couch (*Cynodon dactylon*), speargrass (*Austrostipa scabra* var. *scabra*), slender rats tail grass (*Sporobolus creber*), fairy grass (*Sporobolus caroli*), common everlasting (*Chrysocephalum apiculatum*), kidney weed (*Dichondra repens*), common bog rush (*Schoenus apogon*), winter amulla (*Eremophila debilis*), climbing saltbush (*Einadia nutans* subsp. *nutans*), twining glycine (*Glycine clandestina*) and variable glycine (*Glycine tabacina*).

The following species include the most frequent introduced plants that are encountered: fireweed (*Senecio madagascariensis*), scarlet pimpernel (*Anagallis arvensis*), slender plantain (*Plantago lanceolata*), Paddys lucerne (*Sida rhombifolia*), French flax (*Linum trigynum*), soft brome (*Bromus molliformis*) and prickly pear (*Opuntia stricta* var. *stricta*).

In many areas widely spaced trees are present; the most common species are slaty box (*Eucalyptus dawsonii*), narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*Eucalyptus moluccana*) and Blakelys red gum (*Eucalyptus blakelyi*).

While the presence of this vegetation community has resulted from the clearing of forests and woodlands, it still has reasonable conservation value for native flora and fauna. Rare or threatened plants such as tricolour diuris (*Diuris tricolor*), lobed blue grass (*Bothriochloa biloba*), and tiger orchid (*Cymbidium canaliculatum*) (where remnant trees occur) can still be present where suitable conditions exist. Despite this, the vegetation community is not, in itself, of high conservation significance. The EPBC Act listed lobed blue-grass (*Bothriochloa biloba*) was recorded in the Disturbed Grassland within the Assessment Areas during current surveys, as was the TSC Act listed tricolour diuris (*Diuris tricolor*).

3.2 Fauna

A total of 96 fauna species were identified during surveys undertaken for this project and a complete list of these species is provided in **Appendix B**.

3.2.1 Birds

Fifty-eight bird species were identified as occurring within the Assessment Areas during fauna surveys. These birds included 3 species listed as vulnerable under the TSC Act, 9 species listed as migratory under the EPBC Act and 14 species listed as marine/migratory under the EPBC Act. The identified vulnerable species were the grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), speckled warbler (*Chthonicola sagittata*) and scarlet robin (*Petroica boodang*). The migratory listed bird species included the masked lapwing (*Vanellus miles*), rainbow bee-eater (*Merops ornatus*), Australian reed-warbler (*Acrocephalus australis*) and nankeen kestrel (*Falco cenchroides*). The marine listed bird species included the Australian pelican (*Pelecanus conspicillatus*), fan-tailed cuckoo (*Cacomantis flabelliformis*), dollarbird (*Eurystomus orientalis*) and welcome swallow (*Hirundo neoxena*).

Some of the most commonly identified bird species in the Assessment Areas were the silveryeye (*Zosterops lateralis*), superb fairy wren (*Malurus cyaneus*), Australian magpie (*Gymnorhina tibicen*), grey fantail (*Rhipidura albiscapa*) and noisy miner (*Manorina melanocephala*).

One introduced bird species was also identified in the Assessment Areas, being the common myna (*Sturnus tristis*).

3.2.2 Reptiles

Eight species of reptile were identified in the Assessment Areas during surveys. These were the snake-necked turtle (*Chelodina longicollis*), stone gecko (*Diplodactylus vittatus*), thick-tailed gecko (*Underwoodisaurus milii*), eastern bearded dragon (*Pogona barbata*), striped skink (*Ctenotus robustus*), *Egernia modesta*, tree-skink (*Egernia striolata*) and red-naped snake (*Furina diadema*). The most commonly identified reptile species was the tree skink (*Egernia striolata*).

None of these reptile species are classified as threatened under either the TSC Act or EPBC Act.

3.2.3 Amphibians

Eight species of amphibian were identified within the Assessment Areas. These species were the brown toadlet (*Crinia signifera*), ornate burrowing frog (*Limnodynastes ornatus*), spotted marsh frog (*Limnodynastes tasmaniensis*), wrinkled toadlet (*Uperoleia rugosa*), dwarf tree frog (*Litoria fallax*), broad-palmed frog (*Litoria latopalmata*), Perons tree frog (*Litoria*

peronii) and Tylers tree frog (*Litoria taylori*). The most commonly identified amphibian was the spotted marsh frog (*Limnodynastes tasmaniensis*).

None of these species are classified as threatened under either the TSC Act or EPBC Act.

3.2.4 Mammals

Twenty-two mammal species were identified within the Assessment Areas during surveys for this project. Some of these species included the eastern grey kangaroo (*Macropus giganteus*), common brushtail possum (*Trichosurus vulpecula*), red-necked wallaby (*Macropus rufogriseus*), Goulds wattled bat (*Chalinolobus gouldii*), inland broad-nosed bat (*Scotorepens balstoni*) and eastern broad-nosed bat (*Scotorepens orion*).

The most commonly identified mammal species was the eastern grey kangaroo (*Macropus giganteus*).

Four threatened mammal species were identified in the Assessment Areas, all of which were micro-bats: the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large-eared pied bat (*Chalinolobus dwyeri*), large-footed myotis (*Myotis adversus*) and eastern cave bat (*Vespadelus troughtoni*). The eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large-eared pied bat (*Chalinolobus dwyeri*) and eastern false pipistrelle (*Falsistrellus tasmaniensis*) were recorded from the additional Anabat survey sites positioned along the existing ETL. All of these micro-bats are listed as vulnerable under the TSC Act, with the large-eared pied bat also listed as vulnerable under the EPBC Act.

Four introduced mammal species were identified in the Assessment Areas, these were the house mouse (*Mus musculus*), dog (*Canis lupus familiaris*), fox (*Vulpes vulpes*) and cattle (*Bos taurus*).

3.2.5 Terrestrial Fauna Habitats

Three terrestrial fauna habitat formations occur within the Assessment Areas, these aligning with the mapped vegetation communities (**Figure 3.1**), and being Woodland, Riparian/floodplain and Grassland. The Assessment Areas encompass approximately 25.7 hectares of Grassland habitat, 9.8 hectares of Woodland habitat and 0.5 hectares of Riparian habitat. Of the three habitat formations, the Woodland habitats provide the highest diversity of habitat niches for fauna species. Each of the three habitat formations is reasonably widespread within the locality.

Both the Woodland and Riparian/floodplain habitats provide a number of habitat resources for fauna species. In particular, the blossoming *Eucalyptus* spp. and *Angophora floribunda* provide foraging resources for nectarivorous and insectivorous species. This would include threatened mammals such as the squirrel glider (*Petaurus norfolcensis*), and a wide diversity of micro-bat species known to occur in the area. The understorey stratum in the woodland habitat is generally sparse and therefore provides limited cover for ground and mid-storey dwelling fauna species. However, there is a moderate density of log and rock cover in some remnants, which would provide cover for small reptiles and amphibians. There are limited water resources within the Assessment Areas, aside from Big Flat Creek and scattered small farm dams, which would support common amphibian species such as the common eastern froglet (*Crinia signifera*) and the striped marsh frog (*Limnodynastes peronii*), and provide a freshwater drinking resource for a wide range of fauna species, for example macropods.

Hollow-bearing trees are a valuable fauna habitat resource within the Assessment Areas, and there are many hollow-dependent fauna species recorded within the area with potential to utilise the hollow resources in the Assessment Areas. During the fauna field survey, a

total of 22 hollow-bearing trees were identified as occurring within or in proximity to the Assessment Areas. As the Assessment Areas pass through only very small areas of woodland habitat, there are not significant numbers of hollow-bearing trees present.

3.2.6 Aquatic Fauna Habitats

The Assessment Areas traverse a section of the highly ephemeral Big Flat Creek which flows east-west into Wybong Creek. This portion of the creek supports a narrow band of riparian vegetation comprising Rough-barked Apple Woodland, while the vegetation on the flats comprises Slaty Box Woodland or Disturbed Grassland. The in-channel vegetation of Big Flat Creek is generally dominated by common reed (*Phragmites australis*), bull rush (*Typha orientalis*) and the introduced sharp rush (*Juncus acutus* subsp. *acutus*).

Big Flat Creek supports a range of habitat niches for a diversity of macroinvertebrates, however only low potential for freshwater fishes, due to its ephemeral nature and limited habitat niches. The introduced freshwater fish species, mosquito fish (*Gambusia holbrooki*), was recorded in abundance along Big Flat Creek for the Anvil Hill Project EA (Umwelt 2006).

3.3 Threatened Species, Endangered Populations and Threatened Ecological Communities

The following sections discuss legislatively protected threatened species, endangered populations and TECs that relate to the Assessment Areas.

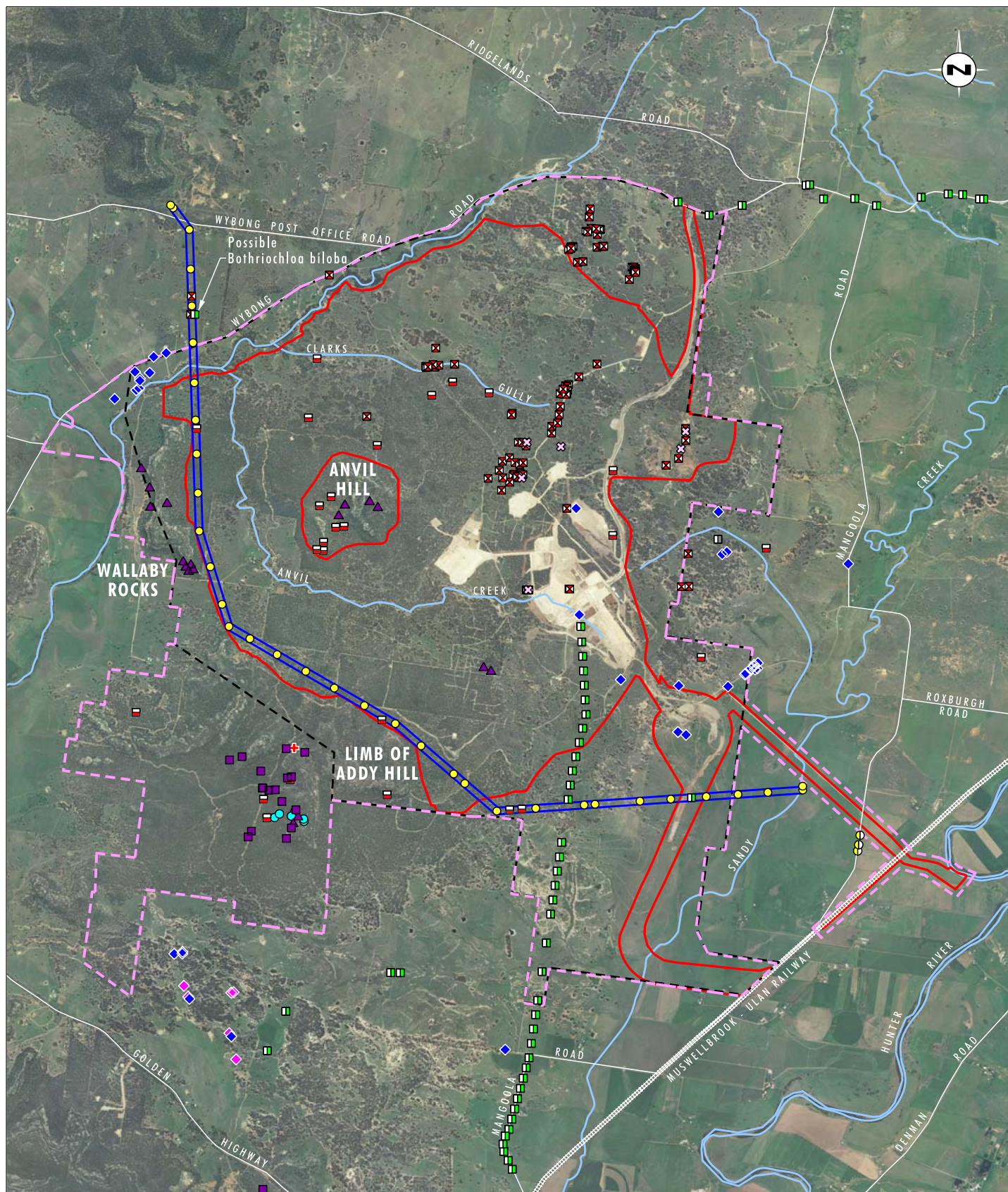
3.3.1 Threatened Flora Species

Table 1 of **Appendix C** lists threatened flora species recorded from ecological database searches within a 20 kilometre radius of the Assessment Areas, records from the Anvil Hill Project EA (Umwelt 2006), results from seasonal monitoring surveys (Eastcoast Flora Survey, 2008-09) and other relevant literature sources, and records from expert knowledge of the local area.

Two threatened flora species were recorded in the Assessment Areas, being lobed bluegrass (*Bothriochloa biloba*) and tricolour diuris (*Diuris tricolor*). More detail on the records of both species is provided below.

3.3.1.1 Lobed bluegrass (*Bothriochloa biloba*)

Lobed bluegrass (*Bothriochloa biloba*) is listed as vulnerable under the EPBC Act. It was previously listed under the TSC Act, however it has been de-listed due to an increasing abundance of records. This species has been recorded in Assessment Area A (**Figure 3.2**), as well as in the grassland habitats in the broader area (Umwelt 2006; Forest Fauna Surveys and Eastcoast Flora Survey 2008-09; Eastcoast Flora Survey 2009a). A tentative but highly probable record of this species was also found in Assessment Area B (**Figure 3.2**). This species is likely to be more widespread in the Assessment Areas than is indicated by the records shown on **Figure 3.2** as, during surveys of the Assessment Areas, many of the grasses did not have a flowering inflorescence or seed head and therefore positive identification was not possible. Based on observations of this species for previous studies, it is considered likely that the majority of grassland habitats within the Assessment Areas would support *Bothriochloa biloba* in varying densities.



Source: DECC Atlas of NSW Wildlife (2006), National Herbarium of NSW (2006), HLA Envirosciences (2003)

Base Map: Dept. of Lands (2003), Xstrata Mangoola (2010)

Legend

- | | | |
|---|--|--|
| Approved Project Disturbance Area | <i>Cymbidium canaliculatum</i> | ◆ <i>Acacia homalophylla-pendula</i> |
| Mining Lease 1626 Boundary | ✕ <i>Diuris tricolor</i> | ✕ <i>Prasophyllum</i> sp. Wybong |
| Project Area | ● <i>Eucalyptus camaldulensis</i> | ◆ <i>Acacia pendula</i> |
| — Proposed 500kV Transmission Line Easement | ● <i>Lasiopetalum longistamineum</i> | |
| ● Proposed Tower Location | ▲ <i>Pomaderris queenslandica</i> | |
| ■ <i>Bothriochloa biloba</i> | ■ <i>Pomaderris reperta</i> | |
| + <i>Commersonia rosea</i> | ■ <i>Thesium australe</i> | |

File Name (A4): R11_V1/2497_078.dgn

FIGURE 3.2

Threatened Flora Locations

3.3.1.2 Tricolour diuris (*Diuris tricolor*)

Tricolour diuris (*Diuris tricolor*) is listed as vulnerable under the TSC Act. Those records occurring in the Muswellbrook LGA (in which the Assessment Areas occur) also comprise the TSC Act listed endangered population of this species – see **Section 3.3.3**.

Two occurrences of tricolour diuris (*Diuris tricolor*) were recorded in the Assessment Areas during surveys for this project, both falling in the vicinity of Tower T29 (**Figure 3.2**). Additionally, one occurrence of tricolour diuris (*Diuris tricolor*) was previously recorded in grassland habitat approximately 1 kilometre to the east of the Assessment Areas, refer to **Figure 3.2** (Umwelt 2006). Within the approved project disturbance area, there are a number of other recorded occurrences of this species, generally falling in grassland or on the edges of open woodland. While there are only two records of this species within the Assessment Areas, the grassland habitats and some of the marginal grassy woodland habitats provide potential habitat for this species. This species has also been recorded in the Habitat Enhancement Area for the Mangoola Coal Project as shown in **Figures 1.4** and **3.2**.

3.3.2 Threatened Ecological Communities

A review of the relevant literature and schedules of the TSC Act and EPBC Act was undertaken to determine if any TECs could potentially occur within the Assessment Areas. These are listed in Table 2 of **Appendix C**. The floristic, structural and physiographic characteristics of each of the vegetation communities present within the Assessment Areas were considered for their potential to comprise any of these TECs.

One listed EEC, one preliminarily listed EEC and one listed VEC have been recorded within the Assessment Areas. Further discussion of each of these is provided in the following sections. One other TEC, the Weeping Myall Woodland EEC, was found to occur approximately 200 metres to the west of Assessment Area B (**Figure 3.2**). This EEC will not be impacted by the project.

3.3.2.1 Hunter Floodplain Red Gum Woodland

Based on the descriptions provided in the Final Determination for the Hunter Floodplain Red Gum Woodland EEC (NSW Scientific Committee 2010c), the geomorphological characteristics, combined with the structural and floristic composition, indicate strong correlations between the Rough-barked Apple Woodland community of Assessment Area B and the Hunter Floodplain Red Gum Woodland EEC.

Within the Assessment Areas, the dominant canopy species of this riparian community are rough-barked apple (*Angophora floribunda*) and swamp oak (*Casuarina glauca*), while elsewhere along Big Flat Creek forest red gum (*Eucalyptus tereticornis*) is also present. While the Hunter Floodplain Red Gum Woodland more commonly supports river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) than swamp oak (*Casuarina glauca*), the presence of the latter in the community of Assessment Area B is not a strong enough factor to rule out the correlation with the EEC. The presence of swamp oak in the riparian community of Assessment Area B is likely to be a residual element of disturbances in the catchment, including clearing and grazing and associated increased soil salinities.

3.3.2.2 Central Hunter Grey Box – Ironbark Woodland

The Ironbark Woodland Complex of the Assessment Areas is consistent with the Central Hunter Grey Box – Ironbark Forest EEC (NSW Scientific Committee 2010a). The Ironbark Woodland Complex of the Assessment Areas is dominated by narrow-leaved ironbark (*Eucalyptus crebra*) and, to a lesser extent, grey box (*Eucalyptus moluccana*), both of which

are characteristic species of the EEC. The understorey structure and composition of both the Ironbark Woodland Complex and the EEC also show strong similarities.

3.3.2.3 Hunter Valley Footslopes Slaty Gum Woodland

The Slaty Box Woodland of the Assessment Areas is consistent with the listed Hunter Valley Footslopes Slaty Gum Woodland VEC. The communities show strong correlations in both floristic and structural composition, as well as geomorphological characteristics.

This community has been listed under the Vulnerable category, as its geographic distribution is estimated or inferred to be moderately restricted, and the nature of its distribution makes it likely that the action of a threatening process could cause it to decline or degrade in extent or ecological function over a time span appropriate to the life cycle and habitat characteristics of the ecological community's component species (NSW Scientific Committee 2010b).

Despite this recent listing, this community is not required to be included in the impact assessment under the EP&A Act. However, the impact on this community has been considered in the development of an offset strategy for the project, due to the provision of habitat for threatened species that this community provides.

3.3.3 Endangered Populations

Table 3 of **Appendix C** lists the endangered populations listed under the TSC Act which have potential to occur within the Assessment Areas. Of these, two were recorded as part of surveys for this project. Two examples of the tiger orchid (*Cymbidium canaliculatum*) were recorded in Assessment Area A, in the vicinity of Towers T9 and T10. Two individuals of tricolour diuris (*Diuris tricolor*) were recorded in Assessment Area B. The locations of each of these are shown on **Figure 3.2**.

There are three endangered populations which were recorded in the vicinity of the Assessment Areas (Umwelt 2006), being the populations of:

- weeping myall (*Acacia pendula*) in the Hunter Catchment;
- tricolour diuris (*Diuris tricolor*) in the Muswellbrook LGA; and
- tiger orchid (*Cymbidium canaliculatum*) in the Hunter Catchment.

One stand of weeping myall (*Acacia pendula*) occurs to the immediate west of Assessment Area B (**Figure 3.2**), extending from Big Flat Creek to Wybong Road. This stand of *Acacia pendula* comprises the endangered population and the listed EEC. This stand will not be disturbed for the project. Another stand of *Acacia pendula* occurs approximately 1 kilometre north of Assessment Area A and similarly will not be disturbed for the project.

The tiger orchid (*Cymbidium canaliculatum*) has been recorded on a number of occasions as part of the Anvil Hill Project EA (Umwelt 2006), as well as part of ongoing monitoring (Forest Fauna Surveys and Eastcoast Flora Survey 2008/9) and ongoing pre-clearing surveys. The Draft ROMP (Umwelt, in prep.) discusses the development of a translocation program for this species, where it is identified from trees that require clearing from the approved project disturbance area. The ecology of this species makes it amenable to such a program, and if successful will assist in greatly minimising impact on this endangered population.

The tricolour diuris (*Diuris tricolor*) was recorded in Assessment Area B, near Tower T29. Refer to **Section 3.3.1** above for further discussion on this species.

3.3.4 Threatened Fauna Species

Table 4 of **Appendix C** lists threatened fauna species recorded from ecological database searches within a 20 kilometre radius of the Assessment Areas, records from the Anvil Hill Project EA (Umwelt 2006), seasonal monitoring for the Mangoola Coal Project (Forest Fauna Surveys and Eastcoast Flora Survey, 2008-9), other relevant literature and records added from expert knowledge of the local area. From this list, a number of threatened fauna species were found to have potential to occur within the Assessment Areas. **Figure 3.3** shows the locations of those threatened fauna species recorded within the Assessment Areas during current surveys and wider locality as part of other local surveys.

Four threatened micro-bat species were recorded in the Assessment Areas during current surveys, being the large-eared pied-bat (*Chalinolobus dwyeri*), large-footed myotis (*Myotis adversus*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and the eastern cave bat (*Vespadelus troughtoni*). All these species were detected via Anabat recorder in both Assessment Areas A and B. Additionally, the eastern false pipistrelle (*Falsistrellus tasmaniensis*), large-eared pied-bat (*Chalinolobus dwyeri*) and eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) were recorded from the additional Anabat survey sites underneath the existing ETL. The locations of these recorded threatened micro-bat species are shown on **Figure 3.3**.

There were also three threatened bird species recorded, being the speckled warbler (*Chthonicola sagittata*), grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) and scarlet robin (*Petroica boodang*) (**Figure 3.3**).

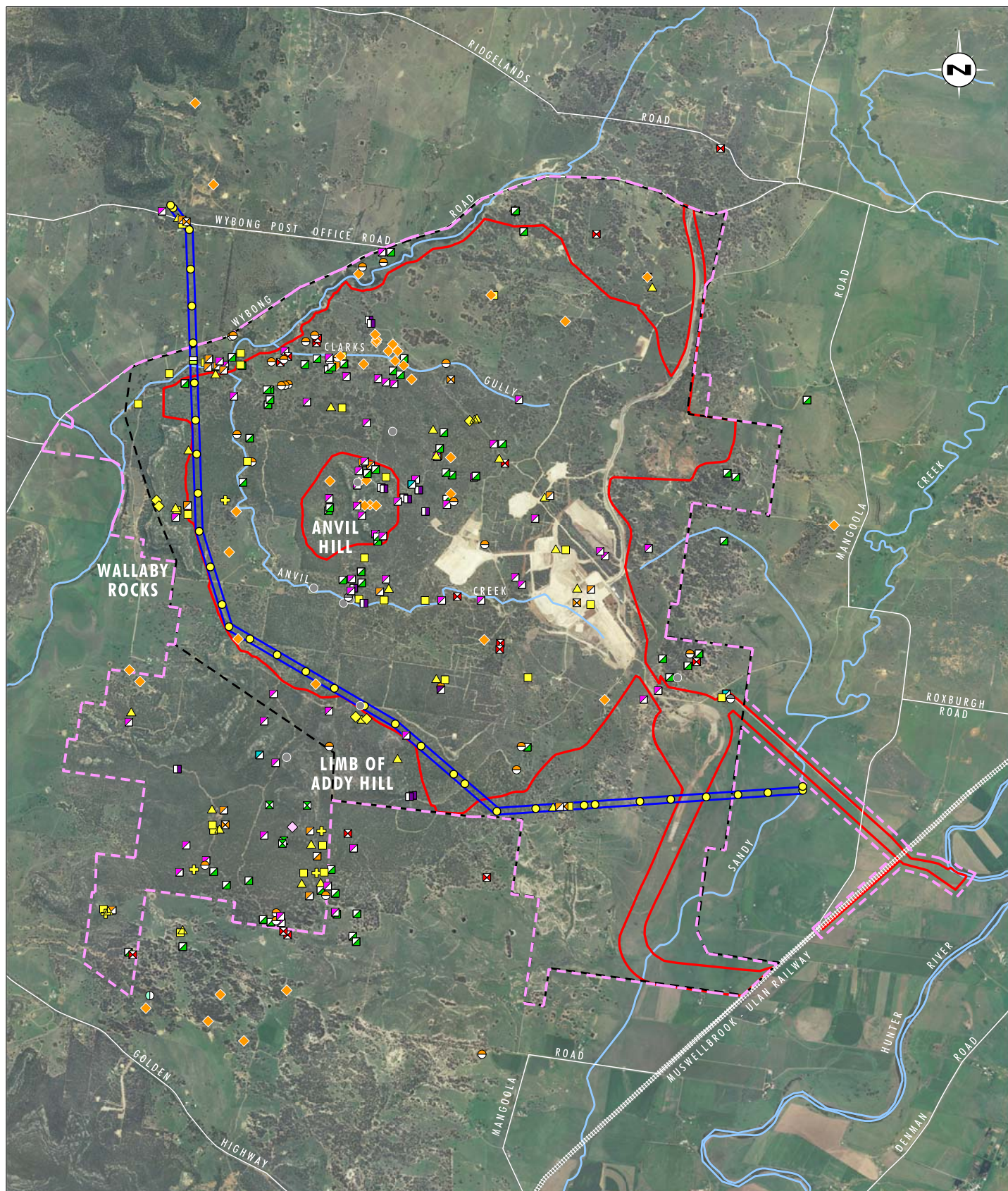
There are a number of other threatened fauna species that were found to have potential to occur within the Assessment Areas based on known distribution and habitat requirements, many of which were recorded for the Anvil Hill Project EA (Umwelt 2006). Potentially occurring threatened fauna species are indicated in Table 4 of **Appendix C**.

3.3.5 EPBC Act Listed Migratory Species

A search of the DEWHA Protected Matters Database was undertaken in order to identify EPBC Act listed threatened, migratory or listed marine species which could potentially occur within a 20 kilometre radius of the centre of the Assessment Areas (based on DEWHA habitat modelling). Table 5 of **Appendix C** lists those species from the database search, as well as records added from the literature review and professional opinion of potential to occur.

3.3.6 SEPP 44 (Koala Habitat) Assessment Results

No SEPP 44 listed koala feed trees were recorded within the Assessment Areas, and no individual koalas (*Phascolarctos cinereus*), or secondary evidence such as scats or tree scratches, were observed during surveys of the Assessment Areas. There are, however records of koala scats from the Anvil Hill Project EA (Umwelt 2006) to the south-west of the Assessment Areas near Limb of Addy Hill (**Figure 3.3**). There is no further evidence to suggest that there is a resident population in the local area, despite ongoing fauna surveys in the Mangoola Coal Project land holdings.



Source: Birds Australia (2006), DECC Atlas of NSW Wildlife (2006), HCRMA (1999),

HLA Envirosciences (2003), Australian Museum (2006)

Base Source: Dept. of Lands (2003), Xstrata Mangoola (2010)

0 1.0 2.0 3km

Legend

Approved Project Disturbance Area

Mining Lease 1626 Boundary

Project Area

Proposed 500kV Transmission Line Easement

Proposed Tower Location

Brush-tailed Rock-wallaby

Diamond Firetail

Eastern Bentwing-bat

Eastern Cave Bat

Eastern False Pipistrelle

Eastern Freetail-bat

Glossy Black-Cockatoo

Greater Broad-nosed Bat

Grey-crowned Babbler

Hooded Robin

Koala

Large-eared Pied Bat

Large-footed Myotis

Masked Owl

Powerful Owl

Speckled Warbler

Squirrel Glider

Turquoise Parrot

Little Lorikeet

Scarlet Robin

Brown Treecreeper

FIGURE 3.3

Threatened
Fauna Locations

4.0 Impact Assessment

A number of threatened flora and fauna species, populations and TECs were recorded or have potential to occur within the Assessment Areas, and these may be impacted by the proposed relocation of the 500 kV ETL. The following impact assessment addresses those direct and indirect impacts that may result on significant ecological features of the Assessment Areas. Direct impacts, in this case, relate to the removal of vegetation and habitat for construction purposes, as well as for ongoing maintenance requirements. Indirect impacts include issues such as fragmentation, potential increases in edge effects, as well as potential weed invasion and increased exposure to predators.

In defining the impact of this project, attention has been paid to the distinction between permanent impacts and temporary impacts. In this case, any clearing or disturbance required to woodland areas is considered to be a permanent impact, and this impact has been addressed within the Biodiversity Offset Strategy.

The approach to impact definition within the grasslands however, has been divided into permanent and temporary impacts. The towers to be constructed within the grasslands have been assessed as comprising a permanent impact, and are addressed within the Biodiversity Offset Strategy. Access tracks within the grasslands have also been defined as a permanent impact. Construction-based disturbance to the grasslands (such as vehicle access and storage areas for construction equipment) have been considered to be temporary impacts only, as this disturbance will abate after construction of the ETL. These temporary impacts are not likely to cause substantial impact to the grasslands, and as such are not included within the Biodiversity Offset Strategy. These temporary impacts are, however, considered in the impact assessment below.

4.1 Construction and Maintenance Impacts

The project involves the construction of a 500 kV ETL within a defined easement that covers an 11 kilometre length, and is 70 metres wide. The majority of direct ecological impacts will occur within this easement, with the exception of the five designated off-easement access tracks. These access tracks have been defined as part of the project, and are assessed accordingly, as they occur within the Biodiversity Offset Areas.

Table 4.1 provides a summary of the impacts considered as part of this assessment. These impacts have been defined on the basis of whether they will be permanent (such as vegetation clearing) or temporary (construction-based disturbance only).

Table 4.1 – Construction Impacts of Proposed ETL Relocation Project

	Vegetation Formation	Vegetation Community	Impact Type	Impact Area (ha)
Permanent Impacts	Grassland	Disturbed Grassland	Construction	4.6
	Woodland	Ironbark Woodland Complex	Construction	3.7
	Woodland	Ironbark Woodland Complex	Maintenance	5.1
	Woodland	Slaty Box Woodland	Maintenance	1.0
	Woodland	Rough-barked Apple Woodland	Maintenance	0.5
Total				14.9
Temporary Impacts	Grassland	Disturbed Grassland	Construction	4.6
Total				4.6

From the above, it can be seen that a permanent impact will occur on a total of 14.9 hectares of vegetation (comprising 10.3 hectares of woodland and 4.6 hectares of grassland). This value includes a total of 6.6 hectares of vegetation that lies underneath the ETL, and will be subject to ongoing maintenance works. These works are required as part of the *TransGrid Easement and Access Track Maintenance Policy* (Revision 5, 2008) and *Line Maintenance Policy* (Revision 7, 2009).

The preferred method of vegetation maintenance within the easement is via lopping or direct removal of trees that have a mature height of over 4 metres. Such trees will be cut off at stump level where they are considered to have potential to create safety concerns for the ETL. All vegetation removal will occur in accordance to the requirements of the Draft Rehabilitation and Offsets Management Plan (ROMP) (Umwelt, in prep.), particularly the pre-clearing and tree-felling procedures. In cases where stumps cannot be removed, herbicides may be used to reduce re-sprouting. Removed vegetation will be mulched/chipped and will be re-used on site in designated rehabilitation areas. Any habitat trees (e.g. trees with hollows) will be managed in accordance with the requirements of the Draft ROMP (Umwelt, in prep.).

As it is not possible to accurately quantify this vegetation impact for maintenance purposes, it is assumed that all woodland/forest vegetation occurring within the Assessment Areas will be subject to this maintenance. It is assumed that the removal of vegetation with the potential to reach a height of 4 metres (being mainly trees and very tall shrubs) will alter the composition of the woodland vegetation within the ETL easement. As such, the Biodiversity Offset Strategy takes into account these impacts over 6.6 hectares of woodland vegetation.

Due to the sensitivity of the EEC along Big Flat Creek, the towers will be spaced to span this area and minimise the need to clear vegetation for tower construction. Also in this area, cables will be strung from each end (i.e. completed aerially), so that there will be no need for heavy equipment to enter this area during the stringing process. The draw wire will be walked through this section of the line to minimise ground disturbance. The draw wire will be pulled by a 4WD vehicle through the remainder of the easement, but the vehicle will follow the access tracks already established within the easement area for construction purposes. Therefore, it is expected that in all spans there will be minimal disturbance from stringing activities.

It is not likely that vegetation maintenance will be required within the majority of the Disturbed Grassland areas. However some scattered remnant trees may again need to be lopped or felled if growing to over 4 metres at mature height.

Designated access tracks will be maintained such that access is available to all weather four wheel drive standard, whilst being mindful of minimising impacts on the land's existing use.

4.2 Decommissioning Impacts for existing ETL

The decommissioning of the existing ETL is likely to be negligible in terms of ecological impact, as all activities will occur either within the approved project disturbance boundary, or within the existing ETL along its 9 kilometre easement. For the remaining eleven towers located outside of the approved project disturbance boundary and the towers located in the Biodiversity Offset Areas (across Big Flat Creek in the Conservation Offset Area, and within the Habitat Enhancement and Sustainable Agriculture Offset Areas), any decommissioning activities will be assessed via a due diligence process, and all decommissioning activities will be confined to these designated areas. Any removal of, or impact to, vegetation (including grasslands) required for the decommissioning process will require inspection and assessment via a due diligence process and will also be required to follow all clearing-related

procedures in the Draft ROMP (Umwelt, in prep.). Such due diligence works will need to consider seasonality issues, particularly in relation to spring-flowering terrestrial orchids.

At sensitive locations (such as within offset areas), towers will be cut off above the ground surface and the tower foundations will remain in the ground. The remains of the towers within these locations will be confined to designated deconstruction areas and will be removed using designated access tracks, with this process being undertaken to avoid all potential vegetation disturbance outside these designated areas.

4.3 Impacts on Flora Species

A total of 129 native flora species were recorded within the Assessment Areas, and individuals of these may be removed in the short term as a result of the construction of the ETL. The majority of the flora diversity of the Assessment Areas is represented in the ground stratum and therefore the majority of flora species would not be impacted by the ongoing maintenance activities, which will mainly require the lopping of larger trees. Only a small proportion of species occur at sufficient height to be impacted by these lopping activities, and those species that are tall enough are known to be well represented in the vegetation of the local area.

It is not likely that there will be a significant loss of floristic diversity as a result of the project.

4.4 Impacts on Vegetation Communities

The following four vegetation communities occur within the Assessment Areas:

- Ironbark Woodland Complex (8.8 hectares);
- Slaty Box Woodland (1.0 hectares);
- Rough-barked Apple Woodland (0.5 hectares); and
- Disturbed Grassland (25.7 hectares).

Of the approximately 14.9 hectares of vegetation to be removed as part of the project, 31 per cent comprises the Disturbed Grassland, where substantial clearing and existing disturbances have already reduced the biodiversity value of this community. The remaining 69 per cent of vegetation to be removed is higher quality woodland vegetation comprising three communities, each of which has legislative significance.

Given the general lack of canopy and understorey strata, the Disturbed Grassland community is unlikely to be substantially disturbed by either initial construction works or ongoing maintenance works. While this community is known to contain habitat for a number of threatened species (with *Diuris tricolor* and *Bothriochloa biloba* both being recorded from this community), the majority of these threatened species are small herbs or grasses which are not likely to be impacted by ongoing maintenance works.

The Disturbed Grassland within the Assessment Areas is not likely to be of high conservation significance in its own right, and as such, the project is not likely to result in a significant reduction in the amount or quality of Disturbed Grassland in a local or regional context.

Approximately 8.8 hectares of Ironbark Woodland Complex and 1.0 hectare of the Slaty Box Woodland will be impacted as a result of the construction and maintenance of the ETL. Both

of these communities are of conservation significance, as they are both consistent with listed TECs. These are discussed further in **Section 4.8**.

Approximately 0.5 hectares of the Rough-barked Apple Woodland will be impacted as a result of the construction and maintenance of the ETL. This community is consistent with the Hunter Floodplain Red Gum Woodland EEC. This is discussed further in **Section 4.8**.

4.5 Impacts on Fauna Species and Habitats

The fauna habitat values of the Assessment Areas are relatively limited, as a result of the highly modified and fragmented nature of the vegetation. Despite this, the Assessment Areas support foraging and nesting resources for a wide range of fauna species, particularly within natural woodland remnants where they adjoin open grassland areas.

The relocation of the 500 kV ETL will result in the permanent disturbance to approximately 10.3 hectares of woodland habitat and 4.6 hectares of grassland, the latter being a highly modified community. A further 4.6 hectares of grassland will be disturbed, however this will be on a temporary basis only as a result of construction activities.

Both the grassland and the woodland habitats have potential to be utilised by a number of fauna species including threatened fauna, however the grassland within the Assessment Areas provides a much lower value habitat. While there is potential habitat for a range of fauna species, it is not expected that the Assessment Areas support habitats that would be essential to the survival of any fauna species within the local area. Fauna species utilising the habitats of the Assessment Areas would be doing so as part of a wider habitat range, and would not rely specifically or solely on the habitats of the Assessment Areas for survival.

The project is likely to require the removal of hollow-bearing trees where they occur at the proposed tower locations, and in parts along the easement. A total of 22 hollow-bearing trees were recorded during surveys of the Assessment Areas, either in the easement, or nearby. It is possible that some of these trees may be able to be retained within the easement, where access tracks may be able to be moved to avoid them, however this will be determined on a case-by-case basis, depending on the location, size and value of each tree.

The loss of hollow-bearing trees has the potential to impact on hollow-dependent fauna species, particularly threatened species. Despite this, the majority of such species are highly mobile (such as large birds and micro-bats), and the surrounding woodland habitats are likely to contain similar densities of hollow-bearing trees as those within the Assessment Areas.

Despite the loss of fauna habitat and of hollow-bearing trees from the Assessment Areas, there are abundant comparable resources adjoining the Assessment Areas, particularly to the north where the proposed easement is contiguous with Crown land, and where the proposed easement is contiguous with the adjacent Biodiversity Offset Areas for the Mangoola Coal Project.

It is not likely that the project will result in the loss of a significant amount of fauna habitat in the local area.

4.6 Impacts on Threatened Flora Species

Two threatened flora species were recorded in the Assessment Areas, being lobed bluegrass (*Bothriochloa biloba*) and tricolour diuris (*Diuris tricolor*). Lobed bluegrass (*Bothriochloa biloba*) has been found to be moderately widespread within the Assessment Areas and grassland habitats of the Mangoola Coal Project area and surrounding areas. Tricolour diuris (*Diuris tricolor*) has been recorded in Assessment Area B to the north of Wybong Road, in the Derived Grassland habitats. This species has potential to occur elsewhere in the Assessment Areas in other grassland or very open woodland habitats. The species has also been recorded in the Mangoola Coal Project site and surrounding areas.

In addition to these two species, *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) has the potential to occur within the habitats of the Assessment Areas. This recently-described orchid species is listed as critically endangered under the EPBC Act. However it is not listed under the TSC Act. This species has been recorded from the approved project disturbance area, in similar habitats to tricolour diuris (*Diuris tricolor*). Ecological surveys of the Assessment Areas targeted these two species during their appropriate flowering period. However, only tricolour diuris (*Diuris tricolor*) was recorded. Despite this, there is potential that *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) could occur in the Assessment Areas.

As all of these species are low-growing (both <1 metre in height), it is unlikely that they would be impacted by ongoing maintenance works within the easement, and therefore potential habitats for these species will not be significantly reduced as part of the maintenance works required for the ETL. However, the permanent impacts from the construction of the ETL will remove habitat for these species. It is likely this will result in the loss of individuals of lobed bluegrass (*Bothriochloa biloba*), and it is also likely that the two recorded individuals of tricolour diuris (*Diuris tricolor*) in the vicinity of Tower 29 will be impacted as a result of construction activities.

The cryptic nature of this species is likely to reduce the potential to avoid the records during construction, however if works occur while the species is dormant (and underground) there is the potential that impact may be minimal if significant ground disturbance is avoided. Despite this potential, the impact assessment will assume this species will be impacted, and an assessment of significance has been prepared for each of these species (see **Appendix D**). An assessment in accordance with the requirements of the EPBC Act has also been undertaken for these species, and is provided in **Appendix E**.

There are no other threatened flora species that are considered to have a reasonable potential to be impacted by the project (**Appendix C**).

The outcomes of both levels of assessment have found that the project is not likely to comprise a significant impact on any occurring or potentially occurring threatened flora species.

4.7 Impacts on Endangered Flora Populations

Two species comprising endangered flora populations were recorded in the Assessment Areas, being tricolour diuris (*Diuris tricolor*) and tiger orchid (*Cymbidium canaliculatum*). An assessment of significance has been completed to assess the impacts of the project on the Muswellbrook LGA population of *Diuris tricolor* (**Appendix D**). This assessment concluded that the project would not result in a significant impact on the endangered population of tricolour diuris (*Diuris tricolor*), despite likely impacts on the two records known from Assessment Area B.

4.8 Impacts on Threatened Ecological Communities

Approximately 0.5 hectares of Hunter Floodplain Red Gum Woodland (EEC) has been recorded (as Rough-barked Apple Open Woodland) along the riparian zone of Big Flat Creek in Assessment Area B, crossing the Biodiversity Offset Area. Upon confirmation of the ecological sensitivity of this riparian area, the proposed tower locations were revised to ensure that the lines span this vegetation, and it was confirmed that stringing would be completed aurally, ensuring that there will be no need for heavy equipment to enter (and potentially damage) this vegetation during the stringing process. In addition, the draw wire will be walked through this area to minimise ground disturbance.

As a result of these modifications, potential construction impacts on this EEC have been minimised to those associated with vegetation maintenance only. Maintenance activities will require the removal of trees with a mature height of 4 metres within this community. This will result in impact on this EEC, however it is not likely that required tree removal will be extensive. The actual amount of trees that will need to be removed for maintenance requirements cannot be quantified until after construction, and as such this assessment assumes this community will be impacted, and an assessment of significance has been prepared accordingly (see **Appendix D**).

The Ironbark Woodland Complex recorded in the Assessment Areas corresponds with the listed EEC, Central Hunter Grey Box – Ironbark Woodland, while the Slaty Box Woodland corresponds with the listed VEC, Hunter Valley Foothills Slaty Gum Woodland. Approximately 8.8 hectares and 1.0 hectare of these communities (respectively) will be impacted as a result of the project. This impact will arise from clearing for the construction of towers in the easement, access requirements and for lopping for maintenance purposes. The actual amount of trees that will need to be removed for maintenance requirements cannot be quantified until after construction, and as such this assessment assumes this community will be impacted, and an assessment of significance has been prepared accordingly (see **Appendix D**). Such an assessment under the EP&A Act is not required for the Hunter Valley Foothills Slaty Gum Woodland VEC.

The extent of impact on the Central Hunter Grey Box – Ironbark Woodland EEC does not constitute a significant loss of this community at either a local or regional scale.

4.9 Impacts on Threatened Fauna Species

Four threatened micro-bats and three threatened bird species have been recorded in the Assessment Areas as part of the current project. In addition to this, a number of other threatened fauna species have been recorded in the Assessment Areas as part of the Anvil Hill Project EA (Umwelt 2006), and ongoing ecological monitoring completed by Umwelt (2007-2008) and Forest Fauna Surveys/Eastcoast Flora Survey (2008-2009). A number of other threatened species also have the potential to occur within the habitats of the Assessment Areas. These have been considered in **Appendix C**.

The impacts on fauna species from the project are likely to arise from the removal of vegetation, particularly hollow-bearing trees. Given the high degree of existing vegetation fragmentation within the Assessment Areas, it is not likely that this removal of small amounts of vegetation will result in further fragmentation impacts on threatened fauna species. It is likely that the low-growing vegetation that is able to be retained within the easement will maintain some of the existing vegetated connectivity, and it is likely that such low-lying vegetation could be utilised for dispersal by faunal groups such as smaller birds (e.g. robins and finches), small mammals (such as antechinus and possibly gliders), reptiles and amphibians.

It is likely that many of the threatened bird and micro-bat species recorded in the Assessment Areas (and surrounding area) will not be impacted by this relatively minor increase in fragmentation, due to their high degrees of mobility.

A higher degree of impact is likely to come from the loss of hollow-bearing trees within the Assessment Areas. Twenty two of these were recorded in, or close to, the Assessment Areas during the current surveys. It is not likely that all of these would require removal, as their retention may be able to be prioritised if they do not pose a safety concern for the ETL. Similarly, access tracks throughout the easement may be able to be moved to retain such trees. However, the tower locations have been determined after a constraints analysis which aimed to avoid impacts on ecological features and Aboriginal heritage items. Hence, their location is not as flexible, and some hollow-bearing trees may require removal if they occur in these areas.

The potential impacts of the loss of such trees come from the loss of roosting/nesting resources, as well as direct injury or death of fauna from (or as a result of) the felling process. To address these impacts, an appropriately designed and maintained nest box program will be enacted to compensate for the loss of hollow resources. Such programs can be effective, provided that boxes of suitable and varied design and sizes are provided, and that they are regularly maintained, replaced if faulty and monitored for feral species.

To minimise direct injury or death from the felling process, a detailed pre-clearing survey procedure will be enacted, as will a tree-felling procedure aimed at minimising potential harm, as much as possible. Both approaches will be adopted to address this impact on threatened fauna species, and these are discussed in further detail in **Section 5.0** of this report.

In addition to this, there is the potential that flying mammal species (in particular, but also potentially bird species) could become entangled within the barbed wire that is used to prevent unauthorised human access to the towers. Entanglement in barbed wire is a recognised threat to numerous native species, including the threatened squirrel glider (*Petaurus norfolcensis*), which has been recorded from the Anvil Hill Project EA (Umwelt 2006). This threat is recognised by DECCW, whereby:

Individuals can get caught in barbed wire fences while gliding (DECCW 2010)

Other species, such as flying-foxes and micro-bats are also known to be impacted by entanglement on barbed wire.

It is likely that barbed wire will be installed on each of the towers for the ETL in order to prevent unauthorised human access. While this is a necessary safety precaution, it is known that other methods can be employed to address this safety requirement without the use of barbed wire. Powerlink in Queensland, for example, has installed fauna-friendly anti-climbing devices on over 300 transmission structures, whereby existing brackets from traditional barbed wire anti-climbing devices are used, and barbed wire strands are replaced with plain wire strands and 100 millimetre x 100 millimetre weld mesh panelling. This has been shown to be effective in reducing entanglement, while providing appropriate safety measures for the ETL.

If adopted, it is likely that methods such as the above would serve to reduce this threat to native fauna species from the ETL, without compromising the safety of the ETL or incurring excessive cost.

An assessment of significance has been completed for the following potentially occurring threatened fauna species, and is provided in **Appendix D**:

- glossy black-cockatoo (*Calyptorhynchus lathami*);
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- scarlet robin (*Petroica boodang*);
- speckled warbler (*Chthonicola sagittata*);
- turquoise parrot (*Neophema pulchella*);
- little lorikeet (*Glossopsitta pusilla*);
- masked owl (*Tyto novaehollandiae*);
- powerful owl (*Ninox strenua*);
- squirrel glider (*Petaurus norfolcensis*);
- eastern freetail-bat (*Mormopterus norfolkensis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- large-footed myotis (*Myotis adversus*);
- eastern cave bat (*Vespadelus troughtoni*);
- large-eared pied bat (*Chalinolobus dwyeri*); and
- greater broad-nosed bat (*Scoteanax rueppellii*).

The assessment of significance (**Appendix D**) has concluded that (in considering the mitigation measures discussed in **Section 5.0**) the project is not likely to result in a significant impact on threatened fauna species within the Assessment Areas.

4.10 Impacts from Electric and Magnetic Fields

One possible indirect impact from the proposed project is the potential for the electric and magnetic fields (EMF) emitted by ETLs to impact on fauna species, particularly micro-bats. The issue of potential impacts on humans has been addressed as part of the Environmental Assessment for this project, and the information provided in that section also includes further background and detail on the issue of EMFs and their potential impacts. The impact of EMF on the bat species would apply along the length of the relocated ETL, not just in the Assessment Areas.

Very little scientific research has been conducted by the scientific community to investigate the potential impacts of EMFs on fauna species. A small number of scientific references have been identified as part of the literature review for this project. However these have not provided any relevant comparisons to assist in the assessment of potential impacts in the current situation (see relevant section in the Environmental Assessment).

From the limited available literature, it is surmised that EMFs broadly have the potential to impact on micro-bats in two main ways:

- by interfering with their echolocation calls, thus causing disorientation, reducing navigation ability/accuracy or by causing an area of habitat subject to EMFs to become unusable for these species; and
- by potential penetration of EMFs into roosts for cave-dependent species, and potentially causing disturbance to normal roosting patterns.

In order to investigate these potential impacts, Umwelt consulted a number of recognised micro-bat experts, who agreed that there is very little in the scientific literature that relates to this, or similar issues. One broadly comparable project has been identified, whereby one of the consulted micro-bat specialists was commissioned to:

provide an independent assessment of the use of geophysical survey equipment that emits electromagnetic radiation, and whether they would have any impact upon cave-dwelling bats... (Greg Richards and Associates 2005).

Although the type of radiation emitted by the equipment in question is not the same as those relevant to this project, the approach used in this investigation is considered relevant, viz the frequency range of the machinery in question was compared to the frequency range that various micro-bat species are known to use for their echolocation calls. This approach is considered valid in this circumstance, and an assessment of the frequency of the relevant micro-bat species was undertaken with respect to the ETL. In this regard, it has been assessed that the proposed ETL at Mangoola will operate relatively constantly around the 50 Hz mark (Paul Flanagan, electrical engineer, Aurecon, pers. comm.).

The Richards report focused on potential impacts on a number of threatened species, with the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large-footed myotis (*Myotis adversus*) and large-eared pied-bat (*Chalinolobus dwyeri*) being common to both that report and the Ecological Assessment for this project. All of these species are known to roost in caves and all have been recorded within the Mangoola Coal Project area. The report concludes that:

Because none of these species have echolocation calls that are within the frequency range of the instruments, it was assumed that there would be no disruption to their echolocation calls reception...

Because the caverns are deep (10 to 90 m), it was considered that the low power transmitted signal would be significantly attenuated as it progressed through the limestone bedrock and into cave chambers. Hence, it was concluded that there would be no impact upon the health of the bats themselves...There was very little previous research on this topic from which to draw any conclusion otherwise...

The transmitted EMF is expected to be within human safety levels and by the time it was transmitted to caverns it would become significantly attenuated...

While not directly comparable to the current project, these conclusions can justifiably be considered in addressing the current project, as electric and magnetic fields emitted by the ETL behave in a similar way and are expected to have similar impacts. Nevertheless, the conclusions relating to frequency and echolocation disruption are relevant. **Table 4.2** identifies the known frequency ranges of threatened micro-bat species that have been recorded in the Assessment Areas, as well as broader Mangoola Coal Project area.

Table 4.2 – Known Frequency Ranges of Threatened Micro-bat Species of Local Area

Common Name	Scientific Name	Status	Characteristic Frequency (kHz)
large-eared pied bat	<i>Chalinolobus dwyeri</i>	V (TSC Act) V (EPBC Act)	21-26
eastern freetail-bat	<i>Mormopterus norfolkensis</i>	V (TSC Act)	31-35
eastern false pipistrelle	<i>Falsistrellus tasmaniensis</i>	V (TSC Act)	35-39
greater broad-nosed bat	<i>Scoteanax rueppellii</i>	V (TSC Act)	32-37
large-footed myotis	<i>Myotis adversus</i>	V (TSC Act)	35-80
eastern bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V (TSC Act)	43-48
eastern cave bat	<i>Vespadelus troughtoni</i>	V (TSC Act)	49-54

Source: Pennay *et al.* (2004).

If adopting the approach from Greg Richards and Associates (2005), it is not likely that the emissions from the ETL will have the potential to impact on the echolocation of threatened micro-bats, as the 50 Hz emissions from the ETL are significantly lower than the echolocation frequencies of the above species.

In relation to the potential for EMFs to impact on roosting micro-bat species, the EMF assessment for this project has found that the strength of both electric and magnetic fields drop dramatically only a short distance from the ETL. The closest cave to the ETL is 67 metres, and at this distance vegetation shielding and rock overhangs mean that levels of EMF reaching the cave are likely to be negligible. When considering the distance of the potential (although unconfirmed) roosting habitat from the proposed ETL (being greater than 50 metres), as well as the shielding effect of the terrain and rock in this area, it is highly unlikely that residual EMF would be able to penetrate roosting caves in sufficient strength to impact on roosting micro-bats.

In order to further investigate the potential impact of the ETL relocation on micro-bat species, additional Anabat surveys were completed underneath (and in the immediate vicinity of) the existing ETL that currently runs through the centre of the approved project disturbance area. These surveys were completed to establish if there was micro-bat activity underneath the current ETL, thereby investigating if these structures (and their EMF emissions) pose a potential impact on the spatial habitat usage of these species.

Figure 2.1 shows the locations of these additional survey points, and the methodology adopted is described in **Section 2.3.4** of this report. Two Anabats were placed under the transmission line at a minimum of approximately 500 metres apart and one further Anabat was placed approximately 100 metres away from the transmission line in order to gauge micro-bat activity in habitats near, although outside of, the existing ETL. All Anabats were placed within similar habitat types, being in a clearing next to dense vegetation. No direct flight paths (such as existing tracks or open creeklines) were available underneath the ETL to target as part of the surveys.

In addition to the above surveys, visual inspections of micro-bat activity under the ETL were completed on one night from sunset to 45 minutes following sunset. This survey identified at least four visual records of micro-bats flying directly underneath the existing ETL. **Table 4.3** identifies the results from the analysis of the Anabat surveys.

Table 4.3 – Anabat Results from Surveys underneath Existing ETL

Anabat Number	Position in Relation to Existing ETL	Number of Species Recorded	Threatened Species recorded	Number of Passes Recorded
1	Next to ETL	8	Eastern bentwing-bat (<i>Miniopterus schreibersii oceanensis</i>)	72
6	Under ETL	11	Large-eared pied bat (<i>Chalinolobus dwyeri</i>) Eastern false pipistrelle (<i>Falsistrellus tasmaniensis</i>) Eastern bentwing-bat (<i>Miniopterus schreibersii oceanensis</i>)	499
7	Under ETL	9	Large-eared pied bat (<i>Chalinolobus dwyeri</i>) Eastern bentwing-bat (<i>Miniopterus schreibersii oceanensis</i>)	115

From the above, it can be seen that three threatened micro-bat species were recorded utilising the habitat directly underneath the existing ETL, while one also used habitat immediately adjacent to the ETL. It is apparent that micro-bat species are making use of the habitats directly beneath the existing ETL, as well as the habitats in the vicinity of this structure. There are no data from this work (or any other data in the existing literature) to suggest that the existing ETL is inhibiting micro-bat activity in any way. It is also notable that surveys completed in the Additional Biodiversity Offset Area at the same time as these surveys returned a similar suite of micro-bat species, at comparable activity levels.

As a result of this, it is reasonable to conclude that potential EMF emissions from the proposed ETL relocation are not likely to cause impact on the micro-bat fauna of the area, as:

- the ETL to be relocated is to be of the same capacity as the existing one, thus will not result in alteration to the existing EMF levels in the area;
- the likely EMF relating to the ETL is at least three orders of magnitude below those used by the micro-bats known to utilise the area; and
- the presence of micro-bat species in the immediate vicinity of the existing ETL suggests that there is no impact of EMF on the ability of these species to utilise areas underneath or near existing ETLs of the same capacity.

As such, it is reasonable to conclude that micro-bat species occurring in the local area will not be impacted by EMFs relating to the relocation of the existing ETL.

4.11 Potential Fragmentation Impacts

Another potential impact from the proposed ETL relocation is from fragmentation of existing habitat from other areas of interconnecting habitats. **Figure 1.3** shows that the proposed route for the relocated ETL lies along the internal edge of the approved project disturbance area. All vegetation within the approved project disturbance boundary is approved for removal, and as such fragmentation impacts are inevitable. Open cut mining was originally planned to occur up to the edge of this boundary, however the mining boundary has been pulled back to allow for the ETL to be constructed along the edge of the disturbance boundary. As such, the relocation of the ETL to areas within the approved project

disturbance boundary will not increase habitat fragmentation above that which was already approved.

The nature of the construction and operation of the ETL is such that vegetation (of less than 4 metres in height) is able to be retained underneath the ETL. This will allow the retention of a ground and shrub layer that will reduce the fragmentation impacts that would certainly arise if all vegetation had to be removed from the easement. The retention of the lower and middle strata of the existing woodland vegetation communities will maintain vegetated connectivity that could be used by amphibians, reptiles, birds and mammals in their movement from the approved disturbance area into the existing Biodiversity Offset Areas. While the removal of trees from the woodland portions of the easement will remove this strata from this connectivity, it is likely that all fauna groups will still be able to safely move into the habitats of the Biodiversity Offset Areas without hindrance from the relocated ETL.

4.12 Impacts on Aquatic Habitat and Species

The proposed relocation of the ETL is not expected to have any impact on aquatic species or habitats within the Assessment Areas. The towers (and all associated construction impacts) have been placed on either side of the Rough-barked Apple Woodland community (comprising the Hunter Floodplain Red Gum Woodland EEC), so these will not cause any impact on the aquatic features of Big Flat Creek. Vegetation maintenance is required within this community, however this will not impact on the aquatic habitats or species of Big Flat Creek.

4.13 Impacts on Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have their species composition and their natural ecological processes determined by groundwater (DLWC 2002). According to the Groundwater Dependent Ecosystem Policy (DLWC 2002), ecosystems which depend on groundwater are:

- wetlands and red gum forests;
- other terrestrial vegetation;
- ecosystems in streams fed by groundwater;
- limestone cave systems;
- springs; and
- hanging valleys and swamps.

Riparian vegetation communities mapped within the Anvil Hill EA (Umwelt 2006) would have the potential to be defined as groundwater dependent ecosystems (GDEs), however only if their associated creeks/waterways are influenced by groundwater in some way. These communities would comprise:

- Forest Red Gum Riparian Woodland;
- Swamp Oak Riparian Forest; and
- Rough-barked Apple Woodland.

In addition, the Paperbark Woodland may be considered as a GDE, as it is likely to occur in a semi-perched location in potential wet soak areas.

In relation to the current project, the Rough-barked Apple Woodland is the only potential GDE that has been mapped within the Assessment Areas. The proposed relocation of the ETL is not expected to have any impact on this community. The towers (and all associated construction impacts) have been placed on either side of the Rough-barked Apple Woodland, so they will not cause any impact on this community. Vegetation maintenance is required within this community, however this is not expected to impact the GDE such that the community will be severely compromised.

4.14 Impacts on Critical Habitat

There are four areas of Critical Habitat declared under the TSC Act, these being:

- Cabbage Tree Island, Port Stephens, Critical Habitat for the Goulds Petrel (*Pterodroma leucoptera leucoptera*);
- North Sydney Harbour, Critical Habitat for the Little Penguin (*Eudyptula minor*);
- Stotts Island Nature Reserve, Critical Habitat for the Mitchells Rainforest Snail (*Thersites mitchellae*); and
- Wollemi National Park, Critical Habitat for the Wollemi pine (*Wollemia nobilis*).

There are a further two locations recommended as Critical Habitat:

- Bomaderry bushland, Shoalhaven, Critical Habitat for the Bomaderry zieria (*Zieria baeuerlenii*); and
- Critical Habitat for the Eastern Suburbs Banksia Scrub EEC.

None of the above listed Critical Habitats or recommended Critical Habitats occur within the Assessment Areas. There are no listings under the EPBC Act for Critical Habitat.

4.15 Impacts from Key Threatening Processes

A number of Key Threatening Processes (KTPs) listed under the Schedules of the TSC Act, the EPBC Act and the FM Act, are relevant to the project. Each of the relevant KTPs is listed in **Table 4.4**, along with a discussion of the relevance to the project.

Table 4.4 – Key Threatening Processes and their Relevance to the Project

Key Threatening Process	Relevant Legislation	Relevance/Implications
Clearing of native vegetation	TSC Act	Clearing of vegetation is the most consequential impact of the project. Outside of the approved project disturbance area, approximately 14.9 hectares will be disturbed, 4.6 hectares of which is Disturbed Grassland.
Land clearance	EPBC Act	As above.

Table 4.4 – Key Threatening Processes and their Relevance to the Project (cont)

Key Threatening Process	Relevant Legislation	Relevance/Implications
Invasion of native plant communities by exotic perennial grasses	TSC Act	There is some potential that the project would lead to an increase in the extent of exotic perennial grasses due to the repeated disturbance of maintenance clearing in the easement.
Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands	TSC Act	The proposed easement crosses a small section of Big Flat Creek. However the ETL will span the creek, causing no impact in it, or adjoining riparian vegetation. It is unlikely that this would affect the natural flow of the creek.
Removal of dead wood and dead trees	TSC Act	The project will result in the removal of some dead wood habitat. If this habitat is not damaged and left <i>in situ</i> or relocated into adjacent bushland areas this will minimise the implications of this KTP.
Loss of hollow-bearing trees	TSC Act	The project will result in the removal of up to 22 hollow-bearing trees. Appropriate mitigation measures have been provided in Section 5.0 , to ensure that the implications of this action are minimised.
The degradation of native riparian vegetation along New South Wales water courses	FM Act	While the easement crosses Big Flat Creek, the riparian vegetation will not be disturbed either for construction works or ongoing maintenance works.

4.16 EPBC Matters of National Environmental Significance

Under the Commonwealth EPBC Act, approval from the Commonwealth Minister for the Environment is required for any action that may have a significant impact on matters of national environmental significance (NES). These matters are:

- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Great Barrier Reef Marine Park; and
- nuclear actions.

Each of these is discussed further in **Table 4.5**.

Table 4.5 – Assessment of EPBC Act Matters of National Environmental Significance

Matter of National Environmental Significance	Potential to Occur within the Assessment Areas	Potential for Significant Impact
The world heritage values of declared World Heritage properties.	Wollemi National Park, which occurs approximately 10 km to the south of the Assessment Areas, is listed as a World Heritage Area.	The project will not impact on this World Heritage property.
The national heritage values of places on the National Heritage List.	There are no National Heritage Listed places within or in proximity to the Assessment Areas. The project is unlikely to impact on any of these National Heritage Listed Places.	No National Heritage Listed places will be impacted as a result of the project.
The ecological character of declared Ramsar wetlands.	The Assessment Areas do not occur within or near a declared Ramsar wetland. The project will not impact on the ecological character of any declared Ramsar wetland sites. The closest declared Ramsar wetland is the Hunter River Estuary, at least 150 km to the south-east of the Assessment Areas.	The project will not have a significant impact on Ramsar wetlands.
Threatened species (other than extinct and conservation-dependent species) and ecological communities (other than vulnerable ecological communities) listed under the EPBC Act.	A number of EPBC Act listed threatened species have been recorded or have potential to occur within the Assessment Areas and may be impacted by the project.	There will be no significant impact on any listed threatened species or ecological communities as a result of the project.
Migratory species listed under the EPBC Act.	A number of EPBC Act listed migratory bird species have potential to occur within the Assessment Areas and may be impacted by the project.	There will be no significant impact on any listed migratory species as a result of the project.
Great Barrier Reef Marine Park	The project does not have the potential to impact on the Great Barrier Reef Marine Park.	There will be no impact on the Great Barrier Reef Marine Park as a result of the project.
Nuclear actions that are likely to have a significant impact on the environment.	The project does not involve any nuclear actions.	The project does not involve any nuclear actions that may have a impact on the environment.
The Commonwealth marine environment.	The Assessment Areas are not within the Commonwealth marine environment.	The project will not have a impact on any areas of the Commonwealth marine environment.

Of these matters, EPBC-listed threatened species and migratory species have been recorded within the Assessment Areas. The potential impact of the project on these is provided by way of an assessment of significance in **Appendix E**.

This assessment has concluded that the project is not likely to have a significant impact on matters of NES. However this project has been referred to the Commonwealth Minister for the Environment, Heritage and the Arts, for consideration of the project and the inter-related mine modification project. The Commonwealth Minister has since deemed that the inter-related projects are not a controlled action.

4.17 Fisheries Management Act 1994

The project spans a small section of Big Flat Creek, however the impacts on the creek at this location are expected to be minimal. There is not expected to be any vegetation clearing for the construction of the easement, however the maintenance works will require modification to 0.5 hectare of Rough-barked Apple Woodland. This will not impact on the aquatic habitats and associated biota of Big Flat Creek.

The Hunter River catchment does not provide habitat for any of the threatened aquatic species, populations and endangered ecological communities listed under the FM Act.

No threatened aquatic species, populations or ecological communities were recorded within the Anvil Hill Project EA (Umwelt 2006), and there is no potential for any to occur within the aquatic habitats of the Assessment Areas.

4.18 Bioregional Impacts

The Mangoola Coal Project area lies in the far north-western part of the Sydney basin Bioregion and on the western extremity of the main floor of the Hunter Valley. It lies centrally within the 22,000 km² Hunter catchment, which is primarily drained by the Hunter and Goulburn Rivers and their tributaries. It is situated approximately 120 kilometres from the coast and 90 kilometres from the western extremity of the Hunter catchment at the Great Dividing Range.

The Sydney Basin Bioregion includes the foothills and isolated ranges on the inland slopes of the Great Dividing Range (Thackway & Cresswell 1995). The project area supports both low Permian hills and valleys, and Triassic conglomerate outcrops and escarpments.

The areas surrounding the Assessment Areas are predominantly composed of two broad vegetation types: rugged escarpment woodlands and heaths; and valley floor woodlands and derived pastures.

Most of the nearby dissected sandstone and conglomerate areas have been studied through a variety of vegetation survey and mapping projects. These studies include:

- Wollemi National Park – Bell (1998): mapped 72 vegetation communities and recorded over 1360 plant species, of which 70 were considered to be rare or threatened. Some vegetation communities within the project area are similar to those recorded on the north-eastern boundary of Wollemi National Park.
- Myambat Military Area – Fallding *et al.* (1999): ten native vegetation communities in the Myambat Military Area, ranging from alluvial forest to rocky heath and sclerophyllous open forests and woodlands, with small areas of dry rainforest in sheltered sites. The survey recorded 391 native plant species, including six rare or threatened Australian plants (ROTAPs), four of which were also listed as threatened under the TSC Act 1995. Several vegetation types recorded in Myambat Military Area are closely related to vegetation communities that occur in the project area.

- Manobalai Nature Reserve and vacant Crown land (VCL) – Peake (1999) and Bell (1997) recorded 15 vegetation communities between the two areas, ranging from dry sclerophyll sandstone forests and heaths, to alluvial forests, basalt-derived woodland and dry rainforest. Bell recorded a total of 246 plant species in Manobalai VCL, including three ROTAPs, one threatened species listed under the TSC Act 1995 and two undescribed species, while Peake recorded 352 plant species in Manobalai Nature Reserve. Both were shown to support several vegetation types that are closely related to those in the project area.
- Goulburn River National Park and Munghorn Gap Nature Reserve – Hill (1999 and 2000): surveyed and mapped vegetation and was shown to support several vegetation units similar to those in the project area. Described 27 vegetation communities and 630 plant species, including 23 ROTAPs and 14 species listed under the TSC Act 1995.
- Central Hunter Valley – Peake (2006): Permian-derived vegetation communities in the project area are also closely related to many of the vegetation types surveyed, mapped and described by Peake (2006) for the floor of the central Hunter Valley. Thirty six vegetation communities were delineated by Peake (2006) in the central Hunter Valley, comprising five rainforest communities, 16 woodlands, 13 open forest communities, one heath and one (unnatural) plantation community. Nine of these occur in the project area. A number of the significant plant species and weeds, and two plant populations recorded by Peake (2006) occur within the project area.

Relatively few fauna surveys or studies of fauna habitats have been undertaken in the local area. Exceptions to this include studies at Myambat Military Area (Fallding *et al.* 1999), south of the project area; Wollemi National Park (Roderick and Carter 1994) south of the project area; and Goulburn River National Park (NSW NPWS 2001), west of the project area. The broad fauna habitat types of grassland, riparian, woodland and aquatic habitat found within the Assessment Areas are representative of the broad habitat types within the surrounding region.

The above studies document that the Assessment Areas relating to the current project contain vegetation communities and habitat types that are well represented in the conservation reserves of the local area. The project will impact on a total of 14.9 hectares of vegetation, 4.6 hectares of which is highly modified grassland habitat. There is no potential that this impact will result in a reduction to the biodiversity values of the Sydney Basin Bioregion.

4.19 Cumulative Impacts with Mangoola Coal Project

The Mangoola Coal Project was approved on the basis of impacts to 2238 hectares of vegetation, comprising 1304 hectares of treed vegetation and 934 hectares of grassland. From this disturbance, came the requirement to provide an offset covering a total of 2800 hectares (comprising of 1924 hectares of proposed Biodiversity Offset Areas as well as an additional area of 1046 hectares). The proposed Biodiversity Offset Areas have been formalised, and the location of the additional 1046 hectares is currently being finalised. This additional area will comprise areas designated for corridors, as well as additional grassland areas for offsetting purposes. **Table 4.6** identifies the cumulative impact of the approved Mangoola Coal Project, as well as the proposed ETL relocation project on the vegetation of the Project Area. This table also identifies the cumulative offsetting commitments from both of these projects.

Table 4.6 – Cumulative Vegetation Impacts from Approved Mangoola Coal Project and Proposed ETL Relocation Project

Vegetation Community	Within Project Area (ha)	Subject to Approved Impact (ha)	Proposed for Impact as Result of Current Project (ha)	Cumulative Impact of Mangoola Coal Project and Current Project (ha)	Amount in Existing Approved Biodiversity Offset Areas (ha)	Additional Offsetting Commitment from Project Approval (Currently being Finalised) (ha)	Amount in Additional Biodiversity Offset Areas (ha)	Total Proposed Biodiversity Offsetting (ha)
Woodland Formation	2125	1251	9.8	1260.8	874	522	51.7	1447.7
Slaty Box Woodland	527	245	1	246	282	0	30.7	312.7
Ironbark Woodland Complex	1393	886	8.8	894.8	507	0	21	528
Bullock Woodland	100	100	0	100	0.4	0	0	0.4
Sheltered Grey Gum Woodland	79	0	0	0	79	0	0	79
Red Ash Sheltered Forest	0.7	0	0	0	0.7	0	0	0.7
Drooping Sheoak Woodland	2	0.8	0	0.8	1	0	0	1
Mixed Species Revegetation/Plantation	0.8	0	0	0	0.8	0	0	0.8
Paperbark Woodland	23	19	0	19	3	0	0	3
Riparian and Floodplain Formation	84	53	0.5	53.5	31	0	1.2	32.2
Exotic Rushland	0.2	0	0	0	0.2	0	0	0.2
Swamp Oak Riparian Forest	21	1	0	1	20	0	0	20
River Oak Riparian Forest	0.6	0	0	0	0.6	0	0	0.6
Rough-barked Apple Woodland	11	0.3	0.5	0.8	11	0	0	11
Forest Red Gum Riparian Woodland	51	51	0	51	0		1.2	1.2
Shrubland Formation	127	0.2	0	0.2	127	0	0	127
Tall Mixed Shrubland Complex	52	0	0	0	52	0	0	52
Weeping Myall Woodland	1	0.1	0	0.1	0.9	0	0	0.9
Coast Myall Exposed Woodland	74	0.2	0	0.2	74	0	0	74
Grassland Formation	1806	934	4.6	938.6	872	524	11.1	1407.1
Disturbed Grassland	1806	934	4.6	938.6	872	524	11.1	1407.1
TOTAL (ha)	4142	2238	14.9	2252.9	1904.0	1046.0	64.0	3014.0

This table shows that a total offset package of 3014 hectares has been offered (2800 hectares of which is currently a formal commitment) as a formal biodiversity offset to address the impacts of the Mangoola Coal Project, and its associated requirements. This area of impact covers a total of 2253 hectares.

5.0 Impact Mitigation Measures

This section describes the detailed impact mitigation strategy that has been developed to ameliorate the impacts of the project on threatened species, endangered populations, TECs and their habitats. The primary approach to this has been to initially avoid ecological impact. Where such an impact has been unavoidable, attempts have been made to minimise impacts, and then provision has been made to offset those unavoidable impacts. This section discusses the measures included in the design of the project to avoid and minimise ecological impacts. **Section 6.0** discusses a Biodiversity Offset Strategy which has been designed to address residual ecological impacts. In combination, the impact mitigation and biodiversity offsetting proposed as part of this project seeks to achieve the overall goal to maintain or improve the biodiversity values of the local area.

The loss of up to 14.9 hectares of vegetation within the Assessment Areas is not likely to result in major impacts on the biodiversity of the local area. This is particularly so when considering that 31 per cent of the vegetation to be removed is Disturbed Grassland that has been heavily cleared and modified in the past. Despite this, it is appropriate to implement mitigation measures for those impacts that have not been able to be avoided and will occur as a result of the project.

5.1 Measures to Avoid or Minimise Impact

This section discusses measures that were applied during a constraints analysis undertaken as part of the project design in order to avoid or, where avoidance was not feasible, minimise potential impact on target ecological features of the Assessment Areas and surrounding area. In some cases, these measures were developed and included in response to specific ecological impact issues. Other measures were included due to other reasons. However their inclusion into the project design still provided an overall reduction in potential ecological impact. These measures have been included within the final design of the project and thus have been considered within the impact assessment provided in **Section 4.0**.

5.1.1 Project Modifications Adopted to Avoid Potential Impacts

The overarching principles employed in the planning of the project were to avoid, minimise and then mitigate unavoidable ecological impacts as much as possible, while allowing a viable project outcome. In adopting this approach, it was acknowledged that it is not possible to fully avoid or minimise all potential ecological impact from large-scale projects such as this one.

5.1.1.1 Avoidance of Impact via Route Selection

The current project is the result of the consideration of a number of alternative routes for the relocation of the 500 kV ETL. Three options were considered as part of a feasibility phase for determining the preferred route, these being:

- Option 1: 8.3 kilometres long with 1.1 kilometres occurring within the approved disturbance area. This option lies to the north and east of the approved project disturbance area;
- Option 2: 11.4 kilometres long with 2.1 kilometres occurring within the approved disturbance area. This option lies to the west and south, outside the approved project disturbance area; and

- Option 3: 11 kilometres long with 5.7 kilometres occurring within the approved disturbance area. This option is located within the western boundary of the approved project disturbance area and on largely cleared land to the south and north of the approved project disturbance boundary.

Section 3.3.2 of the Environmental Assessment provides further discussion on each of these options, as well as an alternative option that was proposed by the local community as part of the consultation process. That section describes each of the options, and provides a justification for the preferred Option that has been adopted as part of this project.

Generally, the preferred option was selected as a large portion of the route runs through areas already approved for disturbance (despite meaning that coal resources are sterilised) thereby minimising the extent of impact through focusing impacts within areas previously approved for disturbance and thus minimising additional ecological impact. To this end, the preferred option comprises Disturbed Grassland for 31 per cent of its length. While this option runs adjacent to portions of the Biodiversity Offset Areas, it was the option that resulted in the least direct disturbance to existing Biodiversity Offset Areas.

5.1.1.2 Minimisation of Impacts

Measures included as part of the project that have resulted in the minimisation of potential ecological impact include:

- Tower relocation to span Big Flat Creek – due to the sensitivity of this area, the towers on either side were relocated outside of the riparian vegetation, to avoid the need to clear riparian vegetation for their construction. This has avoided potential impacts within this EEC vegetation for the construction of towers. To further avoid impact, the stringing process for the cables was altered to adopt an aerial approach to avoid the need for heavy vehicles to enter and therefore directly impact this EEC. The draw wire used during the stringing process will be walked through the existing Big Flat Creek Conservation Area to further minimise impact. Maintenance policies require the removal of trees with a mature height of 4 metres along the length of the easement. In sensitive areas such as the Big Flat Creek Conservation Area, such removal will be kept to a minimum, wherever possible.
- Easement maintenance – rather than clearing all of the vegetation within the easement for safety reasons, this project has adopted an approach for sensitive areas (i.e. Biodiversity Offset Areas or TECs) that will selectively remove or lop trees with a mature height of over 4 metres that are deemed to pose a safety risk for the ETL. This will ensure that vegetation removal for this purpose is as minimal as possible, whilst not compromising the safety and reliability of the ETL. The retention of shrub and ground vegetation within the easement will reduce impacts from fragmentation, by providing vegetated cover for dispersing fauna species.
- Avoidance of hollow-bearing trees – this project has adopted an approach that will avoid the need to remove hollow-bearing trees, wherever possible. Access tracks within and off the easement will be designed to avoid such trees, and lopping for safety requirements will avoid these trees also, wherever possible. This will serve to minimise the impacts of habitat loss for hollow-dependent species within the Assessment Areas.

These alterations to the original project design have contributed to a reduction in the overall impact of the Project on the ecological features of the Assessment Areas, by way of avoiding or minimising potential impacts. These modifications were introduced progressively during project planning and design, and in response to field survey results and preliminary impact assessments.

5.2 Tree Felling and Loss of Hollows

The loss of hollow-bearing trees will be the primary impact of this project on threatened fauna species, and impact mitigation measures can be implemented to ensure that these impacts are minimised. Undertaking a detailed pre-clearing survey and tree-felling process will ensure that potential injury or death to fauna species from tree felling is kept to a minimum.

Mangoola Coal has an existing commitment to a detailed pre-clearing and tree-felling procedure designed to minimise impacts on fauna species. These procedures would apply for the majority of the ETL easement where it traverses Mangoola Coal's approved project disturbance area. In the Assessment Areas, a Construction Environmental Management Plan to be developed for the ETL construction will address the issue of hollow-bearing trees. This Plan will draw on TransGrid's Environmental Management System and Mangoola Coal's Sustainable Development Management System and ensure that practices consistent with Mangoola Coal's existing commitments are applied along the length of the relocated ETL.

These commitments generally involve ecological survey of all areas requiring clearing prior to any clearing works being undertaken. The purpose of the pre-clearance survey is to identify fauna species inhabiting hollows to be cleared. If resident fauna are identified, measures will be adopted to attempt to avoid injury or death of these species. The requirements of each of these procedures are identified within the Anvil Hill Project EA (Umwelt 2006), and are also outlined in the Draft ROMP (Umwelt, in prep.). These procedures will also be followed for the removal of any woody native vegetation (including shrublands and scattered trees in grassland) for the purposes of this project, both within the approved project disturbance area, and within the Assessment Areas.

In addition to these, Mangoola Coal has a detailed nest box strategy in place, which ensures the replacement of felled hollows with suitably-designed nest boxes, targeted for a range of fauna groups. The strategy requires regular maintenance checks of these boxes, and monitoring to remove feral species and assess if they are being utilised by target faunal groups. This nest box strategy was detailed in the Anvil Hill Project EA (Umwelt 2006), and will be included in more detail within the Draft ROMP (Umwelt, in prep.). The key elements of the strategy will be included in the Construction Environmental Management Plan to be developed for the ETL relocation project. This strategy will ensure that there will be no net loss of hollows as a result of the current project.

5.3 General Mitigation Measures

In addition to the above measures, the following measures will be implemented (as much as possible), in order to minimise impacts resulting from the project:

- tree removal for maintenance purposes within the easement will be kept to a minimum, and lopping of branches will be prioritised over tree removal in sensitive areas, wherever possible;
- vegetation removal/lopping for maintenance and access purposes will avoid the shrub and ground layers in sensitive areas, as much as possible. This will ensure that ground habitats are retained to provide protection for fauna moving across the easement and that habitat disturbance for threatened flora species is minimised;
- the retention of hollow-bearing trees within the easement will be prioritised as far as possible. Where possible, access tracks within the easement and off-easement will be located around such trees;

- lopping of hollow-bearing trees will be prioritised over felling;
- any removal of, or impact to vegetation (including grassland) associated with decommissioning activities at the eleven existing towers located outside of the approved project disturbance boundary and the towers located in the Biodiversity Offset Areas require inspection and assessment via a due diligence process and will also be required to follow all clearing-related procedures in the Draft ROMP (Umwelt, in prep.). Such due diligence works will need to consider seasonality issues, particularly in relation to spring-flowering terrestrial orchids;
- vehicle access within and around the easement will be restricted to designated access tracks which are based on locations of existing access tracks as far as possible, in order to minimise disturbance to threatened grassland species such as *Diuris tricolor* and *Bothriochloa biloba*;
- all examples of the tiger orchid (*Cymbidium canaliculatum*) occurring within areas to be cleared will be included in the translocation program for the Mangoola Mine, as per the Draft ROMP (Umwelt, in prep.); and
- the use of 'glider friendly' safety barriers on the towers will be investigated as an alternative to the use of barbed wire (see **Section 4.9**). Each tower would typically be surrounded by barbed wire to prevent unauthorised access/climbing. There is potential that this barbed wire could cause harm to mammals flying near these towers, in particular the threatened squirrel glider (*Petaurus norfolcensis*) and threatened micro-bats. Entanglement of flying mammals and birds in barbed wire is well-documented. In light of this potential threat, it is recommended that an alternative to the use of barbed wire for exclusion purposes is sought. It is known that similar transmission lines in Queensland are using designs that do not use barbed wire, however are cost effective and provide the appropriate safety outcomes to the operators.

6.0 Biodiversity Offsetting

The Biodiversity Offset Strategy presented in this section has been developed progressively, and is included as an integral component of this project. This strategy is designed to address the likely residual impacts on threatened species, endangered populations, TECs and their habitats within the Assessment Areas, as described in **Section 4.0** of this report. Those residual impacts are those that have not been able to be avoided, or fully minimised by the measures discussed in **Section 5.0**.

6.1 Introduction

It is generally expected that for sites which support at least moderate condition native vegetation and fauna habitat, biodiversity offsetting should be provided to ameliorate the impacts of development. Over the course of the last 5-10 years, biodiversity offsets have been used in NSW as an effective measure to ameliorate development impacts on biodiversity. While there are no consistent, universally applied guidelines, it has generally been accepted that in principle, biodiversity offsets should be:

- located as close as possible to the areas subject to impact, depending on the availability of such areas;
- appropriately monitored and managed for biodiversity outcomes;
- appropriately protected; and
- usually at least as large as the area impacted.

Although these principles are not universally employed, it is recognised that they form an appropriate approach around which individual development offsets are assessed. In the past, biodiversity offsetting has taken the form of:

- developers (including mining companies) managing land that is set aside for biodiversity conservation;
- developers donating land to DECCW or other similar bodies; and
- financial contributions to the government to fund land purchases or management, or threatened species recovery.

DECCW has released guidelines titled *Principles for the Use of Biodiversity Offsets in NSW* (DECCW 2008). These guidelines provide a more formal approach through which biodiversity offsetting can be measured, and incorporate some of the principles enshrined in the DECCW BioBanking scheme (see **Section 6.2**). The DECCW (2008) principles state that:

- impacts must be avoided first by using prevention and mitigation measures;
- all regulatory requirements must be met;
- offsets must never reward ongoing poor performance;
- offsets will complement other government programs;
- offsets must be underpinned by sound ecological principles;

- offsets must be enduring and they must offset the impact of the development for the period that the impact occurs;
- offsets should be agreed prior to the impact occurring;
- offsets must be quantifiable and the impacts and benefits must be reliably estimated;
- offsets must be targeted;
- offsets must be located appropriately;
- offsets must be supplementary; and
- offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

Section 6.4 documents how the above DECCW biodiversity offsetting principles have been incorporated into the proposed impact mitigation strategy for the Project.

6.2 BioBanking

The NSW Government developed the BioBanking scheme to enable a more consistent approach to biodiversity offsetting. It forms an alternative approach against which developments can be assessed and through which developers can achieve appropriate biodiversity offsetting without having ongoing management or legal responsibility for the offset areas. Participation in BioBanking is voluntary and the potential for utilising this recently developed and still evolving option is discussed below.

The BioBanking scheme works through applying a rule-based approach to determining the likely impact a development will have on biodiversity, and through then calculating the number of *biodiversity credits* (comprising *ecosystem credits* and/or *threatened species credits*) that are required to be purchased to offset the development's impact. The credits are purchased from registered BioBanking Sites and the funds generated from the purchase are used by the BioBanking site manager(s) to achieve a set of previously-agreed management actions at that site(s). This process is known as credit retirement, and once the developer has purchased all of the necessary credits, their development has been offset and they have no further responsibility to any biodiversity offsetting requirements. BioBanking sites will be protected, managed and funded in-perpetuity. The scheme provides an alternative assessment pathway to that provided through the Part 3A process for offsetting the impact of a development.

Although the project is not required to adopt the BioBanking scheme, it is recognised that many of the principles established under the BioBanking scheme are of relevance. These have been considered in the development of the impact mitigation and biodiversity offset package for this project.

6.3 Proposed Biodiversity Offset Strategy

In order to address residual impacts of the project on threatened species, endangered populations, TECs and their habitats, a Biodiversity Offset Strategy is provided. This Strategy focuses on the provision of a formal offset area within the Mangoola Coal-owned Additional Biodiversity Offset Area, which lies to the south of and adjoins the existing Biodiversity Offset Area established through the project approval process for the Mangoola

Coal Project. The Biodiversity Offset Strategy provides for the protection of this offset area, as well as ongoing management actions to ensure its ecological integrity in the long term.

The Biodiversity Offset Strategy proposed as part of this project, adds to the Biodiversity Offset Strategy proposed as part of the proposed modification project (addressed within the Environmental Assessment). As part of that project, a 34 hectare portion of the Additional Biodiversity Offset Area was offset as part of a Biodiversity Offset Strategy to address ecological impacts of the proposed modification to the approved project disturbance area. The Biodiversity Offset Strategy for this project offers an additional 30 hectare portion of the Additional Biodiversity Offset Area to address unavoidable impacts from this project. Both Biodiversity Offset Strategies have been designed to provide a coordinated offsetting approach for both projects, providing the same management requirements for both parcels of land.

6.3.1 Additional Biodiversity Offset Area

The Additional Biodiversity Offset Area is part of the former 'Nipol' property which has been recently purchased by Xstrata Mangoola due to its suitability for offsetting purposes. This property is 335 hectares in size, and lies to the south of the approved Biodiversity Offset Areas for the Mangoola Coal Project (**Figure 6.1**), adjoining the southern part of the Conservation Offset Area. Historically, the property has been used for agricultural purposes such as cattle grazing, and there is currently a small vineyard (with associated dwelling, sheds, etc.) in the eastern parts of the property. Approximately half of the property is covered with woody vegetation, with the remainder comprising grasslands.

In order to offset the impacts of this project, a 30 hectare portion of this property is being proposed as a formal offset area (the Additional Biodiversity Offset Area). This portion is being offered in addition to the 34 hectares offered as part of the modification project. The additional 30 hectares lie on the western side of the already offered 34 hectare portion of the property (**Figure 6.2**), thereby widening the intended vegetated link between the Conservation Offset Area for the Mangoola Coal Project site, to vegetation adjoining the Golden Highway, and south into the conserved habitats of the Myambat Military Area.

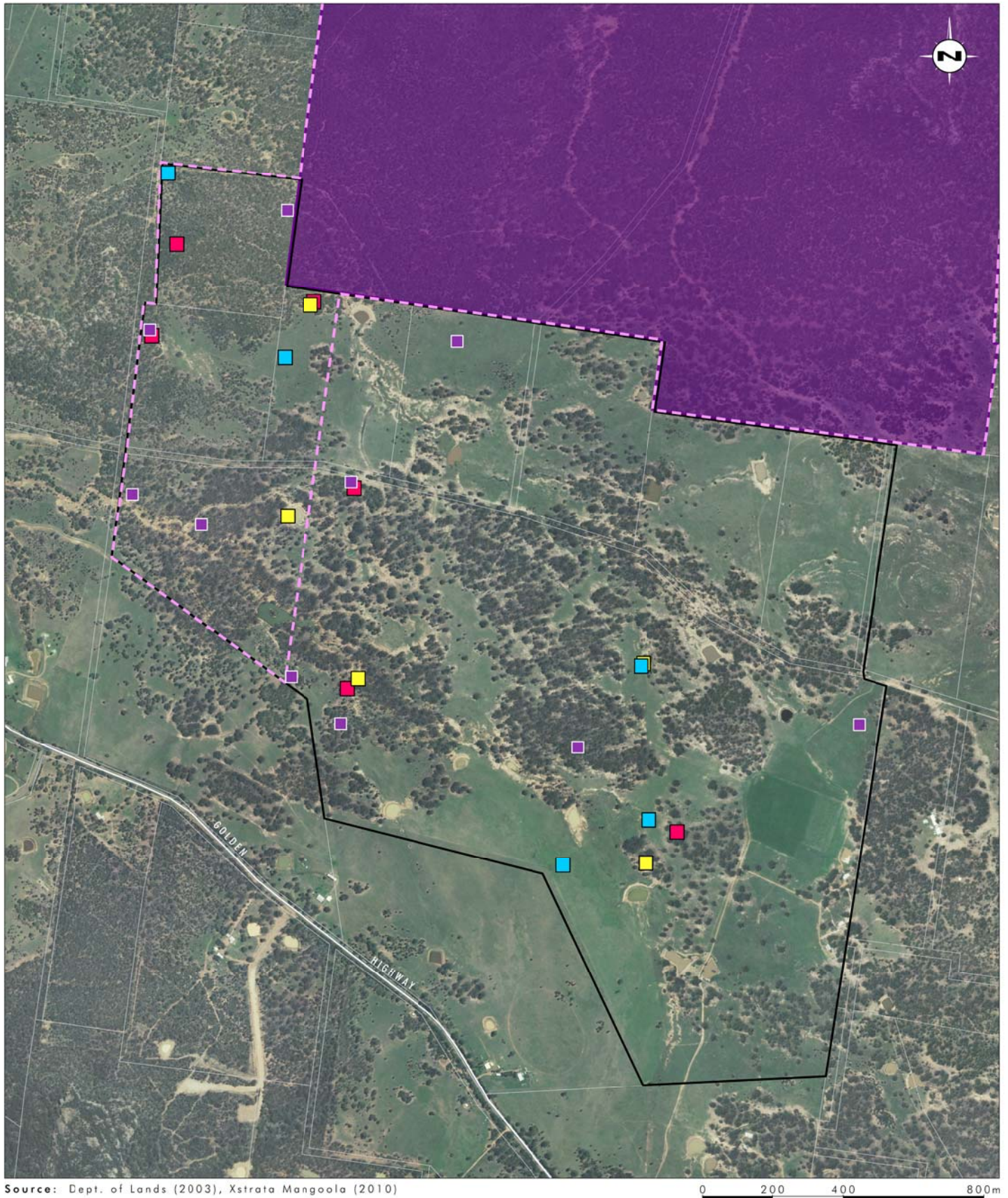
This Additional Biodiversity Offset Area is proposed in order to offset impacts from the project on:

- the permanent impacts from the ETL relocation, whereby native vegetation and fauna habitat will require removal, as well as removal of area from the existing Biodiversity Offset Areas for the Mangoola Coal Project; and
- maintenance works required within woodland areas, whereby vegetation will require lopping to avoid interference with the ETL.

To this end, the 30 hectares proposed as an offset for this project will replace the areas lost from the existing Biodiversity Offset Areas, as well as offset residual impacts from the Assessment Areas. This approach will ensure that the total extent of the existing Biodiversity Offset Areas will not be reduced as a result of this project, rather will be maintained and augmented with an appropriate amount of suitable vegetation to compensate for the impacts from the Assessment Areas.

6.3.2 Ecological Surveys of Additional Biodiversity Offset Area

Once it was identified as a potential offsetting resource, the Additional Biodiversity Offset Area was subject to ecological survey to document its ecological features, and thereby its suitability as an offset for the residual impacts associated with the Assessment Areas.

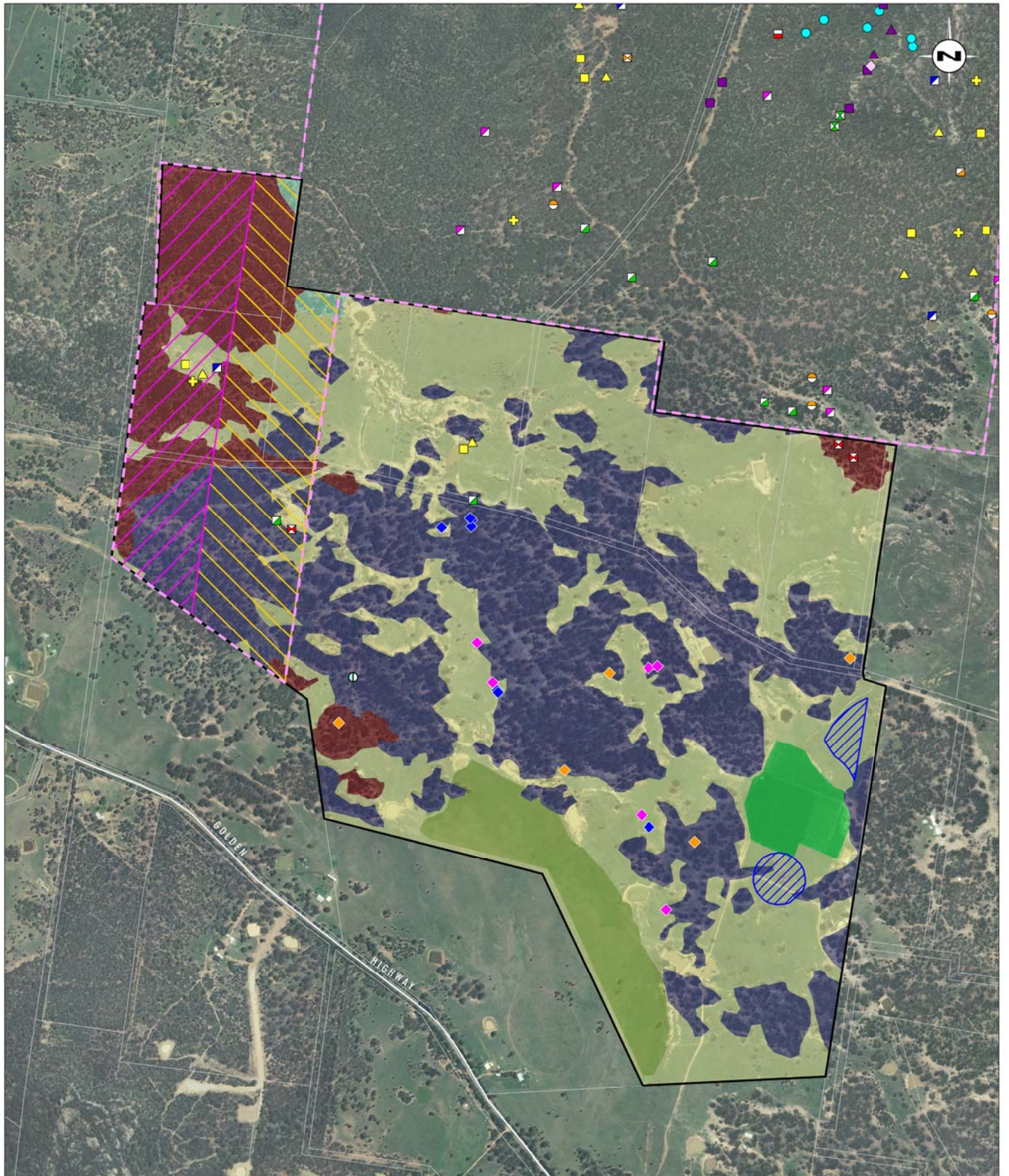


Legend

- Project Area
- Former Nipol Property
- Conservation Offset Area
- Habitat Assessment
- Flora Quadrat
- Rapid Assessment
- Opportunistic Bird/Herpetological Survey

FIGURE 6.1

Survey Locations for Proposed
Additional Biodiversity Offset Area



Source: Dept. of Lands (2003), Xstrata Mangoola (2010)

Legend

- Project Area
- Former Nipol Property
- Proposed ETL Relocation Offset Area (30 hectares)
- Proposed Modification Additional Biodiversity Offset Area (34 hectares)
- Slaty Box Woodland (VEC, TSC Act)
- Ironbark Woodland Complex (EEC, TSC Act)
- Modified Native Grassland
- Vineyard
- Forest Red Gum Riparian Woodland
- Improved Pasture

- Bothriochloa biloba* Area
- ◆ *Acacia pendula*
- ◆ *Acacia homophylla/pendula*
- *Cymbidium canaliculatum*
- *Lasiopetalum longistamineum*
- ▲ *Pomaderris queenslandica*
- *Pomaderris reperta*
- Brown Treecreeper
- Brush-tailed Rock-wallaby
- Diamond Firetail

- Speckled Warbler
- ▲ Eastern Bentwing-bat
- Eastern Cave Bat
- ◆ Eastern False Pipistrelle
- + Eastern Freetail-bat
- Grey-crowned Babbler
- Hooded Robin
- Koala
- Large-eared Pied Bat
- Large-footed Myotis

- Little Lorikeet

FIGURE 6.2
Proposed Additional
Biodiversity Offset Area

These surveys were completed between 15 and 17 February 2010, and covered the entire Additional Biodiversity Offset Area. The whole property (335 hectares) was surveyed in order to enable the informed selection of appropriate areas to offset the ecological impact of the project. Surveys consisted of:

- vegetation mapping and targeted threatened flora searches (including 10 flora plots, five rapid assessment sites and walking transects);
- habitat assessments;
- fauna surveys covering three general sites comprising diurnal bird and herpetofauna surveys, SEPP 44 habitat assessments, as well as nocturnal spotlighting, call playback and Anabat echolocation surveys; and
- opportunistic diurnal bird and herpetofauna surveys.

Each flora plot had dimensions of 20 metres by 20 metres (400 m²), which is a standard size used widely for systematic flora surveys throughout NSW and is recognised by the DECCW and the Royal Botanic Gardens Sydney. Within each plot, two ecologists spent approximately 45 minutes to 1 hour searching for species, walking along-side each other in parallel lines throughout the extent of the plot.

All species encountered within the plot were recorded, and a modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with modifications by Poore 1955 and Austin *et al.* 2001) was used to estimate the cover-abundances of each species (**Table 6.1**).

Table 6.1 - Modified Braun-Blanquet Crown Cover-abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Forbs, sedges and grasses: < 5 individuals Shrubs and small trees: < 5 individuals
2	Many individuals (less than 5% cover)	Forbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20% cover	N/A
4	20 – less than 50% cover	N/A
5	50 – less than 75% cover	N/A
6	75 – 100% cover	N/A

Note: * Modified Braun-Blanquet scale (Braun-Blanquet 1927; Poore 1955; Austin *et al.* 2001).

Information on the structural characteristics of the vegetation in each plot was also recorded, including the height range, canopy cover and the dominant species of each stratum. Information on the general health and condition of the vegetation within each plot was also recorded, including presence of weeds, disturbances such as fire and feral animals, and evidence of dieback or insect attack.

Rapid vegetation assessments were completed primarily to assist in the delineation and refinement of vegetation mapping. These assessment sites were located within each broadly mapped vegetation community to allow data collection for each community without confounding effects from adjacent communities. Dominant, common and some uncommon plant taxa were recorded within each vegetation community along meandering transects, carried out on foot, at each location.

The rapid vegetation assessments did not utilise a quantitative sampling approach, as this method was designed to allow rapid collection of non-quantitative species dominance data across the project area within limited timeframes. A meandering technique was selected instead of the plot-based method because it increased the amount of data that could be collected within the available survey time, thereby maximising the quality and coverage of vegetation description and mapping.

The relative abundance of vascular plants recorded within each vegetation community was determined using the cover-abundance score identified in **Table 6.1**.

The remaining methods applied as part of these surveys are as per those described in **Sections 2.2** and **2.3** of this report. The locations of surveys completed in the Additional Biodiversity Offset Area are displayed in **Figure 6.1**.

6.3.3 Ecological Features of Additional Biodiversity Offset Area

The following sections provide a description of the existing ecological values of the Additional Biodiversity Offset Area, with particular focus on significant ecological features such as threatened species, endangered populations, TECs and their habitats.

6.3.3.1 Vegetation and Vegetation Communities

Five vegetation communities were identified in the Additional Biodiversity Offset Area (refer to **Figure 6.2**). Descriptions of these communities are provided in the following sections, where they differ from those described in **Section 3.1.2** of this report.

Slaty Box Woodland

The Slaty Box Woodland within the Additional Biodiversity Offset Area is consistent with the Slaty Box Woodland present within the Mangoola Coal Project area. See **Section 3.1.2.2** for the floristic and structural description of this community. This community is consistent with the Hunter Valley Foothills Slaty Gum Woodland in the Sydney Basin Bioregion VEC, listed under the TSC Act.

Ironbark Woodland Complex

The Ironbark Woodland Complex is generally consistent with the Ironbark Woodland Complex present within the Mangoola Coal Project area. See **Section 3.1.2.1** for the floristic and structural description of this community.

Two variants were identified within this community, where rough-barked apple (*Angophora floribunda*) and forest red gum (*Eucalyptus tereticornis*) are the dominant canopy species. The understorey species, however, remain consistent with those commonly recorded in the Ironbark Woodland Complex. These variants are only present in small remnants in the south-west of the Additional Biodiversity Offset Area and are consequently heavily influenced by surrounding grassland and woodland communities.

The Ironbark Woodland Complex is consistent with the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC listed under the TSC Act, where the dominant canopy species is narrow-leaved ironbark or grey box.

Forest Red Gum Riparian Woodland

Forest Red Gum Riparian Woodland is found adjacent to an unnamed drainage line in the north-east of the Additional Biodiversity Offset Area. The dominant canopy species is forest red gum (*Eucalyptus tereticornis*), with up to approximately 25 metres in height and

10-30 per cent cover. Grey box (*Eucalyptus moluccana*), narrow-leaved ironbark (*Eucalyptus crebra*) and bulloak (*Allocasuarina luehmanna*) also occur sporadically within this community.

A low tree stratum dominated by white feather honeymyrtle (*Melaleuca decora*) (of between 2 and 10 metres) is commonly present, occurring sparsely or forming a dense understorey layer. There is usually little or no understorey within this community. Species such as native olive (*Notelaea microcarpa* var. *microcarpa*) and narrow-leaved wattle (*Acacia linearifolia*) were also recorded.

A sparse to mid-dense (30-60 per cent cover) groundcover is present, usually less than 0.3 metre in height. The groundcover is highly variable, and is strongly influenced by the surrounding vegetation as this community occurs in a narrow band on the flats and lower slopes adjacent to the drainage line. Common native species include open summer-grass (*Digitaria diffusa*), yellow burr daisy (*Calotis lappulacea*), barbed wire grass (*Cymbopogon refractus*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), kidney weed (*Dichondra repens*), common fringe-rush (*Fimbristylis dichotoma*), twining glycine (*Glycine clandestina*) and native wandering Jew (*Commelina cyanea*). Introduced groundcover species are relatively uncommon, however common prickly pear (*Opuntia stricta* var. *stricta*) and tiger pear (*Opuntia aurantiaca*) occur in relatively low abundance.

This community occurs as a mosaic of the Forest Red Gum Riparian Woodland and Paperbark Woodland, mapped as part of the Anvil Hill Project EA (Umwelt 2006), and there is difficulty in delineating the two communities. The community occurring in this mosaic pattern is similar to what was identified within the Anvil Hill project area. Consequently this community has similarities to, or is partially equivalent to, MU 13 Hunter Floodplain Red Gum Woodland Complex and MU 17 Central Hunter Paperbark Soaks Woodland of Peake (2006), however, within the Additional Biodiversity Offset Area, the community does not occur on a floodplain. The similarity of this community to MU 13 is limited to the presence of forest red gum and few ground cover species, and it is considered to be more floristically similar to MU 17. However, given the narrow width of the community, its species composition is also influenced by the Ironbark Woodland Complex. Peake (2006) indicated that MU 17 may meet the DEH (2006) criteria for listing as an EEC, however there has been insufficient systematic sampling carried out in MU 17, and more should be undertaken to determine its conservation significance.

Modified Native Grassland

The Modified Native Grassland within the Additional Biodiversity Offset Area is broadly similar to the Disturbed Grassland present within the Mangoola Coal Project area, described in **Section 3.1.2.4**. The main difference between these communities is the higher native species diversity present in the Modified Native Grassland, which generally contains relatively few introduced species, which are present in low abundance.

The dominant species present include slender rats tail grass (*Sporobolus creber*), windmill grass (*Chloris truncata*), paddock lovegrass (*Eragrostis leptostachya*), Queensland bluegrass (*Dichanthium sericeum*), silky browntop (*Eulalia aurea*), threeawn speargrass (*Aristida vagans*), common fringe-sedge (*Fimbristylis dichotoma*), yellow buttons (*Chrysocephalum apiculatum*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*) and *Phyllanthus virgatus*. Small-leaved bluebush (*Maireana microphylla*) is scattered throughout this community.

Introduced species are generally present in low abundance. The most commonly recorded introduced species include fireweed (*Senecio madagascariensis*), paspalum (*Paspalum dilatatum*), narrow-leaved cotton bush (*Gomphocarpus fruticosus*) and flaxleaf fleabane (*Conyza bonariensis*).

Scattered slaty box (*Eucalyptus dawsonii*), narrow-leaved ironbark (*Eucalyptus crebra*) and bulloak (*Allocasuarina luehmannii*) are present within this community. Based on the presence of these species and surrounding woodland remnants, this community is likely to be the result of historical clearing of Slaty Box Woodland and Ironbark Woodland Complex. If these grassland areas are able to regenerate into woodland communities then they would likely form part of the Central Hunter Grey Box – Ironbark Woodland EEC or the Hunter Valley Footslopes Slaty Gum Woodland VEC listed under the TSC Act. However, in its current condition, the Modified Native Grassland is not consistent with the EEC or VEC.

A variation of this community is present in the eastern portion of the Additional Biodiversity Offset Area, in which the species composition of grasses and forbs differs from that of the rest of the native grassland areas. This area is dominated by red grass (*Bothriochloa biloba*) (listed as vulnerable under the EPBC Act), *Bothriochloa macra*, *Digitaria divaricatissima*, *Eriochloa pseudoacrotricha*, yellow burr daisy (*Calotis lappulacea*), *Atriplex semibaccata*, *Sida subspicata*, and *Oxalis perennans*. A higher diversity of introduced species was recorded in this variant, which includes narrow-leaved cotton bush (*Gomphocarpus fruticosus*), saffron thistle (*Carthamus lanatus*) and galenia (*Galenia pubescens*).

Improved Pasture

The Improved Pasture is located in the south of the Additional Biodiversity Offset Area. It has been subject to greater disturbance, increased nutrients or a combination of the two and consequently has a greater proportion of introduced species.

Native species present within the Improved Pasture include windmill grass (*Chloris truncata*), couch (*Cynodon dactylon*), common fringe-sedge (*Fimbristylis dichotoma*), paddock lovegrass (*Eragrostis leptostachya*), slender rats tail grass (*Sporobolus creber*), umbrella grass (*Digitaria divaricatissima*) and two-colour panic (*Panicum simile*). Introduced species are common and occur in moderate abundance. Commonly recorded introduced species include Paddys lucerne (*Sida rhombifolia*), galenia (*Galenia pubescens*), Rhodes grass (*Chloris gayana*), perennial ryegrass (*Lolium perenne*) and gomphrena weed (*Gomphrena celosioides*).

As this is not a naturally occurring community and it contains a high proportion of introduced species, it has low conservation significance.

The area of each community is shown in **Table 6.2**.

Table 6.2 – Vegetation Communities of the Additional Biodiversity Offset Area

Vegetation Community	Conservation Significance*	Amount within Additional Biodiversity Offset Area (ha)	Amount within Offset for Proposed ETL Relocation	Amount within Overall Additional Biodiversity Offset Area**
Ironbark Woodland Complex	Common and widespread in the local area and the central Hunter Valley. Moderate conservation significance. Consistent with <i>Central Hunter Grey Box – Ironbark Woodland</i> EEC listed under the TSC Act.	36.7	10.8	21.0

Table 6.2 – Vegetation Communities of the Additional Biodiversity Offset Area (cont)

Vegetation Community	Conservation Significance*	Amount within Additional Biodiversity Offset Area (ha)	Amount within Offset for Proposed ETL Relocation	Amount within Overall Additional Biodiversity Offset Area**
Slaty Box Woodland	Moderately widespread in the local area. Consistent with <i>Hunter Valley Foothills Slaty Gum Woodland</i> VEC listed under the TSC Act.	127.2	15.9	30.7
Forest Red Gum Riparian Woodland	Relatively uncommon in the local area, and of moderate to high conservation significance.	1.4	0.0	1.2
Modified Native Grassland	Moderate abundance in the local area. Not a naturally occurring community therefore mostly has low conservation significance, although has potential to regenerate into Slaty Box Woodland or Ironbark Woodland Complex.	147.4	3.3	11.1
Improved Pasture	Moderate abundance in the local area. Not a naturally occurring community therefore mostly has low conservation significance.	16.8	0.0	0.0
Total		335	30.0	64.0

*Based on expert opinion, and drawing on Peake (2006) where equivalent vegetation communities exist.

**Includes vegetation proposed as offset for proposed modification project.

As shown in **Table 6.2** and **Figure 6.2**, the Modified Native Grassland and Slaty Box Woodland are the most widespread communities in the Additional Biodiversity Offset Area. Ironbark Woodland Complex occurs predominantly in the north-west, as does the small occurrence of Forest Red Gum Riparian Woodland. The Improved Pasture is adjacent to the southern boundary of the property.

6.3.3.2 Flora Species

A total of 153 flora species were recorded within the Additional Biodiversity Offset Area, of which 135 (88 per cent) are native and 18 (12 per cent) are introduced species. A full list of the flora species recorded during survey of the Additional Biodiversity Offset Area is presented in Table 2 of **Appendix A**.

One species was from the Class Coniferopsida (conifers), two species were from the Class Filicopsida (ferns), and 150 from Magnoliopsida (flowering plants) (of which 47 were from sub-class Liliidae (monocots) and 103 from sub-class Magnoliidae (dicots)). Flora species were recorded from 42 plant families, the most speciose being Poaceae (39 species), Asteraceae (20 species) Fabaceae (14 species) and Myrtaceae (9 species).

6.3.3.3 Threatened Flora Species and Endangered Flora Populations

Weeping Myall (*Acacia pendula*)

Weeping myall (*Acacia pendula*) in the Hunter Valley, listed as an endangered population in the Hunter Valley, was recorded in five locations in the Additional Biodiversity Offset Area (refer to **Figure 6.2**).

The weeping myall recorded in the Additional Biodiversity Offset Area are mostly regenerating individuals, present in small discrete patches, within the Slaty Box Woodland or Modified Native Grassland communities. The Hunter Valley Weeping Myall Woodland EEC, listed under the TSC Act, is therefore not considered to be present as the weeping myall does not form a woodland community and the species typically associated with this EEC are not present.

Lobed bluegrass (*Bothriochloa biloba*)

Lobed bluegrass (*Bothriochloa biloba*) is listed as vulnerable under the EPBC Act. It was previously listed under the TSC Act, however it has been de-listed due to an increasing abundance of records. This threatened grass species has been recorded in high abundance in the Additional Biodiversity Offset Area (**Figure 6.2**). Based on observations of this species for previous studies, it is considered likely that the majority of grassland habitats within the Additional Biodiversity Offset Area would support *Bothriochloa biloba* in varying densities.

6.3.3.4 Fauna Habitat

Two terrestrial fauna habitat formations occur within the Additional Biodiversity Offset Area, aligning with the mapped vegetation communities (**Figure 6.2**), being Woodland and Grassland. The Additional Biodiversity Offset Area contains approximately 165.3 hectares of Woodland habitat and 164.2 hectares of Grassland habitat. Each of the habitat formations is reasonably widespread within the locality.

The Woodland habitat is dominated by Ironbark Woodland Complex and Slaty Box Woodland. The structure of this habitat type is characterised by a medium to low canopy height (to 17 metres) with less than 20 per cent canopy cover. The blossoming *Eucalyptus* spp. and *Angophora floribunda* provide foraging resources for nectarivorous and insectivorous species, including threatened mammals such as the squirrel glider (*Petaurus norfolcensis*) and threatened woodland birds such as the brown treecreeper (eastern subsp.) (*Climacteris picumnus victoriae*) and diamond firetail (*Stagonopleura guttata*). Scattered mature hollow-bearing trees provide potential nesting resources for large arboreal mammal, owls, micro-bats and other hollow dependent fauna. Approximately five hollows per hectare were identified within this habitat type in the Additional Biodiversity Offset Area.

The understorey stratum in the Woodland habitat is generally open and therefore provides potential foraging habitat for micro-bats, macropods and woodland birds. A moderate density of log and rock cover occurs throughout the area, which provides cover for small mammal, reptile and amphibian species. Several small farm dams occur throughout the Additional Biodiversity Offset Area and two ephemeral creeks are likely to provide occasional water resources. These water resources support common amphibian species such as the smooth toadlet (*Uperoleia laevis*) and broad-palmed frog (*Litoria latopalmata*), and provide a freshwater drinking resource for a wide range of fauna species. Exposed rocks occur in the north-west of the Additional Biodiversity Offset Area providing foraging and refuge habitat for reptile and small mammal species.

The Grassland habitat consists of an open pasture area, highly disturbed from grazing over many years. This habitat occurs mostly along the northern, eastern and southern boundaries

of the Additional Biodiversity Offset Area. The structure of this habitat is characterised by open grassy areas with scattered isolated trees (to 20 metres) comprising species from adjacent vegetation communities. The scattered trees provide several large and small hollows providing potential nesting resources for arboreal mammals, micro-bats and a range of bird species including large forest owls. The ground cover is dense, dominated by native grasses and forbs, and a large number of fallen logs occur, providing foraging and refuge for small mammal, reptile and amphibian species. Exposed rocks occurs in the north-west of the Additional Biodiversity Offset Area providing foraging and refuge habitat for reptile and small mammal species.

6.3.3.5 Fauna Species

A total of 83 fauna species were identified in the Additional Biodiversity Offset Area during the field surveys, including 54 bird, 6 reptile, 2 amphibian and 21 mammal species. A complete list of these species is provided in Table 2 of **Appendix B**.

Of the 54 bird species recorded during the surveys 4 species are listed as vulnerable under the TSC Act, 6 species listed as migratory under the EPBC Act and 6 species listed as marine/migratory under the EPBC Act. The identified TSC Act listed Vulnerable species included the little lorikeet (*Glossopsitta pusilla*), brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) and diamond firetail (*Stagonopleura guttata*). One introduced bird species was also identified in the Additional Biodiversity Offset Area, being the common myna (*Sturnus tristis*).

Six species of reptile were identified in the Additional Biodiversity Offset Area during surveys including the thick-tailed gecko (*Underwoodisaurus milii*), striped skink (*Ctenotus robustus*), *Egernia modesta*, tree-skink (*Egernia striolata*), garden skink (*Lampropholis guichenoti*) and weasel skink (*Saproscincus musteline*). The most commonly identified reptile species was *Egernia modesta*. None of these species are listed threatened under either the TSC Act or EPBC Act.

Two amphibian species were identified within the Additional Biodiversity Offset Area, being the smooth toadlet (*Uperoleia laevis*) and broad-palmed frog (*Litoria latopalmata*). Both of these species were commonly heard calling during spotlighting. Neither species is listed as under the TSC Act or EPBC Act.

A total of 21 mammal species were identified within the Additional Biodiversity Offset Area during surveys. Terrestrial mammals included the eastern grey kangaroo (*Macropus giganteus*), common brushtail possum (*Trichosurus vulpecula*) and red-necked wallaby (*Macropus rufogriseus*). Sixteen micro-bat species were also recorded. Four threatened mammal species (all micro-bats) were identified, being the eastern freetail-bat (*Mormopterus norfolkensis*), large-eared pied bat (*Chalinolobus dwyeri*), eastern cave bat (*Vespadelus troughtoni*) and eastern bentwing-bat (*Miniopterus schreibersii oceanensis*). These species are listed as vulnerable under the TSC Act, with the large-eared pied bat (*Chalinolobus dwyeri*) also listed as Vulnerable under the EPBC Act. Two introduced mammal species were identified in the Additional Biodiversity Offset Area, the fox (*Vulpes vulpes*) and brown hare (*Lepus capensis*).

6.3.3.6 Threatened Fauna Species

The following threatened fauna species were recorded within the Additional Biodiversity Offset Area, as a result of field surveys completed for this project:

- little lorikeet (*Glossopsitta pusilla*);
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- diamond firetail (*Stagonopleura guttata*);
- eastern freetail-bat (*Mormopterus norfolkensis*);
- large-eared pied bat (*Chalinolobus dwyeri*);
- eastern cave bat (*Vespadelus troughtoni*); and
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

6.3.3.7 Key Ecological Components of the Additional Biodiversity Offset Area

When combined with the offsetting proposed for the 500 kV transmission line project, the Additional Biodiversity Offset Area totals 64 hectares, containing the following significant ecological features:

- 21.0 hectares of the Ironbark Woodland Complex (consistent with Central Hunter Grey Box – Ironbark Woodland EEC);
- 30.7 hectares of Slaty Box Woodland (consistent with Hunter Valley Footslopes Slaty Gum Woodland VEC);
- 1.2 hectares of Forest Red Gum Riparian Woodland;
- records of eastern cave bat (*Vespadelus troughtoni*);
- records of eastern freetail-bat (*Mormopterus norfolkensis*);
- records of eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- records of large-eared pied bat (*Chalinolobus dwyeri*);
- records of the brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*); and
- records of the diamond firetail (*Stagonopleura guttata*).

When combined, these records contribute to the ecological value of this area, and highlight the suitability of it as an offset area for the impacts of the proposed modification and ETL relocation projects.

6.3.3.8 Corridor Value

Apart from the above ecological features of this offset area, it provides valuable corridor function within a generally fragmented landscape. The Additional Biodiversity Offset Area is primarily vegetated, and its protection will ensure existing vegetated connectivity from the heavily vegetated existing Conservation Offset Area in the north to the vegetated habitats of the Myambat Military Area. This will provide additional security to the existing corridor function of this area, which will assist in preserving movement corridors for flora and fauna in

the local area. This improved security will, in turn assist in securing this connectivity on a regional basis.

On a larger scale, the Additional Biodiversity Offset Area will integrate with the existing Biodiversity Offset Area by way of adding to the existing corridor value of these offsets. Part of the approval conditions of the Anvil Hill Project EA (Umwelt 2006), was a requirement to provide:

one external corridor to the north and one external corridor to the west.

These corridors are to form part of the Biodiversity Offset Areas for the Mangoola Coal Project, by way of providing vegetated egress from the approved project disturbance area in front of the advancing mine, as well as to provide a recolonisation pathway following rehabilitation of the post-mining landscape. To this end, the two external corridors will connect the project area with nearby secure habitats within either the conservation or Crown lands systems.

The locations of these external corridors are currently being finalised, however they will be subject to revegetation works (where necessary) to provide a continuous vegetated connectivity throughout the local area in the long term. The location of the proposed Additional Biodiversity Offset Area will complement this corridor package in the local area, by way of securing existing vegetated cover in a southern direction from the bottom of the existing Biodiversity Offset Areas into the Myambat Military Area. This will add to the security of flora and fauna passage throughout the local area in the long term.

6.3.4 Ecological Management

A number of general management strategies will be employed across the Additional Biodiversity Offset Area to ensure the future ecological integrity of the property. These include the following:

- Removal of Stock – Grazing will cease in the offset area upon establishment, apart from specific cases where short term strategic grazing (under specific ecological requirements and strict management via the Draft ROMP) is deemed appropriate for the control of undesirable pasture species in the grassland community. Such strategic grazing would only occur in specific short-term periods, and would be heavily regulated. The general exclusion of stock will remove existing pressures on the offset areas, and is likely to encourage natural regeneration of native species from the seed bank, and migration of vegetation from adjoining vegetated areas.

It is not practicable to remove grazing impacts from native fauna species such as macropods in these areas. However grazing from native animals generally has a much lower impact on native vegetation.

- Fencing/Access Control – Fencing will be used to ensure that the Additional Biodiversity Offset Area is appropriately protected from impacts such as grazing, damage to vegetation from vehicles or trampling, increased rubbish dumping and alteration to normal fauna behaviour patterns due to human presence. Any fencing will use non-barbed (plain) wire only, as these areas are to be managed specifically for ecological purposes. The exclusion of barbed wire from fencing will minimise potential injury or death of fauna species, particularly macropods and gliding or flying mammals, such as the squirrel glider (*Petaurus norfolcensis*) and threatened micro-bats. Fencing design will also consider the use of as few wire strands as practical to reduce potential for macropod entanglement. Appropriate signage will be used throughout the area to identify the purpose of the area and also to identify areas of high ecological significance.

- Weed and Feral Animal Control – The presence of weed and feral animal species has the potential to significantly decrease the value of this offset area to native species, particularly threatened species. Weed and feral animal management controls will be incorporated into the management of this offset area, to detail the types of species known to be present and required control methods and frequencies. Weeds and feral animals will be monitored on a regular basis to ensure infestations do not decrease the ecological integrity of this offset area.

6.3.5 Monitoring

The Additional Biodiversity Offset Area will be subject to annual monitoring and maintenance actions, to document the ecological integrity of the area. The monitoring will focus on the most appropriate indicators and methods that:

- provide a good indication of the status of the environmental value that the offset area aims to protect;
- are relatively simple to measure and are reproducible; and
- are cost effective.

Monitoring events will identify any maintenance actions required, whether assistance is required to achieve target native vegetation communities, and will target issues such as fence condition, progression of regeneration and the need for targeted weeding.

Monitoring works to be completed within the Additional Biodiversity Offset Area will be of a comparable type, frequency and effort to those that are being undertaken within the Biodiversity Offset Areas for the Mangoola Coal Project, as defined within the Draft ROMP (Umwelt, in prep.). Baseline data will be collected as soon as the offset area is established, to ensure an appropriate benchmark is set from which to compare the ongoing ecological condition.

6.4 Performance Against DECCW Offsetting Principles

This section provides a comparison of the performance of the impact mitigation and biodiversity offsetting measures proposed as part of the Project against the principles for biodiversity offsetting (DECCW 2008).

- **Impacts must be avoided first by using prevention and mitigation measures**

The project has been designed in a manner that creates as little disturbance to the ecological features of the Biodiversity Offset Areas as possible, whilst maintaining the economic feasibility and practicality of the project. Redesign of one of the Proposed Modification Areas has resulted in the avoidance of a substantial sub-population (at least 120 individuals) of tricolour diuris (*Diuris tricolor*). Where impact on ecological features has been unavoidable, robust Impact Mitigation and Biodiversity Offset Strategies have been provided to address mitigation of residual impacts in the long term.

- **All regulatory requirements must be met**

The Impact Mitigation and Biodiversity Offset strategies for this project have been developed in accordance with the offsetting regulatory requirements, particularly the requirements of the Director-General of the Department of Planning (which includes consideration of the issues of concern of all other relevant regulatory authorities).

- **Offsets must never reward ongoing poor performance**

Xstrata has a long history of ecological management and monitoring within its holdings, which include a number of large mines that have been operating for many years. All ecological management and monitoring within the Biodiversity Offset Areas is subject to detailed requirements of the existing Project Approval including the ROMP, and will be subject to regular review as part of the audit process established by the current Project Approval.

- **Offsets will complement other government programs**

The proposed Impact Mitigation and Biodiversity Offset Strategies do not contradict any government programs relevant to the local area, nor do they impact on national parks, nature reserves, state conservation areas or state forests in the area. The Impact Mitigation and Biodiversity Offset Strategies will complement the existing ecological management and monitoring requirements for Mangoola Coal, and these have been documented within the Draft ROMP (Umwelt, in prep.).

- **Offsets must be underpinned by sound ecological principles**

The Impact Mitigation and Biodiversity Offset Strategies have been developed with the aim to improve the biodiversity values of the area. To achieve this, a variety of actions/strategies will be employed to address specific impacts of the project. Such actions and strategies are commonly employed in projects of this type, and are well tested and accepted in relation to their ability to address impacts. The Additional Biodiversity Offset Area has been selected due to its existing ecological features (that are similar to those within the Proposed Modification Areas) as well as its vegetated contiguity with the existing Conservation Offset Area for the Mangoola Coal Project and other adjoining areas. This positioning of the offset will provide the area within protected vegetation that connects through the western portion of the Mangoola Coal Project area, in the Additional Biodiversity Offset Area and then south in to the protected habitats of the Myambat Military Area.

- **Offsets should aim to result in a net improvement in biodiversity over time**

The proposed Impact Mitigation and Biodiversity Offset Strategies have been developed with the aim to maintain or improve the biodiversity values of the area. With the various impact mitigation strategies to be employed as part of the project, it is likely that such an improvement will occur. This will primarily be as a result of the long-term protection of at least 34 hectares of native vegetation (plus the 30 hectares proposed for the 500 kV relocation project), the natural regeneration of disturbed vegetation within the offset area and long-term ecological management and monitoring of the area.

- **Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs**

The proposed impact mitigation and biodiversity offset commitments for this project will occur over the long-term (that is beyond the life of the mine), until such time that the commitments have been achieved, completion criteria have been met and sign-off has occurred.

The Additional Biodiversity Offset Area will be secured for long-term conservation. The mechanism for securing this conservation will be determined in consultation with DoP and DECCW.

- **Offsets should be agreed prior to the impact occurring**

The proposed Impact Mitigation and Biodiversity Offset Strategies contained within this Ecological Assessment represent the entire suite of actions that will be employed in order to reduce the impact of the project on ecological features. The Draft ROMP for the Mangoola Coal Project will further define the commitments within this document, and address any additional issues that arise as part of the review and approvals process. The ROMP has been submitted to the relevant authorities for approval.

The Impact Mitigation and Biodiversity Offset Strategies allow for the up-front protection of the Additional Biodiversity Offset Area, to provide immediate compensation for loss of habitat from the Proposed Modification Areas.

Clearing of vegetation within the Proposed Modification Areas will occur progressively, which will help to ensure the impact from loss of vegetation is minimised. Similarly, the return of hollows (via nest boxes or salvaged hollows) will occur within no more than three months of their initial removal, to ensure breeding opportunities are not lost as a result of loss of habitat.

- **Offsets must be quantifiable and the impacts and benefits must be reliably estimated**

The Impact Mitigation and Biodiversity Offset Strategies have been developed through detailed consideration of known impacts on known records of threatened species, endangered populations and TECs (including their habitats), which have been identified and discussed in **Section 4.0**. The planning of the Additional Biodiversity Offset Area took into account such identified impacts, and identified preferences based on the ability of such available areas to appropriately address such impacts.

The area of impact has been derived from detailed mapping of project boundaries and impact areas, and the ecological survey, mapping and impact assessments have been completed by qualified ecologists with considerable experience in the region.

- **Offsets must be targeted**

The development of the Impact Mitigation and Biodiversity Offset Strategies has been based on addressing the identified ecological impacts of the project (see **Section 4.0**). These impacts have been identified via a thorough survey and assessment process, which has been described in detail within this document. Following this identification of impact, the Impact Mitigation and Biodiversity Offset Strategies have been designed to provide mitigation actions targeted at each of the major impacts.

- **Offsets must be located appropriately**

The Additional Biodiversity Offset Area is located on land that is wholly owned by Xstrata Mangoola, and adjoins the existing Conservation Offset Area for the Mangoola Coal Project. The vegetation and habitats represented within this offset area are representative of the vegetation types and habitats that will be lost within the Proposed Modification Areas.

- **Offsets must be supplementary**

The Additional Biodiversity Offset Area is being proposed in addition to the existing extensive Biodiversity Offset Areas that have been put forward as part of the Mangoola Coal Project. Thirty hectares of this property have been offered to offset impacts from the proposed 500 kV relocation project, and an additional 34 hectares is proposed to

offset impacts from the current modification project. There are currently no existing conservation-based commitments on this area.

- **Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.**

As the Impact Mitigation and Biodiversity Offset Strategies are being proposed as an integral component of this project, it is expected that the commitments in these strategies will be included within the project approval conditions and any other legally binding consents as they form part of the Statement of Commitments for the Environmental Assessment for the project.

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APPENDIX A

Flora Species List

Appendix A – Flora Species List

Table 1 of this appendix provides a list of all vascular plants recorded in the Assessment Areas during the fieldwork completed (see Section 2.2 of the main report). **Table 2** documents those vascular plants recorded during surveys of the additional biodiversity offset area (see Section 6.3.2 of the main report). Not all species are readily detected at any one time of the year, therefore the list will not necessarily include all plant species likely to occur in the areas surveyed. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

- | | |
|-------|---|
| sp. | specimens that are identified to genus level only; |
| ? | specimens for which identification was uncertain; |
| prob. | specimens for which identification was considered highly likely but not definite; |
| poss. | specimens for which identification was considered likely but not definite; |

The following abbreviations or symbols are used in the list:

- | | |
|--------------|---|
| asterisk (*) | denotes species not indigenous to the Assessment Areas; |
| subsp. | subspecies; |
| var. | variety; |
| f. | forma; and |
| X | hybrid. |

Threatened species or endangered populations are indicated in bold type.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2009), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Table 1 – Flora Species Recorded from Assessment Areas

Family	Scientific Name	Common Name
Coniferopsida (Conifers)		
Cupressaceae	<i>Callitris endlicheri</i>	black cypress pine
Filicopsida (Ferns)		
Adiantaceae	<i>Cheilanthes distans</i>	bristly cloak fern
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	poison rock fern
Aspleniaceae	<i>Asplenium flabellifolium</i>	necklace fern
Magnoliopsida (flowering plants) - Liliidae (monocots)		
Anthericaceae	<i>Caesia parviflora</i>	pale grass-lily
Anthericaceae	<i>Laxmannia gracilis</i>	slender wire lily
Anthericaceae	<i>Tricoryne elatior</i>	yellow autumn-lily
Cyperaceae	<i>Carex appressa</i>	tall sedge
Cyperaceae	<i>Carex inversa</i>	knob sedge
Cyperaceae	<i>Cyperus enervis</i>	
Cyperaceae	<i>Cyperus polystachyos</i>	
Cyperaceae	<i>Eleocharis plana</i>	flat spike-sedge
Cyperaceae	<i>Gahnia aspera</i>	rough saw-sedge
Cyperaceae	<i>Lepidosperma laterale</i>	
Cyperaceae	<i>Schoenus apogon</i>	fluke bogrush
Juncaceae	* <i>Juncus acutus</i> subsp. <i>acutus</i>	sharp rush
Juncaceae	<i>Juncus mollis</i>	
Lomandraceae	<i>Lomandra confertifolia</i>	mat rush
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	wattle mat rush
Lomandraceae	<i>Lomandra longifolia</i>	spiny-headed mat-rush
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	many-flowered mat-rush
Orchidaceae	<i>Cymbidium canaliculatum</i>	tiger orchid
Orchidaceae	<i>Diuris tricolor</i>	tricolour diuris
Orchidaceae	<i>Microtis unifolia</i>	common onion orchid
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>	blue-flax lily
Poaceae	<i>Aristida ramosa</i>	purple wiregrass
Poaceae	<i>Aristida vagans</i>	threeawn speargrass
Poaceae	<i>Austrodanthonia</i> sp.	
Poaceae	<i>Austrostipa scabra</i> subsp. <i>scabra</i>	speargrass
Poaceae	<i>Austrostipa</i> sp.	
Poaceae	<i>Austrostipa verticillata</i>	slender bamboo grass
Poaceae	* <i>Avena sativa</i>	oats
Poaceae	<i>Bothriochloa biloba</i>	lobed blue-grass
Poaceae	<i>Bothriochloa decipiens</i>	red grass
Poaceae	* <i>Briza minor</i>	shivery grass
Poaceae	* <i>Bromus catharticus</i>	prairie grass
Poaceae	* <i>Bromus molliformis</i>	soft brome

Family	Scientific Name	Common Name
Poaceae	* <i>Chloris gayana</i>	Rhodes grass
Poaceae	<i>Cymbopogon refractus</i>	barbed wire grass
Poaceae	<i>Chloris truncata</i>	windmill grass
Poaceae	<i>Cynodon dactylon</i>	common couch
Poaceae	<i>Dichelachne crinita</i>	longhair plumegrass
Poaceae	* <i>Hordeum leporinum</i>	barley grass
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	blady grass
Poaceae	* <i>Lolium perenne</i>	perennial ryegrass
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	weeping grass
Poaceae	* <i>Phalaris aquatica</i>	phalaris
Poaceae	<i>Sporobolus caroli</i>	fairy grass
Poaceae	<i>Sporobolus contiguus</i>	
Magnoliopsida (flowering plants) - Magnoliidae (dicots)		
Acanthaceae	<i>Brunoniella australis</i>	blue trumpet
Aizoaceae	* <i>Galenia pubescens</i>	galenia
Anacardiaceae	* <i>Schinus areira</i>	pepper tree
Apiaceae	* <i>Cyclospermum leptophyllum</i>	slender celery
Apiaceae	<i>Centella asiatica</i>	pennywort
Apiaceae	<i>Daucus glochidiatus</i>	native carrot
Apiaceae	<i>Hydrocotyle laxiflora</i>	stinking pennywort
Apocynaceae	* <i>Nerium oleander</i>	oleander
Asclepiadaceae	* <i>Gomphocarpus fruticosus</i>	narrow-leaved cotton bush
Asclepiadaceae	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	native pear
Asteraceae	* <i>Aster subulatus</i>	wild aster
Asteraceae	* <i>Bidens subalternans</i>	greater beggars ticks
Asteraceae	<i>Brachycome spathulata</i>	
Asteraceae	<i>Calocephalus citreus</i>	lemon beauty-heads
Asteraceae	<i>Calotis lappulacea</i>	yellow burr-daisy
Asteraceae	* <i>Carthamus lanatus</i>	saffron thistle
Asteraceae	<i>Cassinia arcuata</i>	sifton bush
Asteraceae	<i>Cassinia laevis</i>	cough bush
Asteraceae	<i>Cassinia quinquefaria</i>	cough bush
Asteraceae	<i>Chrysocephalum apiculatum</i>	common everlasting
Asteraceae	* <i>Cirsium vulgare</i>	spear thistle
Asteraceae	* <i>Conyza sumatrensis</i>	tall fleabane
Asteraceae	* <i>Facelis retusa</i>	
Asteraceae	* <i>Gamochaeta americana</i>	cudweed
Asteraceae	<i>Olearia elliptica</i>	sticky daisy bush
Asteraceae	* <i>Senecio madagascariensis</i>	fireweed
Asteraceae	* <i>Silybum marianum</i>	variegated thistle
Asteraceae	* <i>Sonchus oleraceus</i>	common sowthistle
Asteraceae	* <i>Taraxacum officinale</i>	dandelion
Asteraceae	<i>Vittadinia muelleri</i>	

Family	Scientific Name	Common Name
Asteraceae	* <i>Xanthium occidentale</i>	Noogoora burr
Asteraceae	* <i>Xanthium spinosum</i>	Bathurst burr
Asteraceae	* <i>Xanthium</i> sp.	
Boraginaceae	* <i>Echium plantagineum</i>	Patersons curse
Brassicaceae	* <i>Capsella bursa-pastoris</i>	shepherds purse
Brassicaceae	* <i>Coronopus didymus</i>	lesser swinecress
Brassicaceae	* <i>Lepidium bonariense</i>	
Brassicaceae	* <i>Rapistrum rugosum</i>	turnip weed
Brassicaceae	* <i>Sisymbrium irio</i>	London rocket
Brassicaceae	<i>Rorippa laciniata</i>	
Cactaceae	* <i>Opuntia aurantiaca</i>	tiger pear
Cactaceae	* <i>Opuntia stricta</i> var. <i>stricta</i>	common prickly pear
Campanulaceae	<i>Wahlenbergia communis</i>	tufted bluebell
Campanulaceae	<i>Wahlenbergia gracilis</i>	Australian bluebell
Caryophyllaceae	* <i>Paronychia brasiliensis</i>	Chilean whitlow wort
Caryophyllaceae	* <i>Petrorhagia velutina</i>	velvet pink
Caryophyllaceae	* <i>Silene gallica</i> var. <i>gallica</i>	French catchfly
Casuarinaceae	<i>Allocasuarina littoralis</i>	black sheoak
Casuarinaceae	<i>Allocasuarina luehmannii</i>	bulloak
Casuarinaceae	<i>Casuarina glauca</i>	swamp oak
Celastraceae	<i>Maytenus silvestris</i>	narrow-leaved orangebark
Chenopodiaceae	<i>Chenopodium</i> sp.	
Chenopodiaceae	<i>Einadia hastata</i>	berry saltbush
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>nutans</i>	climbing saltbush
Chenopodiaceae	<i>Enchylaena tomentosa</i>	ruby saltbush
Chenopodiaceae	<i>Maireana microphylla</i>	small-leaved bluebush
Chenopodiaceae	<i>Sclerolaena birchii</i>	galvanized burr
Chloanthaceae	<i>Spartothamnella juncea</i>	bead bush
Clusiaceae	<i>Hypericum gramineum</i>	small St Johns wort
Convolvulaceae	<i>Dichondra repens</i>	kidney weed
Crassulaceae	<i>Crassula decumbens</i> var. <i>decumbens</i>	
Crassulaceae	<i>Crassula sieberiana</i> subsp. <i>sieberiana</i>	Australian stonecrop
Droseraceae	<i>Drosera peltata</i> subsp. <i>peltata</i>	sundew
Epacridaceae	<i>Melichrus urceolatus</i>	urn heath
Euphorbiaceae	<i>Phyllanthus virgatus</i>	
Fabaceae (Faboideae)	<i>Bossiaea heterophylla</i>	variable bossiaea
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	broom bitter pea
Fabaceae (Faboideae)	<i>Desmodium gunnii</i>	slender tick trefoil
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	twining glycine
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	variable glycine
Fabaceae (Faboideae)	<i>Kennedia rubicunda</i>	red Kennedy pea
Fabaceae (Faboideae)	* <i>Medicago orbicularis</i>	button medic
Fabaceae (Faboideae)	<i>Pultenaea cinerascens</i>	

Family	Scientific Name	Common Name
Fabaceae (Faboideae)	<i>*Trifolium arvense</i>	haresfoot clover
Fabaceae (Faboideae)	<i>*Trifolium campestre</i>	hop clover
Fabaceae (Faboideae)	<i>*Trifolium glomeratum</i>	clustered clover
Fabaceae (Faboideae)	<i>*Trifolium repens</i>	white clover
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	western golden wattle
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	hickory wattle
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	cooba
Fabaceae (Mimosoideae)	<i>Acacia</i> sp.	
Geraniaceae	<i>Erodium crinitum</i>	blue storksbill
Geraniaceae	<i>Geranium</i> sp.	
Goodeniaceae	<i>Goodenia heterophylla</i> subsp. <i>heterophylla</i>	
Goodeniaceae	<i>Goodenia ovata</i>	hop goodenia
Goodeniaceae	<i>Goodenia pinnatifida</i>	
Lamiaceae	<i>Salvia reflexa</i>	mintweed
Lamiaceae	<i>Ajuga australis</i>	austral bugle
Lobeliaceae	<i>Isotoma axillaris</i>	showy isotome
Lobeliaceae	<i>Pratia concolor</i>	poison pratia
Loranthaceae	<i>Amyema</i> sp.	
Malvaceae	<i>*Modiola caroliniana</i>	red-flowered mallow
Malvaceae	<i>*Sida rhombifolia</i>	Paddys lucerne
Malvaceae	<i>Sida corrugata</i>	corrugated sida
Malvaceae	<i>Sida filiformis</i>	
Malvaceae	<i>Sida spinosa</i>	
Malvaceae	<i>Sida subspicata</i>	
Myoporaceae	<i>Eremophila debilis</i>	amulla
Myoporaceae	<i>Myoporum montanum</i>	western boobialla
Myrtaceae	<i>Angophora floribunda</i>	rough-barked apple
Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved ironbark
Myrtaceae	<i>Eucalyptus dawsonii</i>	slaty box
Myrtaceae	<i>Eucalyptus moluccana</i>	grey box
Myrtaceae	<i>Kunzea ambigua</i>	tick bush
Myrtaceae	<i>Melaleuca decora</i>	
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	native olive
Oxalidaceae	<i>Oxalis exilis</i>	wood sorrell
Oxalidaceae	<i>Oxalis perennans</i>	wood sorrell
Oxalidaceae	<i>Oxalis</i> sp.	
Papaveraceae	<i>*Argemone ochroleuca</i>	Mexican poppy
Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	blackthorn
Plantaginaceae	<i>*Plantago lanceolata</i>	lambs tongues
Plantaginaceae	<i>Plantago debilis</i>	native plantain
Polygonaceae	<i>*Rumex crispus</i>	curled dock
Polygonaceae	<i>Rumex brownii</i>	swamp dock
Primulaceae	<i>*Anagallis arvensis</i>	scarlet pimpernel
Proteaceae	<i>*Grevillea robusta</i>	silky oak

Family	Scientific Name	Common Name
Ranunculaceae	<i>Clematis aristata</i>	old mans beard
Rosaceae	<i>Acaena echinata</i>	sheeps burr
Rubiaceae	<i>Asperula conferta</i>	common woodruff
Rubiaceae	<i>Galium</i> sp.	
Rubiaceae	<i>Psydrax odorata</i>	shiny-leaved canthium
Sapindaceae	<i>Dodonaea viscosa</i>	sticky hop bush
Scrophulariaceae	* <i>Verbascum virgatum</i>	twiggy mullein
Scrophulariaceae	<i>Veronica plebeia</i>	trailing speedwell
Solanaceae	* <i>Lycium ferocissimum</i>	African boxthorn
Solanaceae	<i>Solanum americanum</i>	glossy nightshade
Solanaceae	* <i>Solanum nigrum</i>	black-berry nightshade
Solanaceae	<i>Solanum prinophyllum</i>	forest nightshade
Solanaceae	<i>Solanum</i> sp.	
Solanaceae	<i>Solanum stelligerum</i>	devils needles
Stackhousiaceae	<i>Stackhousia muricata</i>	
Stackhousiaceae	<i>Stackhousia viminea</i>	slender stackhousia
Sterculiaceae	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	kurrajong
Verbenaceae	* <i>Verbena bonariensis</i>	purpletop
Verbenaceae	* <i>Verbena rigida</i>	veined verbena

Table 2 – Flora Species Recorded from Additional Biodiversity Offset Area

Family	Scientific Name	Common Names
Coniferopsida (Conifers)		
Cupressaceae	<i>Callitris endlicheri</i>	black cypress pine
Filicopsida (Ferns)		
Adiantaceae	<i>Cheilanthes distans</i>	bristly cloak fern
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	poison rock fern
Magnoliopsida (Flowering Plants) – Lillidae (Monocots)		
Anthericaceae	<i>Dichopogon strictus</i>	chocolate lily
Anthericaceae	<i>Laxmannia gracilis</i>	slender wire lily
Anthericaceae	<i>Tricoryne elatior</i>	yellow autumn-lily
Commelinaceae	<i>Commelina cyanea</i>	native wandering Jew
Cyperaceae	<i>Carex appressa</i>	tall sedge
Cyperaceae	<i>Cyperus gracilis</i>	
Cyperaceae	<i>Fimbristylis dichotoma</i>	common fridge-sedge
Phormiaceae	<i>Dianella</i> sp.	
Poaceae	* <i>Aristida jerichoensis</i> var. <i>jerichoensis</i>	Jericho wiregrass
Poaceae	<i>Aristida queenslandica</i> var. <i>queenslandica</i>	
Poaceae	<i>Aristida ramosa</i>	purple wiregrass
Poaceae	<i>Aristida</i> sp.	
Poaceae	<i>Aristida vagans</i>	threeawn speargrass
Poaceae	<i>Austrodanthonia fulva</i>	wallaby grass
Poaceae	<i>Austrodanthonia</i> sp.	
Poaceae	<i>Austrostipa scabra</i>	speargrass
Poaceae	<i>Austrostipa scabra</i> subsp. <i>scabra</i>	corkscrew grass
Poaceae	<i>Austrostipa verticillata</i>	slender bamboo grass
Poaceae	<i>Bothriochloa biloba</i>	lobed bluegrass
Poaceae	<i>Bothriochloa decipiens</i>	red grass
Poaceae	<i>Bothriochloa macra</i>	red grass
Poaceae	<i>Chloris divaricata</i>	
Poaceae	* <i>Chloris gayana</i>	Rhodes grass
Poaceae	<i>Chloris truncata</i>	windmill grass
Poaceae	<i>Chloris ventricosa</i>	tall chloris
Poaceae	<i>Cymbopogon refractus</i>	barbed wire grass
Poaceae	<i>Cynodon dactylon</i>	common couch
Poaceae	<i>Dactyloctenium radulans</i>	button grass
Poaceae	<i>Dichanthium sericeum</i>	queensland bluegrass
Poaceae	<i>Dichelachne micrantha</i>	shorthair plumegrass
Poaceae	<i>Digitaria diffusa</i>	
Poaceae	<i>Digitaria divaricatissima</i>	umbrella grass
Poaceae	<i>Elymus scaber</i>	
Poaceae	<i>Enneapogon gracilis</i>	slender nineawn
Poaceae	<i>Eragrostis leptostachya</i>	paddock lovegrass
Poaceae	<i>Eragrostis parviflora</i>	weeping lovegrass
Poaceae	<i>Eragrostis</i> sp.	

Family	Scientific Name	Common Names
Poaceae	<i>Eriochloa pseudoacrotricha</i>	early spring grass
Poaceae	<i>Eulalia aurea</i>	silky browntop
Poaceae	* <i>Lolium perenne</i>	perennial ryegrass
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	weeping grass
Poaceae	<i>Panicum effusum</i>	poison or hairy panic
Poaceae	<i>Panicum simile</i>	two-colour panic
Poaceae	* <i>Paspalum dilatatum</i>	paspalum
Poaceae	<i>Paspalidium distans</i>	
Poaceae	<i>Sporobolus creber</i>	slender rats tail grass
Poaceae	<i>Tragus australianus</i>	small burrgrass
Magnoliopsida (flowering plants) – Magnoliidae (dicots)		
Acanthaceae	<i>Brunoniella australis</i>	blue trumpet
Aizoaceae	* <i>Galenia pubescens</i>	galenia
Amaranthaceae	<i>Alternanthera denticulata</i>	lesser joyweed
Amaranthaceae	* <i>Gomphrena celosioides</i>	gomphrena weed
Amaranthaceae	<i>Ptilotus semilanatus</i>	
Asclepiadaceae	* <i>Gomphocarpus fruticosus</i>	narrow-leaved cotton bush
Asteraceae	<i>Calocephalus citreus</i>	lemon beauty-heads
Asteraceae	<i>Calotis cuneifolia</i>	purple burr-daisy
Asteraceae	<i>Calotis lappulacea</i>	yellow burr-daisy
Asteraceae	* <i>Carthamus lanatus</i>	saffron thistle
Asteraceae	<i>Cassinia arcuata</i>	sifton bush
Asteraceae	<i>Cassinia laevis</i>	cough bush
Asteraceae	<i>Chrysocephalum apiculatum</i>	common everlasting
Asteraceae	<i>Chrysocephalum semipapposum</i>	clustered everlasting
Asteraceae	* <i>Cirsium vulgare</i>	spear thistle
Asteraceae	* <i>Conyza bonariensis</i>	flaxleaf fleabane
Asteraceae	<i>Epaltes australis</i>	spreading nut-heads
Asteraceae	<i>Glossogyne tannensis</i>	cobblers tack
Asteraceae	<i>Olearia elliptica</i>	sticky daisy bush
Asteraceae	<i>Ozothamnus diosmifolius</i>	white dogwood
Asteraceae	* <i>Schkuhria pinnata</i>	
Asteraceae	* <i>Senecio madagascariensis</i>	fireweed
Asteraceae	* <i>Taraxacum officinale</i>	dandelion
Asteraceae	<i>Vittadinia muelleri</i>	
Asteraceae	<i>Vittadinia pterochaeta</i>	rough fuzzweed
Asteraceae	<i>Vittadinia</i> sp.	
Cactaceae	* <i>Opuntia aurantiaca</i>	tiger pear
Cactaceae	* <i>Opuntia stricta</i> var. <i>stricta</i>	common prickly pear
Campanulaceae	<i>Wahlenbergia communis</i>	tufted bluebell
Campanulaceae	<i>Wahlenbergia gracilis</i>	spawling bluebell
Campanulaceae	<i>Wahlenbergia</i> sp.	
Caryophyllaceae	* <i>Paronychia brasiliiana</i>	Chilean whitlow wort
Casuarinaceae	<i>Allocasuarina littoralis</i>	black sheoak
Casuarinaceae	<i>Allocasuarina luehmannii</i>	bullock

Family	Scientific Name	Common Names
Chenopodiaceae	<i>Atriplex semibaccata</i>	creeping saltbush
Chenopodiaceae	<i>Einadia hastata</i>	berry saltbush
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>linifolia</i>	climbing saltbush
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>nutans</i>	climbing saltbush
Chenopodiaceae	<i>Enchylaena tomentosa</i>	ruby saltbush
Chenopodiaceae	<i>Maireana microphylla</i>	small-leaved bluebush
Chloanthaceae	<i>Spartothamnella juncea</i>	native broom
Clusiaceae	<i>Hypericum gramineum</i>	small St Johns wort
Convolvulaceae	<i>Dichondra repens</i>	kidney weed
Convolvulaceae	<i>Evolvulus alsinoides</i>	
Dilleniaceae	<i>Hibbertia acicularis</i>	
Epacridaceae	<i>Leucopogon muticus</i>	blunt beard-heath
Euphorbiaceae	<i>Chamaesyce drummondii</i>	caustic weed
Euphorbiaceae	<i>Euphorbia planiticola</i>	plains spurge
Euphorbiaceae	<i>Phyllanthus virgatus</i>	
Fabaceae (Faboideae)	<i>Desmodium brachypodum</i>	large tick-trefoil
Fabaceae (Faboideae)	<i>Desmodium gunnii</i>	
Fabaceae (Faboideae)	<i>Desmodium varians</i>	slender tick-trefoil
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	
Fabaceae (Faboideae)	<i>Swainsona behriana</i>	a Swainson-pea
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	western golden wattle
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>	
Fabaceae (Mimosoideae)	<i>Acacia filicifolia</i>	fern-leaved wattle
Fabaceae (Mimosoideae)	<i>Acacia homalophylla–melvillei</i> complex	yarran
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	hickory wattle
Fabaceae (Mimosoideae)	<i>Acacia linearifolia</i>	narrow-leaved wattle
Fabaceae (Mimosoideae)	<i>Acacia</i> prob. <i>pendula</i>	weeping myall
Geraniaceae	<i>Geranium solanderi</i>	native geranium
Lamiaceae	<i>Ajuga australis</i>	austral bugle
Lamiaceae	<i>Mentha satuireioides</i>	native pennyroyal
Linaceae	<i>Linum marginale</i>	native flax
Loranthaceae	<i>Amyema quandang</i>	
Malvaceae	<i>Hibiscus sturtii</i>	hill hibiscus
Malvaceae	<i>Sida corrugata</i>	corrugated sida
Malvaceae	<i>Sida filiformis</i>	
Malvaceae	* <i>Sida rhombifolia</i>	Paddys lucerne
Malvaceae	<i>Sida subspicata</i>	

Family	Scientific Name	Common Names
Myoporaceae	<i>Eremophila debilis</i>	amulla
Myrtaceae	<i>Angophora floribunda</i>	rough-barked apple
Myrtaceae	<i>Eucalyptus blakelyi</i>	Blakelys red gum
Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved ironbark
Myrtaceae	<i>Eucalyptus dawsonii</i>	slaty box
Myrtaceae	<i>Eucalyptus moluccana</i>	grey box
Myrtaceae	<i>Eucalyptus punctata</i>	grey gum
Myrtaceae	<i>Eucalyptus tereticornis</i>	forest red gum
Myrtaceae	<i>Kunzea</i> sp. 'Mt Kaputar'	
Myrtaceae	<i>Melaleuca decora</i>	
Nyctaginaceae	<i>Boerhavia dominii</i>	tarvine
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	native olive
Oxalidaceae	<i>Oxalis exilis</i>	
Oxalidaceae	<i>Oxalis perennans</i>	
Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	native blackthorn
Plantaginaceae	<i>Plantago debilis</i>	native plantain
Polygonaceae	<i>Rumex brownii</i>	swamp dock
Portulacaceae	<i>Portulaca oleracea</i>	pigweed
Rhamnaceae	<i>Alphitonia excelsa</i>	red ash
Rubiaceae	<i>Asperula conferta</i>	common woodruff
Rubiaceae	* <i>Richardia stellaris</i>	
Rubiaceae	<i>Opercularia aspera</i>	coarse stinkweed
Rubiaceae	<i>Psydrax odorata</i>	shiny-leaved canthium
Scrophulariaceae	<i>Veronica plebeia</i>	trailing speedwell
Solanaceae	<i>Solanum brownii</i>	violet nightshade
Solanaceae	<i>Solanum cinereum</i>	Narrawa burr
Solanaceae	<i>Solanum opacum</i>	green-berry nightshade
Solanaceae	<i>Solanum prinophyllum</i>	forest nightshade
Stackhousiaceae	<i>Stackhousia monogyna</i>	creamy candles
Stackhousiaceae	<i>Stackhousia viminea</i>	slender stackhousia

APPENDIX B

Fauna Species List

Appendix B – Fauna Species List

The following list was developed from surveys of the Assessment Areas and the additional biodiversity offset area detailed in Section 2.3 and 6.3.2 (respectively) of the main report. It includes all vertebrate fauna species recorded in the defined areas during fieldwork.

The following abbreviations or symbols are used in the list:

X recorded sighting or audio identification of the species' call during Umwelt surveys;

asterisk (*) denotes species not indigenous to the Assessment Areas;

MAR Listed marine species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);

MIG Listed migratory species under the EPBC Act; and

V Vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act) or EPBC Act.

All threatened species are indicated in **bold** type.

Birds recorded were identified using descriptions in Slater *et al.* (2003) and the scientific and common name nomenclature and taxonomy adopted by Birds Australia. Reptiles recorded were identified using keys and descriptions in Cogger (2000), Swan *et al.* (2004), Weigel (1990) and Wilson and Swan (2003) and the scientific and common name nomenclature and taxonomy adopted by Cogger (2000).

Amphibians recorded were identified using keys and descriptions in Cogger (2000), Robinson (1998), Anstis (2002) and Barker *et al.* (1995) and the scientific and common name nomenclature of Cogger (2000). Mammals recorded were identified using keys and descriptions in Strahan and Van Dyck (2008), Churchill (2008) and Menkhorst and Knight (2004) and the scientific and common name nomenclature of Strahan and Van Dyck (2008), for non-bat species and Churchill (2008) for bats.

Scientific Name	Common Name	Conservation Status		Sites	
		TSC Act	EPBC Act	Assessment Areas	Additional Biodiversity Offset Area
Anatidae					
<i>Chenonetta jubata</i>	Australian wood duck		MIG	X	X
<i>Anas gracilis</i>	grey teal		MIG		X
<i>Anas superciliosa</i>	Pacific black duck		MIG		X
<i>Tachybaptus novaehollandiae</i>	Australasian grebe			X	X
Columbidae					
<i>Phaps chalcoptera</i>	common bronzewing				X
<i>Ocyphaps lophotes</i>	crested pigeon			X	X
Podargidae					
<i>Podargus strigoides</i>	tawny frogmouth				X
Aegothelidae					
<i>Aegotheles cristatus</i>	Australian owllet-nightjar			X	X
Phalacrocoracidae					
<i>Pelecanus conspicillatus</i>	Australian pelican		MAR	X	
Ardeidae					
<i>Egretta novaehollandiae</i>	white-faced heron				X
Accipitridae					
<i>Haliastur sphenurus</i>	whistling kite		MAR & MIG	X	
<i>Aquila audax</i>	wedge-tailed eagle		MIG	X	X
Falconidae					
<i>Falco cenchroides</i>	nankeen kestrel		MAR & MIG	X	
Rallidae					
<i>Porphyrio porphyrio</i>	purple swamphen			X	
Charadriidae					
<i>Vanellus miles</i>	masked lapwing		MIG	X	X
Turnicidae					
<i>Turnix varius</i>	painted button-quail			X	
Cacatuidae					
<i>Cacatua roseicapillus</i>	galah			X	
<i>Cacatua galerita</i>	sulphur-crested cockatoo				X
Psittacidae					
<i>Glossopsitta pusilla</i>	little lorikeet	V			X
<i>Alisterus scapularis</i>	Australian king-parrot			X	
<i>Platycercus eximius</i>	eastern rosella			X	X
<i>Psephotus haematonotus</i>	red-rumped parrot				X
Cuculidae					
<i>Eudynamis orientalis</i>	eastern koel			X	
<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo		MAR	X	

Scientific Name	Common Name	Conservation Status		Sites	
		TSC Act	EPBC Act	Assessment Areas	Additional Biodiversity Offset Area
Strigidae					
<i>Ninox novaeseelandiae</i>	southern boobook		MAR/MIG	X	
Halcyonidae					
<i>Dacelo novaeguineae</i>	laughing kookaburra			X	X
<i>Todiramphus macleayii</i>	forest kingfisher		MAR	X	X
<i>Merops ornatus</i>	rainbow bee-eater		MAR & MIG	X	X
Coraciidae					
<i>Eurystomus orientalis</i>	dollarbird		MAR	X	
Climacteridae					
<i>Corombates leucophaea</i>	white-throated treecreeper			X	X
<i>Climacteris picumnus victoriae</i>	brown treecreeper (eastern subsp.)	V			X
Maluridae					
<i>Malurus cyaneus</i>	superb fairy-wren			X	X
Acanthizidae					
<i>Chthonicola sagittata</i>	speckled warbler	V		X	
<i>Gerygone fusca</i>	western gerygone				X
<i>Gerygone albogularis</i>	white-throated gerygone			X	X
<i>Acanthiza nana</i>	yellow thornbill			X	X
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill			X	X
<i>Acanthiza pusilla</i>	brown thornbill			X	
Pardalotidae					
<i>Pardalotus punctatus</i>	spotted pardalote			X	X
<i>Pardalotus striatus</i>	striated pardalote			X	X
Meliphagidae					
<i>Lichenostomus chrysops</i>	yellow-faced honeyeater			X	X
<i>Lichenostomus leucotis</i>	white-eared honeyeater				X
<i>Lichenostomus penicillatus</i>	white-plumed honeyeater			X	X
<i>Manorina melanocephala</i>	noisy miner			X	X
<i>Phylidonyris niger</i>	white-cheeked honeyeater			X	X
<i>Melithreptus brevirostris</i>	brown-headed honeyeater				X
<i>Melithreptus albogularis</i>	white-throated honeyeater				X
<i>Philemon corniculatus</i>	noisy friarbird			X	X
<i>Plectorhyncha lanceolata</i>	striped honeyeater			X	

Scientific Name	Common Name	Conservation Status		Sites	
		TSC Act	EPBC Act	Assessment Areas	Additional Biodiversity Offset Area
Pomatostomidae					
<i>Pomatostomus temporalis temporalis</i>	grey-crowned babbler (eastern subsp.)	V		X	X
<i>Pomatostomus superciliosus</i>	white-browed babbler				X
Campephagidae					
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike		MAR	X	X
<i>Lalage sueurii</i>	white-winged triller			X	
Pachycephalidae					
<i>Pachycephala rufiventris</i>	rufous whistler			X	X
<i>Colluricincla harmonica</i>	grey shrike-thrush			X	X
Artamidae					
<i>Cracticus torquatus</i>	grey butcherbird			X	
<i>Cracticus nigrogularis</i>	pied butcherbird			X	X
<i>Gymnorhina tibicen</i>	Australian magpie			X	X
<i>Strepera graculina</i>	pied currawong			X	X
Rhipiduridae					
<i>Rhipidura albiscapa</i>	grey fantail			X	X
<i>Rhipidura leucophrys</i>	willie wagtail			X	
Laniidae					
<i>Corvus coronoides</i>	Australian raven			X	X
Monarchidae					
<i>Grallina cyanoleuca</i>	magpie-lark		MAR	X	X
Corcoracidae					
<i>Corcorax melanorhamphos</i>	white-winged chough				X
Petroicidae					
<i>Microeca leucophaea</i>	jacky winter			X	X
<i>Petroica boodang</i>	scarlet robin	PD V		X	
<i>Eopsaltria australis</i>	eastern yellow robin				X
Acrocephalidae					
<i>Acrocephalus australis</i>	Australian reed-warbler		MAR & MIG	X	
Megaluridae					
<i>Cincloramphus mathewsi</i>	rufous songlark		MIG	X	
<i>Zosterops lateralis</i>	silvereye		MAR	X	X
Hirundinidae					
<i>Hirundo neoxena</i>	welcome swallow		MAR	X	
<i>Hirundo nigricans</i>	tree martin		MAR	X	X
Sturnidae					
* <i>Sturnus tristis</i>	common myna			X	
Estrildidae					

Scientific Name	Common Name	Conservation Status		Sites	
		TSC Act	EPBC Act	Assessment Areas	Additional Biodiversity Offset Area
<i>Taeniopygia bichenovii</i>	double-barred finch			X	X
<i>Stagonopleura guttata</i>	diamond firetail	V			X
REPTILES					
Cheloniidae					
<i>Chelodina longicollis</i>	snake-necked turtle		MIG	X	
Gekkonidae					
<i>Diplodactylus vittatus</i>	stone gecko			X	
<i>Underwoodisaurus milii</i>	thick-tailed gecko			X	X
Agamidae					
<i>Pogona barbata</i>	eastern bearded dragon			X	
Scincidae					
<i>Ctenotus robustus</i>	stripped skink			X	X
<i>Egernia modesta</i>					X
<i>Egernia striolata</i>	tree skink			X	X
<i>Lampropholis guichenoti</i>	garden skink				X
<i>Saproscincus mustelina</i>	weasel skink				X
Elapidae					
<i>Furina diadema</i>	red-naped snake			X	
AMPHIBIANS					
Myobatrachidae					
<i>Crinia signifera</i>	brown froglet			X	
<i>Limnodynastes ornatus</i>	ornate burrowing frog			X	
<i>Limnodynastes tasmaniensis</i>	spotted marsh frog			X	
<i>Uperoleia laevis</i>	smooth toadlet				X
<i>Uperoleia rugosa</i>	wrinkled, or eastern burrowing toadlet			X	
Hylidae					
<i>Litoria fallax</i>	green reed frog, dwarf tree frog			X	
<i>Litoria latopalmata</i>	broad-palmed frog			X	X
<i>Litoria peronii</i>	Peron's tree frog			X	
<i>Litoria tyleri</i>	Tyler's tree frog			X	
MAMMALS					
Phalangeridae					
<i>Trichosurus vulpecula</i>	common brushtail possum			X	X
Macropodidae					
<i>Macropus giganteus</i>	eastern grey kangaroo			X	X
<i>Macropus rufogriseus</i>	red-necked wallaby			X	X
Molossidae					
<i>Mormopterus norfolkensis</i>	eastern freetail-bat	V		X	X

Scientific Name	Common Name	Conservation Status		Sites	
		TSC Act	EPBC Act	Assessment Areas	Additional Biodiversity Offset Area
<i>Mormopterus "Species 2"</i>	freetail-bat			X	X
<i>Mormopterus "Species 4"</i>	freetail-bat			X	X
<i>Mormopterus planiceps</i>	southern freetail-bat			X	
<i>Nyctinomus australis</i>	white-striped freetail-bat			X	X
Vespertilionidae					
<i>Miniopterus schreibersii oceanensis</i>	eastern bentwing-bat	V		X	X
<i>Nyctophilus sp</i>	unidentified long-eared bat			X	X
<i>Chalinolobus dwyeri</i>	large-eared pied bat	V	V	X	X
<i>Chalinolobus gouldii</i>	Gould's wattled bat			X	X
<i>Chalinolobus morio</i>	chocolate wattled bat			X	X
<i>Falsistrellus tasmaniensis</i>	eastern false pipistrelle	V		X	
<i>Myotis adversus</i>	large-footed myotis	V		X	
<i>Scotorepens balstoni</i>	inland broad-nosed bat			X	X
<i>Scotorepens orion</i>	eastern broad-nosed bat			X	X
<i>Vespadelus darlingtoni</i>	large forest bat			X	X
<i>Vespadelus pumilus</i>	eastern forest bat				X
<i>Vespadelus troungtoni</i>	eastern cave bat	V		X	X
<i>Vespadelus vulturnus</i>	little forest bat			X	X
Muridae					
<i>*Mus musculus</i>	house mouse			X	
<i>*Rattus sp</i>				X	
Canidae					
<i>*Canis lupus familiaris</i>	dog			X	
<i>*Vulpes vulpes</i>	fox			X	X
Leporidae					
<i>*Lepus capensis</i>	brown hare				X
Bovidae					
<i>*Bos taurus</i>	cow			X	

APPENDIX C

Threatened Species Tables

Appendix C – Threatened Species Tables

The following tables list all threatened species, endangered populations, TECs and EPBC Act listed migratory species which were found to occur or have potential to occur within a 20 kilometre radius of the Assessment Areas. These records have been collated from the literature review, including ecological database searches. An assessment of the potential for each of these records to occur within the Assessment Areas has been made. This assessment is based on the known range and habitat requirements of each species, and comparison with the current understanding of the habitats of the Assessment Areas. Further to this, indication is given as to whether a species requires further assessment of significance in accordance with the requirements of the EP&A Act, in the form of an Assessment of Significance. Some species listed under the EPBC Act require further assessment under that Act.

Table 1 – Threatened Flora Species

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
THREATENED FLORA SPECIES						
lobed blue-grass <i>Bothriochloa biloba</i>	V (EPBC)	Grows in woodlands and grasslands on poorer soils.	Regionally recorded across much of the central and upper Hunter Valley with fewer records in the lower Hunter but as far east as Maitland. This species was recorded within the grasslands of the Anvil Hill Project EA (Umwelt 2006).	This species is not known from any conservation reserves in the region.	There are records of <i>Bothriochloa biloba</i> in grassland habitats of the Assessment Areas and in the local area.	Yes (see Appendix E)
Sandy Hollow commersonia <i>Commersonia rosea</i>	E (TSC) E (EPBC)	Prostrate shrub 0.1-0.3 m high, producing trailing branches up to 60 cm long (Bell and Copeland 2004). Flowering has been observed in August, November, January and February (Bell and Copeland 2004). Occurs on skeletal sandy soils derived from Triassic Narrabeen sandstone, in scrub or heath vegetation (Bell and Copeland 2004). The species is believed to be fire-ephemeral, flowering and fruiting only after disturbance has occurred (Bell and Copeland 2004).	<i>Commersonia rosea</i> is only known from four sites in the Sandy Hollow district in the upper Hunter Valley (Bell and Copeland 2004). This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	This species is not known from any conservation reserves in the region.	This species typically is found in skeletal soils in escarpment areas. There is very limited potential for this species to occur in the Assessment Areas as it does not encompass the nearby escarpment habitats. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Cynanchum elegans</i>	E (TSC) E (EPBC)	The species has been recorded from rainforest gullies and scree slopes, but is thought to mainly occur at the ecotone between dry rainforest and sclerophyll forest or woodland (DECCW 2010). The species has been recorded in dry subtropical rainforest, littoral rainforest, coastal scrub, open forest and woodland and open scrub.	<i>Cynanchum elegans</i> is restricted to eastern NSW from Yabbra State Forest in the north to Gerroa in the south and Merriwa in the west (DECCW 2010). The Assessment Areas occur within the known distribution of this species.	Within the Hunter Valley <i>C. elegans</i> has been recorded in Wollemi and Goulburn River National Parks.	There are no dry rainforest ecotones or sheltered gullies present within the Assessment Areas, which are specific habitat areas occupied by this species. There is no potential for the project to have a significant impact on this species.	No
finger panic grass <i>Digitaria porrecta</i>	E (TSC) E (EPBC)	Native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire.	Found in NSW and Queensland. In NSW, occurs on north-west slopes and plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. The Assessment Areas occur outside the distribution of known records of this species.	This species is not known from any conservation reserves within the region.	The Assessment Areas do not support suitable habitat for this species and is outside the known distribution. There is no potential for the project to have a significant impact on this species.	No
tricolour diuris <i>Diuris tricolor</i>	V (TSC)	Sclerophyll forest among grass, often with <i>Callitris</i> . Sandy soils, either on flats or small rises.	Muswellbrook LGA is the eastern limit of the known range and the only recorded occurrence in the Sydney Basin Bioregion. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), as well as by Eastcoast Flora Survey 2009a).	Tricolour diuris (<i>Diuris tricolor</i>) has been recorded within a conservation reserve(s) within the region (Briggs and Leigh 1996), however there are no records stating which reserve(s) the species occurs in.	This species was recorded in the Assessment Areas. Potential habitat for <i>Diuris tricolor</i> occurs throughout the grassland and open grassy woodland habitats of the Assessment Areas.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Diuris pedunculata</i>	E (TSC) E (EPBC)	A terrestrial herb flowering August to September (Jones 1993). The species typically grows in moist grassy areas in sclerophyll forest (Jones 1993b).	<i>Diuris pedunculata</i> is known to occur from Port Jackson to Tenterfield in the North Coast, Central Coast and Northern Tablelands botanical subdivisions (Jones 1993b). The Assessment Areas occur within the known distribution of this species.	This species is not known from any conservation reserves in the region.	The Assessment Areas lie outside of the known distribution of this species, and supports only marginal habitat for this species. There is no potential for the project to have a significant impact on this species.	No
slaty red gum <i>Eucalyptus glaucina</i>	V (TSC) V (EPBC)	This species grows in grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils.	Found only on the north coast of NSW and in separate districts: near Casino (where it can be locally common) and further south, from Taree to Broke, west of Maitland. Scattered occurrences around Singleton. The Assessment Areas occur slightly west of the known distribution of this species.	Belford NP	Despite extensive surveys of the Assessment Areas and the surrounding locality, this species has not been recorded. It is unlikely to occur within the Assessment Areas. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
Pokolbin mallee <i>Eucalyptus pumila</i>	V (TSC) V (EPBC)	The species occupies north-west-facing slopes derived from sandstone.	Currently known only from a few small populations west of Pokolbin in the Hunter Valley. Historical records also exist for Wyong and Sandy Hollow, however, has not been recorded recently in these areas. The Assessment Areas occur within the known distribution of this species.	This species is not known to occur in any reserves in the region.	The Assessment Areas do not support suitable habitats for this species. The current populations are known only to occur about 50 km east of the Assessment Areas. There is no potential for the project to have a significant impact on this species.	No
<i>Homoranthus darwinioides</i>	V (TSC) V (EPBC)	Grows in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand.	Rare in the central tablelands and western slopes of NSW, occurring from Putty to the Dubbo district. Found west of Muswellbrook between Merriwa and Bylong, and north of Muswellbrook to Goonoo SF. Collected from Lee's Pinch, but not relocated at its original locality north of Mt Coricudgy above the headwaters of Widden Brook. Goonoo SF is established as a definite locality. Assessment Areas occur east of the known distribution of this species.	Goulburn River NP	This species has not been recorded in the locality and there is limited habitat suitable for it to occur. This species is unlikely to occur in the Assessment Areas. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Kennedia retrorsa</i>	V (TSC) V (EPBC)	A prostrate or climbing herb, with stems growing to 2 metres long flowering in spring (Gardner and James 2002). The preferred habitat of the species is variable, ranging from mountain sides to riparian zones, from sheltered forest to steep, exposed rocky ridgelines.	The species occurs chiefly on Mt Dangar and Goulburn River valley to near Putty (Gardner and James 2002). The Assessment Areas occur within the known distribution of this species.	Sites occur within Goulburn River and Wollemi National Parks and nearby private land (DECCW 2010).	The Assessment Areas are within the known distribution of this species however the habitats present are unlikely to support this species. There is no potential for the project to have a significant impact on this species.	No
<i>Olearia cordata</i>	V (TSC) V (EPBC)	Populations are typically small and scattered. Grows in dry open sclerophyll forest and open shrubland, on sandstone ridges.	A NSW endemic with a scattered distribution generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. The Assessment Areas occur within the broad distribution of this species.	Yengo NP Wollemi NP	The Assessment Areas do not support sandstone ridges in which this species is associated. As such there is no potential for it to occur. There is no potential for the project to have a significant impact on this species.	No
<i>Ozothamnus tessellatus</i>	V (TSC) V (EPBC)	Dry sclerophyll forest and woodlands.	Restricted to a few locations north of Rylstone. The Assessment Areas occur to the east of the known records of this species.	Goulburn River NP	The Assessment Areas are east of the known distribution of this species. While the Assessment Areas supports potential habitat, it is not likely to occur. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Lasiopetalum longistamineum</i>	V (TSC) V (EPBC)	The species typically grows in rich alluvial deposits and flowers in spring. Little is known about this species' ecology or biology.	This species occurs in the Mt Dangar – Gungah area within Upper Hunter and Muswellbrook LGAs. Three sites are recorded within Gungah River NP. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	The species is known from Gungah River NP.	While this species has been recorded in the locality, the habitats of the Assessment Areas are unlikely to support this species. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Philothea ericifolia</i>	V (EPBC)	Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include <i>Melaleuca uncinata</i> , <i>Eucalyptus crebra</i> , <i>E. rossii</i> , <i>E. punctata</i> , <i>Corymbia trachyphloia</i> , <i>Acacia triptera</i> , <i>A. burrowii</i> , <i>Beyeria viscosa</i> , <i>Philothea australis</i> , <i>Leucopogon muticus</i> and <i>Calytrix tetragona</i> . This species flowers in the spring and produces fruit from November to December.	This species is known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW. The records are scattered over a range of over 400 km between West Wyalong and the Pilliga Scrub. In the upper Hunter it grows on exposed rocky outcrops around Scone. The Assessment Areas occur at the edge of the known distribution of this species.	Wingen Maid NR	This species typically occupies sandy flats and rocky ridge habitats, which are not present within the Assessment Areas. There is no potential for the project to have a significant impact on this species.	No
hawk weed <i>Picris evae</i>	V (TSC) V (EPBC)	When this species occurs it is sporadically placed and occasional, occurring in black, dark grey, red-brown, or reddish medium clay to clay-loam. It is mostly found in eucalypt forest, <i>Dichanthium</i> grassland, roadsides and cultivated habitats, and is commonly associated with modified habitats.	The species is found on the north-western slopes and plains regions, from the northern point of Elsmore (east of Inverell) through to the south most point at Oxley Park (Tamworth) and to the east Dangar Falls in the Oxley Wild Rivers NP in the NSW Northern Tablelands.	This species is not known to occur in any reserves in the region.	The Assessment Areas do not support potential habitat for this species and it is outside the known range. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
Bodalla pomaderris <i>Pomaderris bodalla</i>	V (TSC)	<i>Pomaderris bodalla</i> is a shrub 2-4 m high. The species occurs in moist open forest along sheltered gullies or along stream banks.	Confined to the Nerrigundah and Brogo areas in the South Coast botanical subdivision and in the upper Hunter Valley near Muswellbrook. The Assessment Areas occur within proximity to a disjunct population of this species in the Muswellbrook area.	<i>Pomaderris bodalla</i> is in the conservation reserves of Kooraban National Park on the south coast, and in Wollemi National Park and Wingen Maid Nature Reserve in the north of its range.	The Assessment Areas do not support habitats suitable for this species. There is no potential for the project to have a significant impact on this species.	No
<i>Pomaderris queenslandica</i>	E (TSC)	This species is found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	This species is widely scattered but not common in north-east NSW and in Queensland. It is only known from a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolatai, and also from several locations on the NSW North Coast. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	This species is not known from any conservation reserves in the region.	This species was not recorded within the Assessment Areas, and the habitats present are not likely to support this species. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Pomaderris reperta</i>	E (TSC) CE (EPBC)	This species occupies woodland in association with <i>Eucalyptus crebra</i> , <i>E. blakelyi</i> , <i>Notelaea microcarpa</i> , and <i>Allocasuarina littoralis</i> . This species grows on a sandy loam on sandstone or conglomerate.	This species has been recorded from a small number of sites near Denman in the upper Hunter Valley (Muswellbrook local government area). This species is also known from the Wybong area. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	This species is not known from any conservation reserves in the region.	The habitats of the Assessment Areas are not likely to support this species. There is no potential for the project to have a significant impact on this species.	No
leek orchid <i>Prasophyllum</i> sp. Wybong (C.Phelps ORG 5269)	CE (EPBC)	This species generally occurs in grassy and scrubby habitats in open eucalypt woodland and grasslands.	This species is endemic to NSW, from which there are only seven known populations from near NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. It is not known to occur outside the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes bioregions. Its area of occupancy is estimated at 1.5km ² . This species has been recorded within the approved project disturbance area by Eastcoast Flora Surveys (2009a).	This species is not known from any conservation reserves in the region.	This species was not recorded within the Assessment Areas, however it has been recorded from the Mangoola Mine. Potential habitat occurs throughout the grassland and open grassy woodland habitats of the Assessment Areas.	Yes (see Appendix E)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Prostanthera cineolifera</i>	V (TSC) V (EPBC)	An erect, strongly aromatic shrub, growing to 1-4 m high and flowering September to October (Conn 1992). The species grows on exposed sandstone ridges usually on shallow or skeletal sands (DECCW 2010).	It is restricted to a few localities near Walcha, Scone and St Albans (DECCW 2010). The Assessment Areas occur within the known distribution of this species.	Yengo NP	There are no exposed sandstone ridges within the Assessment Areas, therefore there is very low potential for this species to occur. There is no potential for the project to have a significant impact on this species.	No
<i>Prostanthera cryptandroides</i>	V (TSC) V (EPBC)	In the Denman-Gungal and Widden-Baerami Valley areas, this species occurs on rocky ridgelines on Narrabeen Group Sandstones in association with a range of communities. Associated communities include: Narrabeen Rocky Heath, Narrabeen Acacia Woodland, Narrabeen Exposed Woodland; Open Heath of <i>Calytrix tetragona</i> , <i>Leptospermum parviflorum</i> , <i>Isopogon dawsonii</i> ; and Open Scrubland of <i>Eucalyptus dwyeri</i> , <i>Baeckea densifolia</i> , <i>Dillwynia floribunda</i> , <i>Aotus ericoides</i> and <i>Hemigenia cunefolia</i> . This species flowers from September to May.	This species occurs in restricted areas but over a fairly broad range from the Lithgow and Sandy Hollow Districts into the Border Rivers/Gwydir Catchment and up into Queensland. Occurs in the Wollemi National Park and is likely to also occur within the Goulburn River National Park. The Assessment Areas occur within the known distribution of this species.	Wollemi NP	The Assessment Areas do not comprise vegetation communities associated with this species. There is no potential habitat for this species. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Prostanthera discolor</i>	V (TSC) V (EPBC)	An erect, strongly aromatic shrub 0.6-3 m high, flowering September to October (Conn 1992). The species grows in dry sclerophyll forest in gullies (Conn 1992), often on rocky or well-drained alluvial substrates.	It is restricted to a few localities from Bylong to the Baerami Valley within the Rylstone and Muswellbrook local government areas (DECCW 2010). The Assessment Areas occur within the known distribution of this species.	Goulburn River NP Wollemi NP	The Assessment Areas do not support the rocky gullies in which this species is known to occur. There is no potential for the project to have a significant impact on this species.	No
mintbush <i>Prostanthera stricta</i>	V (EPBC) V (TSC)	This species grows in sandy/alluvium soils near watercourses, and is associated with sclerophyll forests (Botanic Gardens Trust 2010)	It is distributed in the Widden Valley district in the botanical subdivisions of the Central Tablelands and the Central- western Tablelands (Botanic Gardens Trust 2010).	This species is not known to occur in any reserves in the region.	The habitats of the Assessment Areas are not likely to support this species. There is no potential for the project to have a significant impact on this species.	No
<i>Pterostylis gibbosa</i>	E (TSC) E (EPBC)	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage.	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra).	This species is not known to occur in any reserves in the region.	The Assessment Areas lie outside of the known distribution of this species, however it does support potential habitat. There is no potential for the project to have a significant impact on this species.	No
austral toadflax <i>Thesium australe</i>	V (TSC) V (EPBC)	This species occurs in grassland or grassy woodland and is often found in damp sites in association with kangaroo grass (<i>Themeda australis</i>). This species is a root parasite that takes water and some nutrient from other plants, especially kangaroo grass.	This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania, Queensland and in eastern Asia. This species was recorded in the locality by Umwelt (2007-8).	This species is not known from any conservation reserves in the region.	This species has been recorded in grassland habitats in the vicinity. However, due to the highly modified nature of the grassland in the Assessment Areas, there is limited potential for this species to occur. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Rulingia procumbens</i>	V (TSC)	Grows in sandy sites, often along roadsides.	Endemic to NSW, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recent collections made from the Upper Hunter region. The Assessment Areas occur to the east of known records of this species.	This species is not known to occur in any conservation reserves within the region.	The Assessment Areas lack the sandy substrate required by this species. There is no potential for the project to have a significant impact on this species.	No
Wollemi pine <i>Wollemia nobilis</i>	E (TSC) E (EPBC)	Occurs in warm-temperate rainforest and rainforest margins on remote sandstone canyons.	This species has a distribution which is limited to remote canyons of Wollemi NP to the north-west of Sydney. The Assessment Areas do not occur within the known range of this species.	Wollemi NP	This species has a highly restricted distribution and habitat niche, and does not occur in or near to the Assessment Areas. There is no potential for the project to have a significant impact on this species.	No

Key:

CE:	critically endangered
E:	endangered
EPBC:	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
LGA:	Local Government Area
NR:	Nature Reserve
NP:	National Park
TSC:	<i>Threatened Species Conservation Act 1995</i>
V:	vulnerable

Table 2 – Threatened Ecological Communities

THREATENED ECOLOGICAL COMMUNITIES (TECs)						
Species	Legal Status	Specific Habitat	Distribution in relation to the Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions	EEC (TSC)	This community typically occurs in the form of an open forest or woodland and occurs upon Permian sediments of the Hunter Valley. The canopy layer is dominated by grey box (<i>Eucalyptus moluccana</i>), broad-leaved ironbark (<i>Eucalyptus fibrosa</i>), slaty red gum (<i>Eucalyptus glaucina</i>), forest red gum (<i>Eucalyptus tereticornis</i>) and narrow-leaved ironbark (<i>Eucalyptus crebra</i>).	This community occurs in the NSW North Coast and Sydney Basin Bioregions. It has been recorded in the LGAs of Cessnock, Muswellbrook and Singleton but is thought to occur in other areas of the NSW North Coast and Sydney Basin Bioregion. This community is not known to occur in the region of the Assessment Areas.	Belford NP	No areas of this EEC were found to occur within the Assessment Areas. There is no potential for the project to impact on this EEC.	No
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion	EEC (TSC)	A dense to open tree canopy up to 15 m tall, depending on disturbance and regrowth history. Most common tree is weeping myall (<i>Acacia pendula</i>), may occur with narrow-leaved ironbark (<i>Eucalyptus crebra</i>), cooba (<i>Acacia salicina</i>) and/or trees of the <i>Acacia homalophylla</i> – <i>Acacia melvillei</i> complex. Understorey shrubs may include stiff canthium (<i>Psydrax odorata</i>), sticky hopbush (<i>Dodonaea viscosa</i>), wilga (<i>Geijera parviflora</i>), native olive (<i>Notelaea microphylla</i> var. <i>microphylla</i>) and silver cassia (<i>Senna zygomphylla</i>).	Currently known from parts of the Muswellbrook and Singleton LGAs, but may occur elsewhere, including the Upper Hunter LGA. This community was recorded in the Anvil Hill Project EA (Umwelt 2006).	No known natural remnants or populations of <i>Acacia pendula</i> occur in conservation areas, and only two stands, both part of the same population (at Jerrys Plains Cemetery), occur on community-owned land that is managed by a Council (Singleton).	A stand of this EEC occurs 275 m to the west of the Assessment Areas, which will not be disturbed as a result of the project. There are no records within the Assessment Areas. There is no potential for the project to have a significant impact on this EEC.	No

THREATENED ECOLOGICAL COMMUNITIES (TECs)						
Species	Legal Status	Specific Habitat	Distribution in relation to the Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	VEC (TSC)	Lower Hunter Valley Dry Rainforest typically occurs on Carboniferous sediments of the Barrington footslopes along the northern rim of the Hunter Valley Floor, where it occupies gullies and steep hillslopes with south facing aspects. It is generally found at elevations less than 300 m ASL with a mean annual rainfall less than 900 mm.	Lower Hunter Valley Dry Rainforest has been recorded from the LGAs of Cessnock, Maitland and Port Stephens, and is also likely to occur or have occurred in Muswellbrook, Singleton, Upper Hunter and Dungog.	This VEC is not known from any conservation reserves in the region.	No areas of this VEC were found to occur within the Assessment Areas. There is no potential for the project to impact on this VEC.	No
Weeping Myall – Coobah – Scrub Wilga Shrubland	CEEC (EPBC)	This CEEC consists of a woodland of weeping myall (<i>Acacia pendula</i>) with coobah (<i>Acacia salicina</i>) and scrub wilga (<i>Geijera salicifolia</i>). yarran (<i>Acacia omalophylla</i>) and stiff canthium (<i>Psydrax odoratum</i>) are also present in the small tree/shrub layer. The ground stratum is dense and primarily grassy. Grasses include kangaroo grass (<i>Themeda triandra/australis</i>), wallaby grass (<i>Austrodanthonia</i> spp.), snow grass (<i>Poa sieberiana</i>) and barbed wire grass (<i>Cymbopogon refractus</i>). Some exotic grasses have also invaded the site.	The CEEC occurs in a small stand on heavy, brown clay soil at Jerrys Plains in the Hunter Valley, in the South Hunter Province of the Sydney Basin Bioregion. The Assessment Areas occur outside of the known distribution of this CEEC.	No known natural remnants or populations of <i>Acacia pendula</i> occur in conservation areas. There are no known occurrences of this CEEC within the conservation reserves of the region.	This CEEC was not recorded within the Assessment Areas. There is no potential for the project to have a significant impact on this CEEC.	No

THREATENED ECOLOGICAL COMMUNITIES (TECs)						
Species	Legal Status	Specific Habitat	Distribution in relation to the Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
White Box - Yellow Box - Blakelys Red Gum Grassy Woodland and Derived Native Grasslands	CEEC (EPBC)	This CEEC can occur as either woodland or derived grassland (grassy woodland from which trees have been removed). Groundlayer consists of native tussock grasses and herbs, and a sparse, scattered shrub layer. White box (<i>Eucalyptus albens</i>), yellow box (<i>E. melliodora</i>), or Blakelys red gum (<i>E. blakelyi</i>), dominate, where trees remain. Sites dominated by other tree species that do not have white box, yellow box, or Blakelys red gum as co-dominants are not considered to be part of the community, except in the Nandewar bioregion. In the Nandewar Bioregion, grey box (<i>E. moluccana</i> or <i>E. microcarpa</i>) may also be dominant or co-dominant in the community.	This CEEC occurs along the western slopes and tablelands of the Great Dividing Range from southern Queensland through NSW to central Victoria. The Assessment Areas occur within the known distribution of this CEEC.	Wollemi NP Manobalai NR There are possible occurrences of this CEEC in the Goulburn River NP and Wingen Maid NR.	The floristic and structural composition of the vegetation communities within the Assessment Areas were compared with those of this CEEC. This resulted in the finding that there are no remnants of vegetation within the Assessment Areas which comprise this CEEC. There is no potential for the project to have a significant impact on this CEEC.	No.

THREATENED ECOLOGICAL COMMUNITIES (TECs)						
Species	Legal Status	Specific Habitat	Distribution in relation to the Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
White Box – Yellow Box – Blakelys Red Gum Woodland	EEC (TSC)	This EEC is characterised by the presence or prior occurrence of white box, yellow box and/or Blakelys red gum. The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees, including wattles. Commonly co-occurring eucalypts include apple box (<i>E. bridgesiana</i>), red box (<i>E. polyanthemus</i>), candlebark (<i>E. rubida</i>), snow gum (<i>E. pauciflora</i>), Argyle apple (<i>E. cinerea</i>), brittle gum (<i>E. mannifera</i>), red stringybark (<i>E. macrorhyncha</i>), grey box (<i>E. microcarpa</i>), cabbage gum (<i>E. amplifolia</i>) and others. The understorey in intact sites is characterised by native grasses and a high diversity of herbs; the most commonly encountered include kangaroo grass (<i>Themeda australis</i>) poa tussock (<i>Poa sieberiana</i>), wallaby grasses (<i>Austrodanthonia</i> spp.) and spear-grasses (<i>Austrostipa</i> spp.). Shrubs are generally sparse or absent, though they may be locally common.	This EEC is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW. The Assessment Areas occur within the known distribution of this EEC.	Goulburn River NP Manobalai NR Towarri NP Wingen Maid NR Wollemi NP	The floristic and structural composition of the vegetation communities within the Assessment Areas were compared with those of this EEC. This resulted in the finding that there are no remnants of vegetation within the Assessment Areas which comprise this EEC. There is no potential for the project to have an impact on this EEC.	No.

THREATENED ECOLOGICAL COMMUNITIES (TECs)						
Species	Legal Status	Specific Habitat	Distribution in relation to the Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
River-flat Eucalypt Forest on Coastal Floodplains	EEC (TSC)	Given its habitat, the community has an important role in maintaining river ecosystems and riverbank stability. Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level.	Known from parts of the LGAs of Port Stephens, Maitland, Singleton, Cessnock, Lake Macquarie, Wyong, Gosford, Hawkesbury, Baulkham Hills, Blacktown, Parramatta, Penrith, Blue Mountains, Fairfield, Holroyd, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Palerang, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions.	None known.	No areas of this EEC were found to occur within the Assessment Areas. There is no potential for the project to impact on this EEC.	No
Hunter Floodplain Red Gum Woodland	EEC (TSC)	This community occurs along the Hunter river and associated tributaries, on floodplains and associated floodplain rises. The communities are tall to very tall woodlands that are typically dominated by river red gum (<i>Eucalyptus camaldulensis</i>) and grow on alluvial soils.	The community is known from the Maitland, Muswellbrook, Singleton and Upper Hunter LGAs but is predicted to occur in other areas of the Sydney and NSW North Coast bioregions.	A very small area of this community is known to occur in Towarri NP near Scone. Also in Singleton Military Area (ERM 2005).	The Rough-barked Apple Woodland of the Assessment Areas is consistent with this EEC.	Yes (see Appendix D)

THREATENED ECOLOGICAL COMMUNITIES (TECs)						
Species	Legal Status	Specific Habitat	Distribution in relation to the Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
Hunter Valley Footslopes Slaty Gum Woodland	VEC (TSC)	This community generally occurs at the interface of Narrabeen sandstone and Permian sediments and grows in the form of a low to medium high woodland. The canopy layer of this community is dominated by grey box (<i>Eucalyptus moluccana</i>), narrow-leaved ironbark (<i>Eucalyptus crebra</i>) and slaty gum (<i>Eucalyptus dawsonii</i>).	Generally found in the Hunter Valley, all sites are within the Sydney Basin Bioregion. This community is known to occur in the LGAs of Singleton and Muswellbrook, but is thought to occur elsewhere in the Sydney Basin Bioregion. This community is comparable to the Slaty Box Woodland recorded within the Assessment Areas, as well as the Anvil Hill Project EA (Umwelt 2006).	This VEC is not known from any conservation reserves in the region.	The Slaty Box Woodland of the Assessment Areas corresponds to this VEC. This VEC will be impacted by the project.	A VEC does not require assessment under Part 3A of the EP&A Act.
Central Hunter Grey Box – Ironbark Woodland	EEC (TSC)	This community generally occurs on Permian sediments in the Hunter Valley. This community is typically identified on slopes and undulating hills and forms a woodland or open forest. Typical canopy layer species are inclusive of narrow-leaved ironbark (<i>Eucalyptus crebra</i>) and grey box (<i>Eucalyptus moluccana</i>).	This community is distributed throughout the NSW North Coast and Sydney Basin Bioregion. It has been recorded from the LGAs of Muswellbrook, Singleton and Cessnock, but may occur elsewhere in the Sydney Basin Bioregion. The Assessment Areas occur within its distribution.	This EEC is not known from any conservation reserves in the region.	The Ironbark Woodland Complex of the Assessment Areas correspond to this EEC. This EEC will be impacted by the project.	Yes (see Appendix D)

Key: ASL – Above sea level
 CEEC = Critically Endangered Ecological Community
 EEC = Endangered Ecological Community
 EPBC = *Environment Protection and Biodiversity Conservation Act 1999*
 NP = National Park

NR = Nature Reserve
 PD = preliminary determination
 TSC = *Threatened Species Conservation Act 1995*
 VEC= vulnerable ecological community

Table 3 – Endangered Populations

ENDANGERED POPULATIONS						
Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
weeping myall <i>Acacia pendula</i> in the Hunter Catchment	EP (TSC)	Grows on major river floodplains on heavy clay soils, sometimes as the dominant species and forming low open woodlands. Within the Hunter catchment it typically occurs on heavy soils, sometimes at the margins of small floodplains, but also in more undulating locations remote from floodplains, such as at Jerrys Plains.	There are 17 confirmed and four unconfirmed naturally occurring remnants of the <i>A. pendula</i> population in the Hunter catchment. These range as far east as Warkworth, and west of Sandy Hollow. <i>Acacia pendula</i> is not known to occur naturally further north than the Muswellbrook-Wybong area. This EP was recorded within the Anvil Hill Project EA (Umwelt 2006), outside, although close to the Assessment Areas.	No known natural remnants or populations of <i>Acacia pendula</i> occur on land zoned for conservation and only two stands, both part of the same population (at Jerrys Plains Cemetery), occur on community-owned land that is managed by a Council (Singleton).	Stands of this species occur 275 m to the west of the Assessment Areas, adjacent to Wybong Road. These stands will not be disturbed for the project. No records of this species were found within the Assessment Areas. There is no potential for the project to have a significant impact on this EP.	No
tiger orchid <i>Cymbidium canaliculatum</i> in the Hunter Catchment	EP (TSC)	This species occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees. It is usually found occurring singly or as a single clump, typically between two and six metres above the ground.	The population of <i>Cymbidium canaliculatum</i> in the Hunter Catchment is at the south-eastern limit of the geographic range for this species. This EP was recorded within the Anvil Hill Project EA (Umwelt 2006).	Wollemi NP Goulburn River NP	There are two records of this species from within the Assessment Areas.	Yes (see Appendix D)

ENDANGERED POPULATIONS						
Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
river red gum <i>Eucalyptus camaldulensis</i> in the Hunter Catchment	EP (TSC)	This endangered population may occur with <i>Eucalyptus tereticornis</i> , <i>Eucalyptus melliodora</i> , <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> and <i>Angophora floribunda</i> .	The Hunter population occurs from the west at Bylong, south of Merriwa, to the east at Hinton, on the bank of the Hunter River. It has been recorded in the LGAs of Lithgow, Maitland, Mid-Western Regional, Muswellbrook, Port Stephens, Singleton and Upper Hunter. The Assessment Areas occur within the known distribution of this endangered population.	This species is not known from any conservation reserves in the region.	No records of this species occur within the Assessment Areas and no suitable habitats are present for this species to occur. There is no potential for the project to have a significant impact on this EP.	No
tricolour diuris <i>Diuris tricolor</i> in Muswellbrook LGA	EP (TSC)	Sclerophyll forest among grass, often with <i>Callitris</i> . Sandy soils, either on flats or small rises.	This endangered population is only known from a small number of locations within the Hunter Valley, including Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. This EP was recorded within the Anvil Hill Project EA (Umwelt 2006), as well as within the Assessment Areas.	There are no records of <i>Diuris tricolor</i> from a conservation reserve in the Hunter Catchment.	This species was recorded in the Assessment Areas. Potential habitat for <i>Diuris tricolor</i> occurs throughout the grassland and grassy woodland habitats of the Assessment Areas.	Yes (see Appendix D)
<i>Leionema lamprophyllum</i> subsp. <i>obovatum</i> in the Hunter Catchment	EP (TSC)	The Hunter Catchment population occurs near Pokolbin, where it is found on a rocky cliff line in a dry eucalypt forest.	The Hunter Catchment population of <i>L. lamprophyllum</i> subsp. <i>obovatum</i> is currently found at one location within Pokolbin State Forest. The Assessment Areas occur outside the currently known range of this species.	There are no records of <i>L. lamprophyllum</i> subsp. <i>obovatum</i> from a conservation reserve in the Hunter Catchment.	The Assessment Areas contain potential habitat for this species, however all known records in the Hunter Catchment occur about 50 km to the east of the Assessment Areas. This species is unlikely to occur, and therefore there is no potential for the project to have a significant impact on this EP.	No

Key: TSC = *Threatened Species Conservation Act 1995*
EP = Endangered Population

Table 4 – Threatened Fauna Species

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
REPTILES						
pink-tailed worm-lizard <i>Aprasia parapulchella</i>	V (EPBC) V (TSC)	Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites. Inhabits sloping, open woodland areas with predominantly native grassy ground layers, particularly those dominated by kangaroo grass (<i>Themeda australis</i>).	Known only from the Central and Southern Tablelands and the South Western Slopes of NSW. Records are concentrated around the Canberra region, while other populations have been found in Cooma, Yass, Bathurst, Albury and West Wyalong. The Assessment Areas occur outside the known distribution of this species.	This species is not known to occur in any reserves in the region.	The Assessment Areas are outside the known distribution of this species and the habitats are not suitable. There is no potential for the project to have a significant impact on this species.	No
Rosenbergs goanna <i>Varanus rosenbergi</i>	V (TSC)	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat.	Occurs on the Sydney Sandstone in Wollemi NP to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. The Assessment Areas occur outside the known distribution of this species.	Wollemi NP Yengo NP	This species is generally associated with Sydney sandstone habitats and is unlikely to occur. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
pale-headed snake <i>Hoplocephalus bitorquatus</i>	V (TSC)	Found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. Favours streamside areas, particularly in drier habitats.	A patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. The Assessment Areas occur within the known distribution of this species.	This species is not known to occur in any reserves in the region.	This species has potential to inhabit the escarpment areas nearby but not within the Assessment Areas. There is no potential for the project to have a significant impact on this species.	No
broad-headed snake <i>Hoplocephalus bungaroides</i>	E (TSC)	Nocturnal. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. The Assessment Areas occur just outside the known distribution of this species.	Wollemi NP Yengo NP	The Assessment Areas do support potential habitat for this species however the likelihood of it occurring is low. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
AMPHIBIANS						
green and golden bell frog <i>Litoria aurea</i>	E (TSC) V (EPBC)	Occurs amongst emergent aquatic or riparian vegetation and amongst vegetation, fallen timber, including grassland, cropland and modified pastures. Breeds in still or slow flowing waterbodies with some vegetation such as <i>Typha</i> spp. and <i>Eleocharis</i> spp.	NSW North Coast near Brunswick Heads, southwards along the NSW Coast to Victoria where it extends into east Gippsland. The Assessment Areas occur west of the inland limit of this species' known distribution.	This species is not known from any conservation reserves in the region.	This species was not recorded within the Assessment Areas. There are a small number of highly degraded farm dams within the Assessment Areas. These dams are not considered to provide potential habitat for this species. There is no potential for a significant impact on this species.	No
Booroolong frog <i>Litoria booroolongensis</i>	E (TSC)	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge.	The Booroolong frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. It has disappeared from the Northern Tablelands and is now rare throughout most of the remainder of its range. Most recent records are from the south-west slopes of NSW. The Assessment Areas occur within the known range of this species.	Mount Royal NP	The Assessment Areas do not support any permanent streams and therefore does not provide potential habitat for this species. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
giant barred frog <i>Mixophyes iteratus</i>	E (TSC)	This species forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams.	Coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold.	This species is not known to occur in any reserves in the region.	giant barred frog <i>Mixophyes iteratus</i>	No
BIRDS						
bush stone-curlew <i>Burhinus grallarius</i>	E (TSC)	This species inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. The bush stone-curlew is largely nocturnal, being especially active on moonlit nights. It nests on the ground in a scrape or small bare patch laying two eggs in spring and early summer.	The bush stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however, and in the south-east it is either rare or extinct throughout its former range. The Assessment Areas occur within the known distribution of this species.	This species is not known from any conservation reserves in the region.	The habitats of the Assessment Areas are not suitable for this species. There are only historic records of this species in the locality. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
mallefowl <i>Leipoa ocellata</i>	E (TSC) V (EPBC)	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300-450 mm mean annual rainfall) areas. Less frequently found in other eucalypt woodlands. Prefers areas of light sandy to sandy loam soils and habitats with a dense but discontinuous canopy, dense and variable shrub and herb layers.	Recorded mainly from the southern half of the western NSW, from the Pilliga forest, south-west to the Griffith and Wentworth districts, excluding the southern Riverina.	This species is not known to occur in any reserves in the region.	The Assessment Areas are outside the known distribution of this species and there is no potential habitat for this species. There is no potential for the project to have a significant impact on this species.	No
freckled duck <i>Stictonetta naevosa</i>	V (TSC)	This species prefers permanent freshwater swamps and creeks with heavy growth of cumbungi, lignum or tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. This species generally rests in dense cover during the day, usually in deep water. Nesting usually occurs between October and December but can take place at other times when conditions are favourable. The nests are usually located in dense vegetation at or near water level.	The freckled duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. This species may also occur as far as coastal NSW and Victoria during such times. The Assessment Areas occur within the known distribution of this species.	This species is not known from any conservation reserves in the region.	This species was not recorded within the Assessment Areas during surveys. The two dams occurring within the Assessment Areas do not contain suitable habitat characteristics for this species. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
black-necked stork <i>Ephippiorhynchus asiaticus</i>	E (TSC)	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.	This species is widespread across coastal northern and eastern Australia, becoming uncommon further south into NSW, and rarely found south of Sydney.	This species is not known to occur in any reserves in the region.	This species requires permanent freshwater wetland habitat, which is absent from the Assessment Areas. There is no potential for the project to have a significant impact on this species.	No
square-tailed kite <i>Lophoictinia isura</i>	V (TSC)	This species is usually recorded within 300 kilometres of the coast (Hollands 2003). This kite is found in a variety of timbered habitats including dry woodlands and open forests, showing a particular preference for timbered watercourses (DECCW 2010). Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs (DECCW 2010). This species appears to occupy large hunting ranges of more than 100 km ² (DECCW 2010). It is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage (DECCW 2010).	The square-tailed kite (<i>Lophoictinia isura</i>) ranges along coastal and sub coastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems (DECCW 2010). The Assessment Areas occur within the known distribution of this species.	This species is not known from any conservation reserves in the region.	This species was not recorded within the Assessment Areas during surveys. The potential habitats present would only account for a very minor component of the habitat range for any individual of this species within the local area, and there will be minimal disturbance to these habitats as part of the project. As such, the project will not result in a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
osprey <i>Pandion haliaetus</i>	V (TSC)	Habitat for this species includes inshore coastal and estuarine waters, and occasionally inland rivers and lakes (Debus 2001). This species feeds mainly on fish, however also takes crustaceans, reptiles, small mammals or birds (Debus 2001). Breeding occurs from July to September and nests are often in dead trees and on headlands and rocky islands (Hollands 2003). Nests are re-used for many years (Hollands 2003), and are usually within one kilometre of the ocean (DECCW 2010).	The osprey (<i>Pandion haliaetus</i>) has a distribution along the majority of the eastern coastline, however is absent from Tasmania and rare in Victoria (Debus 2001). It is common around the northern coast, especially on rocky shorelines, islands and reefs (DECCW 2010). The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. The Assessment Areas occur west of the known distribution of this species.	This species is not known from any conservation reserves in the region.	There is no foraging habitat for this coastal species within the Assessment Areas. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
red goshawk <i>Erythroriorchis radiatus</i>	E (TSC) V (EPBC)	In NSW, preferred habitat is mixed tropical rainforest Melaleuca Swamp Forest and Open Eucalypt Forest along coastal rivers, often in rugged terrain (DECCW 2010). It favours patches of dense forest interspersed with open woodland or cleared land and often hunts along forest edges and ecotones (DECCW 2010). Habitats are generally close to permanent bodies of freshwater, nest sites being only up to 1 kilometre away from such water bodies.	The red goshawk (<i>Erythroriorchis radiatus</i>) has been recorded from across northern Australia, south through eastern Queensland to far north-east NSW. The species is very rare in NSW. Most records are from the Clarence River Catchment, with a few about the lower Richmond and Tweed Rivers (DECCW 2010). The Assessment Areas occur south of the known distribution of this species.	This species is not known from any conservation reserves in the region.	The Assessment Areas are situated outside the known range of this species and the habitats present are not consistent with the preferred habitats of this species. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
grey falcon <i>Falco hypoleucos</i>	V (TSC)	It is usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast, and also occurs near wetlands where surface water attracts prey (DECCW 2010). The species is found in timbered lowland plains, particularly acacia shrublands, crossed by tree-lined watercourses (Garnett and Crowley 2000). It hunts far out into treeless areas and frequents tussock grasslands and open woodland, especially in winter (Garnett and Crowley 2000).	The grey falcon (<i>Falco hypoleucos</i>) occurs in arid and semi-arid Australia, including the Murray-Darling basin, Eyre basin, central Australia and Western Australia where there is average annual rainfall of less than 500 mm (Garnett and Crowley 2000). Within NSW the species is found within the Murray-Darling basin and is occasionally recorded east of the Great Dividing Range (DECCW 2010). The Assessment Areas occur within the known distribution of this species.	This species is not known from any conservation reserves in the region.	This species was not recorded within the Assessment Areas during surveys. The potential habitats present would only account for a very minor component of the habitat range for any individual of this species within the local area, and there will be minimal disturbance to these habitats as part of the project. As such, the project will not result in a significant impact on this species.	No
spotted harrier <i>Circus assimilis</i>	V (TSC)	Their habitat of choice is open grassy woodland, grassland, inland riparian woodland and shrub steppe. Although mostly associated with native grasslands it has also been identified in agricultural farmland. Their nest is made in a tree and composed of sticks. Individuals of this species are sparsely distributed throughout Australia and occur as a single population.	The spotted harrier can be found throughout mainland Australia except for areas of dense forest on the coast, escarpments and ranges and rarely ever in Tasmania.	This species is not known to occur in reserves in the region.	This species was not recorded in the Assessment Areas. This species has potential to forage within the Assessment Areas as part of a wider foraging range. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
little eagle <i>Hieraaetus morphnoides</i>	V (TSC)	This species is typically identified in open eucalypt forests, woodlands and open woodlands, and other areas where prey are plentiful. The nest in tall living trees within remnant patches. This species occurs as a single population within Australia.	The little eagle is distributed throughout mainland Australia except for the most densely forested parts of the Great Dividing Range escarpment. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), and has been listed since that record.	Barrington Tops NP Mt Royal NP Tuggolo SF	This species was not recorded in the Assessment Areas. This species has potential to forage within the Assessment Areas as part of a wider foraging range. There is no potential for the project to have a significant impact on this species.	No
red-backed button-quail <i>Turnix maculosa</i>	V (TSC)	This species inhabits grasslands, woodlands and cropped lands of warm temperate areas that annually receive 400 mm or more of summer rain (DECCW 2010). It appears to prefer sites near water, including grasslands and sedgeland near creeks, swamps and springs, and wetlands. Breeding is usually in dense grass near water, and nests are made in a shallow depression sparsely lined with grass and ground litter (DECCW 2010).	In Australia, the species has a largely coastal and sub-coastal range from the Kimberley region, Western Australia, through the Northern Territory, Queensland and NSW (DECCW 2010). In NSW, the majority records are from the North Coast Bioregion with a small number of records south as far as Sydney. Three outlying records are known from western NSW. The Assessment Areas occur within the known distribution of this species.	This species is not known from any conservation reserves in the region.	The Assessment Areas do not support swampy, marshy habitats in which this species inhabits. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
Australian painted snipe <i>Rostratula australis</i>	E (TSC)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	This species is not known to occur in any reserves in the region.	The habitats of the Assessment Areas are not suitable for this typically wetland species. There is no potential for the project to have a significant impact on this species.	No
gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V (TSC)	In summer this species occurs in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter this species moves to drier more open eucalypt forests and woodlands. It favours old growth trees for nesting and roosting.	In NSW this species occurs from the south east coast to the Hunter region and inland to the Central Tablelands and South-west Slopes. The Assessment Areas occur within the known distribution of this species.	Barrington Tops NP Goulburn River NP Wollemi NP Yengo NP	This species was not recorded during surveys. This species has potential to forage within the Assessment Areas as part of a wider foraging range, although there is limited nesting habitat. There is no potential for the project to have a significant impact on this species.	No
glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V (TSC)	Habitat for this species includes forests on low-nutrient soils, specifically those containing key <i>Allocasuarina</i> feed species. They will also eat seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as eating insect larvae. Breeding occurs in autumn and winter, with large hollows required.	The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Goulburn River NP Wollemi NP Yengo NP Barrington Tops NP Mount Royal NP	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). Potential nesting and roosting trees for this species are present although limited.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
varied sittella <i>Daphoenositta chrysoptera</i>	V (TSC)	The varied sittella can typically be found in eucalypt forests and woodlands, especially of rough-barked species and mature smooth-barked gums with dead branches, it can also be identified in mallee and acacia woodlands. This species builds a cup shaped nest made of plant fibres and spiders webs which is placed at the canopy level in the fork of a living tree.	The varied sittella is a sedentary species that inhabits the majority of mainland Australia with the exception of the treeless deserts and open grasslands. Its NSW distribution is basically continuous from the coast to the far west. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), and has been listed since that record.	Wallabadah NR Barrington Tops NP Tuggolo SF Mernot SF Mount Royal NP	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). This species has potential to forage within the Assessment Areas as part of a wider foraging range. There is no potential for the project to have a significant impact on this species.	No
grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis temporalis</i>	V (TSC)	Open box-gum woodlands on the slopes. Box-cypress-pine and open box woodlands on alluvial plains. Also found in acacia shrubland and adjoining areas. Feeds on invertebrates; forage on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses (DECCW 2010). Occupy territories from 1 to 50 hectares.	Occurs throughout northern and south-eastern Australia. In NSW, this species occurs on the western slopes of the Great Dividing Range and on the western plains reaching as far west as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Belford NP Goulburn River NP Wollemi NP Yengo NP	This species was recorded within the Assessment Areas, as well in the vicinity (Umwelt 2006). Foraging and nesting habitats are present.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
brown treecreeper (eastern subspecies) <i>Climacteris picumnus victoriae</i>	V (TSC)	Typical habitat for this species includes drier forests, woodlands and scrubs with fallen branches; river red gums on watercourses and around lake-shores; paddocks with standing dead timber; and margins of denser wooded areas. This species prefers areas without a dense understorey.	This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	This species is known to occur in Goulburn River NP Wollemi NP Yengo NP	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). Marginal potential habitat for this species exists within the Assessment Areas.	Yes (see Appendix D)
turquoise parrot <i>Neophema pulchella</i>	V (TSC)	This species lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. It nests in tree hollows, logs or posts, from August to December.	The turquoise parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. This species was recorded within the Anvil Hill Project EA (Umwelt 2006).	Goulburn River NP Wollemi NP Yengo NP	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). Potential nesting and roosting trees for this species are present although limited.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
swift parrot <i>Lathamus discolor</i>	E (TSC) E (EPBC)	This species often visits box-ironbark forests, feeding on nectar and lerps. This species occupy areas where winter-flowering eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Preferred winter-flowering resources include swamp mahogany (<i>Eucalyptus robusta</i>), spotted gum (<i>Corymbia maculata</i>), red bloodwood (<i>C. gummifera</i>), Mugga ironbark (<i>E. sideroxylon</i>), and white box (<i>E. albens</i>).	In NSW this species has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW. The Assessment Areas occur within the known distribution of this species.	Wollemi NP	There are limited potential foraging resources for this species within the woodland habitats of the Assessment Areas. Due to the migratory and highly mobile nature of this species, there is no potential for the habitat loss associated with the project to have a significant impact on this species.	No
regent honeyeater <i>Anthochaera phrygia</i>	E (TSC) E (EPBC)	Generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine casuarina woodlands. Key foraging species (typically winter-flowering species in the Hunter Valley) include mugga ironbark (<i>Eucalyptus sideroxylon</i>), yellow box (<i>E. melliodora</i>), Blakelys red gum (<i>Eucalyptus blakelyi</i>), white box (<i>E. albens</i>) and swamp mahogany (<i>E. robusta</i>).	Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. The Assessment Areas occur within the known distribution of this species.	Goulburn River NP Wollemi NP Yengo NP	There are limited potential foraging resources for this species within the woodland habitats of the Assessment Areas. Due to the migratory and highly mobile nature of this species, there is no potential for the habitat loss associated with the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
superb parrot <i>Polytelis swainsonii</i>	V (EPBC) V (TSC)	Habitats include Box-Gum, Box-Cypress Pine and Boree woodlands and River Red Gum Forest. Nest in hollows of large trees, often in colonies. May forage up to 10 kilometres from nesting sites, primarily in grassy box woodlands. Feeds in trees, understorey shrubs and on the ground for grass seeds and herbaceous plants, and, less commonly, fruit, flowers, nectar, insects and buds.	Occurs throughout eastern inland NSW, with a core breeding area bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Migrate north to the region of the upper Namoi and Gwydir Rivers in winter. The Assessment Areas occur within the known distribution of this species.	Not known.	Given that there are no records of this species from the Hunter Valley, and given the small area of marginal woodland habitats within the Assessment Areas, there is very limited potential for this species to occur within the Assessment Areas.	No
little lorikeet <i>Glossopsitta pusilla</i>	V (TSC)	This species can be found in dry-open eucalypt forests and woodlands, and have been identified in remnant vegetation, old growth vegetation, logged forests, and roadside vegetation. The little lorikeet usually forages in small flocks, not always with birds of their own species. They nest in hollows, mostly in living smooth-barked apples.	This species is distributed from just north of Cairns, around the east coast of Australia down to Adelaide. In NSW this species is found from the coast to the western slopes of the Great Dividing Range, extending as far west as Albury, Dubbo, Parkes and Narrabri. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), and has been listed since that record.	Wallabadah NR Mt Royal NP Tuggolo SF	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). Potential nesting and roosting trees for this species are present although limited.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
painted honeyeater <i>Grantiella picta</i>	V (TSC)	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	The greatest concentration of this species and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. The Assessment Areas occur within the known distribution of this species.	This species is not known to occur in any conservation reserves within the region.	The Assessment Areas support a low abundance of foraging resources for this mistletoe feeding species which may be utilised as part of a much wider foraging range. Given the limited resources and mobile nature of this species, there is no potential for a significant impact on this species as part of the project.	No
black-chinned honeyeater (eastern subspecies) <i>Melithreptus gularis gularis</i>	V (TSC)	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>Eucalyptus albens</i>), Grey Box (<i>Eucalyptus microcarpa</i>), Yellow Box (<i>Eucalyptus melliodora</i>) and Forest Red Gum (<i>Eucalyptus tereticornis</i>). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	The subspecies is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.	Yengo NP Wollemi NP	This species is highly nomadic and has a low potential to utilise the habitats of the Assessment Areas. Although the Assessment Areas provide potential foraging resources for this species, these would form a very minor part of the wider range of this species. There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
olive whistler <i>Pachycephala olivacea</i>	V (TSC)	Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes. Forage in trees and shrubs and on the ground.	Inhabits the wet forests on the ranges of the east coast. It has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to Victoria.	Mt Royal NP Barrington Tops NP	This species prefers moist forests above 500 m altitude and therefore the habitats of the Assessment Areas are not suitable. The Assessment Areas are outside the known range of this species. There is no potential for the project to have a significant impact on this species.	No
hooded robin (south-eastern form) <i>Melanodryas cucullata cucullata</i>	V (TSC)	This species prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Hooded robins require structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses (DECCW 2010).	This form of the hooded robin is distributed throughout south-eastern Australia, from central Queensland to the Spencer Gulf, South Australia. This form occurs throughout NSW except for the north-west, where it intergrades with the northern form <i>M. cucullata picata</i> . This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	Goulburn River NP Wollemi NP	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). The potential habitats present within the Assessment Areas would only account for a very minor component of the habitat range for any individual of this species within the local area, and there will be minimal disturbance to these habitats as part of the project. As such, the project will not result in a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
scarlet robin <i>Petroica boodang</i>	V (TSC)	This robin can be found in woodlands and open forests from the coast through to inland slopes. The birds can sometimes be found on the eastern fringe of the inland plains in the colder months of the year. Woody debris and logs are both important structural elements of its habitat. It forages from low perches on invertebrates either on the ground or in woody debris or tree trunks.	The scarlet robin can be found in south-eastern Australia, from Tasmania to the southern end of Queensland, to western Victoria and south SA. In NSW it is found throughout the eastern areas of the state, no further than 500 km from the coast. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), and has been listed since that record.	Wollemi NP	This species was recorded in the Assessment Areas, and has been recorded in the vicinity (Umwelt 2006).	Yes (see Appendix D)
flame robin <i>Petroica phoenicea</i>	V (TSC)	This species is known to breed in moist eucalypt forests and woodlands. It can usually be seen on ridges and slopes in areas where there is an open understorey layer. This species migrates during the winter to more lowland areas such as grasslands where there are scattered trees, as well as open woodland of the inland slopes and plains.	This robin is located in south-eastern Australia from the Queensland border to Tasmania and into Victoria as well as south-east SA.	Polblue CR Stewarts Brook SF Ben Halls Gap NP	This species was not recorded in the Assessment Areas. This species has potential to forage within the Assessment Areas as part of a wider foraging range. There is no potential for the project to have a significant impact on this species.	No

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speckled warbler <i>Chthonicola sagittata</i>	V (TSC)	The speckled warbler occurs in eucalypt-dominated communities that have a grassy understorey, leaf litter and shrub cover, often on rocky ridges or in gullies.	Patchy distribution throughout south-eastern Queensland, eastern half of NSW and into Victoria, as far west as the Grampians. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Goulburn River NP Wollemi NP Yengo NP	This species was recorded within the Assessment Areas, as well as the vicinity (Umwelt 2006).	Yes (see Appendix D)
diamond firetail <i>Stagonopleura guttata</i>	V (TSC)	Habitat includes a range of eucalypt dominated communities with a grassy understorey, including woodland, forest and mallee. It appears that populations are unable to persist in areas where there are no vegetated remnants larger than 200 hectares.	The diamond firetail occurs through central and eastern NSW, north into southern and central Queensland and south through Victoria to South Australia. In NSW it mainly occurs west of the Great Dividing Range, although populations are known from drier coastal areas such as the Cumberland Plain and the Hunter, Clarence, Richmond and Snowy River valleys. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Goulburn River NP Wollemi NP	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). There is no potential for the project to have a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
masked owl <i>Tyto novaehollandiae</i>	V (TSC)	This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land.	The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea. This species was recorded in the Anvil Hill Project EA (Umwelt 2006)	Goulburn River NP Wollemi NP Yengo NP Barrington Tops NPMount Royal NP	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). Potential nesting and roosting trees for this species are present although limited.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
barking owl <i>Ninox connivens</i>	V (TSC)	Habitat for this species includes dry forests and woodlands, often in association with hydrological features such as rivers and swamps.	The barking owl is distributed sparsely throughout temperate and semi-arid areas of mainland Australia, however it is most abundant in the tropical north. Most records for this species occur west of the Great Dividing Range.	Goulburn River NP Wollemi NP Yengo NP Barrington Tops NP	This species was not recorded within the Assessment Areas during surveys. The potential habitats present within the Assessment Areas would only account for a very minor component of the habitat range for any individual of this species within the local area, and there will be minimal disturbance to these habitats as part of the project. As such, the project will not result in a significant impact on this species.	No
powerful owl <i>Ninox strenua</i>	V (TSC)	The powerful owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It generally requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	The powerful owl occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south western Victoria to Bowen in Queensland. This species was recorded in the Anvil Hill Project EA (Umwelt 2006).	Goulburn River NP Wollemi NP Yengo NP Barrington Tops NP Mount Royal NP	This species was not recorded in the Assessment Areas, however has been recorded in the vicinity (Umwelt 2006). Potential nesting and roosting trees for this species are present although limited.	Yes (see Appendix D)
sooty owl	V (TSC)	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Nests in very large tree hollows.	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands.	Mt Royal NP Wollemi NP Yengo NP Barrington Tops NP	This species typically occurs in tall, moist forests, generally mature forests. The Assessment Areas do not support the appropriate habitat characteristics for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
MAMMALS						
spotted-tailed quoll <i>Dasyurus maculatus</i>	V (TSC) E (EPBC)	Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops. Suitable den sites including hollow logs, tree hollows, rocky outcrops or caves.	In NSW the spotted-tailed quoll occurs on both sides of the Great Dividing Range, with the highest densities occurring in the north east of the state. It occurs from the coast to the snowline and inland to the Murray River. The Assessment Areas occur within the known distribution of this species.	This species is known to occur in Wollemi NP, Yengo NP, Barrington Tops NP and Mount Royal NP.	This species was not recorded during surveys. While there is potential for this species to occur within the Assessment Areas, it is unlikely that the fragmented habitats of the Assessment Areas would be important for a local population of this species. There is no potential for a significant impact on this species.	No
brush-tailed phascogale (southern Australian subspecies) <i>Phascogale tapoatafa tapoatafa</i>	V (TSC)	Prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	This species has a patchy distribution around the coast of Australia. In NSW it is more frequently found in forest on the Great Dividing Range in the north-east and south-east of the State. There are also a few records from central NSW.	Mt Royal NP Barrington Tops NP	There are potential habitats and foraging resources for this species within the Assessment Areas however it is unlikely to occur. The project will not result in a significant impact on this species.	No
common planigale <i>Planigale maculata</i>	V (TSC)	Common planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water.	Coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its southern distribution limit on the NSW lower north coast.	Barrington Tops NP	The Assessment Areas do not support appropriate habitat for this species which prefers areas with dense ground cover and close to water. The project will not result in a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
eastern pygmy possum <i>Cercartetus nanus</i>	V (TSC)	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	This species is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes.	Wollemi NP Yengo NP Barrington Tops NP	The Assessment Areas do not support sufficient diversity and density of understorey flowering resources for this species. The project will not result in a significant impact on this species.	No
koala <i>Phascolarctos cinereus</i>	V (TSC)	This species inhabits eucalypt forest and woodland, with suitability influenced by tree species and age, soil fertility, climate, rainfall and fragmentation patterns. The species is known to feed on a large number of eucalypt and non-eucalypt species, however it tends to specialise on a small number in different areas. <i>Eucalyptus tereticornis</i> , <i>E. punctata</i> , <i>E. cypellocarpa</i> , <i>E. viminalis</i> , <i>E. microcorys</i> , <i>E. robusta</i> , <i>E. albens</i> , <i>E. camaldulensis</i> and <i>E. populnea</i> are some preferred species.	The koala has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west. It is known to occur along inland rivers on the western side of the Great Dividing Range. Tentative records of this species (through scats) were recorded in the Anvil Hill Project EA (Umwelt 2006).	Goulburn River NP Wollemi NP Yengo NP Barrington Tops NP Mount Royal NP	The Assessment Areas do not contain potential koala habitat. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
parma wallaby <i>Macropus parma</i>	V (TSC)	Preferred habitat for this species is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. It typically feeds at night on grasses and herbs in more open eucalypt forest and the edges of nearby grassy areas. During the day it shelters in dense cover.	Although it once occurred from north-eastern NSW to the Bega area in the southeast, its range is now confined to the coast and ranges of central and northern NSW. The Assessment Areas occur within the known distribution of this species.	This species is known to occur in Yengo NP, Barrington Tops and Mount Royal NP.	This species generally favours habitats with a dense, shrubby understorey. The Assessment Areas do not support such habitats. The project will not result in a significant impact on this species.	No
brush-tailed rock-wallaby <i>Petrogale penicillata</i>	E (TSC) V (EPBC)	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. It browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. This species shelters or bask during the day in rock crevices, caves and overhangs and is most active at night.	Its distribution roughly followed the Great Dividing Range for 2500 km from the Grampians in West Victoria to Nanango in south-east Queensland, with outlying populations in coastal valleys and ranges to the east of the divide, and the slopes and plains as far west as Cobar in NSW and Injune (500km NW of Brisbane) in Queensland. Tentative records of this species (through very old scats) were made in the Anvil Hill Project EA (Umwelt 2006).	Goulburn River NP Wollemi NP Yengo NP Barrington Tops NP	This species potentially occupies the escarpment habitats which occur nearby to the Assessment Areas. These habitats will not be disturbed or fragmented, therefore this species would not be impacted by the project.	No

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squirrel glider <i>Petaurus norfolcensis</i>	V (TSC)	Inhabits a variety of mature or old growth habitats, including box, box-ironbark woodlands, river red gum forest, and blackbutt-bloodwood forest with heath understorey. It prefers mixed species stands with a shrub or acacia mid-storey, and requires abundant tree hollows for refuge and nest sites.	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Wollemi NP Yengo NP Mount Royal NP	This species has potential to forage and nest within the woodland habitats of the Assessment Areas.	Yes (see Appendix D)
grey-headed flying-fox <i>Pteropus poliocephalus</i>	V (TSC) V (EPBC)	This species occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Grey-headed flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.	Wollemi NP Yengo NP Barrington Tops NP	There is potential for this species to forage within the woodland habitats of the Assessment Areas as part of a much larger foraging range. Given the small extent of vegetation clearing, and the mobile nature of this species, the project will not result in a significant impact on this species.	No
eastern freetail-bat <i>Mormopterus norfolkensis</i>	V (TSC)	This species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.	The eastern freetail-bat is found along the east coast from south Queensland to southern NSW. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Wollemi NP Yengo NP Barrington Tops NP	There is potential for this species to forage within the woodland habitats of the Assessment Areas as part of a wider foraging range. There is potential roosting habitat in the tree hollows present in the Assessment Areas.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V (TSC)	This species hunts in forested areas and uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. It forms discrete populations centered on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Eastern bentwing-bats occur along the east and north-west coasts of Australia. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Goulburn River NP Wollemi NP Yengo NP Barrington Tops NP Mount Royal NP	This species was recorded in the Assessment Areas. There are no potential roosting caves for this species within the Assessment Areas. This species likely utilises the habitats of the Assessment Areas as part of a wider foraging range.	Yes (see Appendix D)
eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V (TSC)	Habitat for this species includes sclerophyll forest. It prefers wet habitats, with trees over 20 metres high, and generally roosts in tree hollows or trunks.	This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Goulburn River NP Wollemi NP Yengo NP Barrington Tops NP	There is potential for this species to forage within the woodland habitats of the Assessment Areas as part of a wider foraging range. There is potential roosting habitat in the tree hollows present in the Assessment Areas.	Yes (see Appendix D)
little bentwing-bat <i>Miniopterus australis</i>	V (TSC)	Prefers moist eucalypt forest, rainforest or dense coastal banksia scrub. This species roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Occurs in coastal north-eastern NSW and eastern Queensland.	Wollemi NP	This species has a habitat preference for moist forests, rainforests and heath which are absent from the Assessment Areas. The project will not result in a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
greater broad-nosed bat <i>Scoteanax rueppellii</i>	V (TSC)	The greater broad-nosed bat appears to prefer moist environments such as moist gullies in coastal forests, or rainforest. They have also been found in gullies associated with wet and dry sclerophyll forests and open woodland. It roosts in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings.	The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however it does not occur at altitudes above 500 metres. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Wollemi NP Yengo NP Barrington Tops NP	There is potential for this species to forage within the woodland habitats of the Assessment Areas as part of a wider foraging range. There is potential nesting habitat in the small number of tree hollows present in the Assessment Areas.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
yellow-bellied sheathtail-bat <i>Saccolaimus flaviventris</i>	V (TSC)	This species forages for insects, flies high and fast over the forest canopy, but lower in more open country. It forages in most habitats across its very wide range, with and without trees; and appears to defend an aerial territory. It roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to use mammal burrows.	The yellow-bellied sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes.	Wollemi NP	This species has not been recorded in the Mangoola project area despite extensive surveys over six years. There is very limited potential for this species to occur in the Assessment Areas.	No
large-footed myotis <i>Myotis adversus</i>	V (TSC)	This species generally roosts in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. It forages over streams and pools catching insects and small fish by raking its feet across the water surface.	The large-footed myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Wollemi NP	This species was recorded in the Assessment Areas. This species likely utilises the habitats of the Assessment Areas as part of a wider foraging range. This species may roost within the tree hollows present within the Assessment Areas.	Yes (see Appendix D)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
eastern cave bat <i>Vespadelus troughtoni</i>	V (TSC)	This species is a cave-roosting bat that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. It has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals, and is occasionally found along cliff-lines in wet eucalypt forest and rainforest.	The eastern cave bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Goulburn River NP Wollemi NP	This species was recorded in the Assessment Areas. There are no potential roosting areas for this species within the Assessment Areas. This species likely utilises the habitats of the Assessment Areas as part of a wider foraging range.	Yes (see Appendix D)
large-eared pied bat <i>Chalinolobus dwyeri</i>	V (TSC) V (EPBC)	The large-eared pied bat is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands, however, it probably tolerates a wide range of habitats. It tends to roost in the twilight zones of mines and caves, generally in colonies or common groups.	This species has a distribution from south western Queensland to NSW from the coast to the western slopes of the Great Dividing Range. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), broadly across the area.	Goulburn River NP Wollemi NP Yengo NP	This species was recorded in the Assessment Areas. There are no potential roosting areas for this species within the Assessment Areas. This species likely utilises the habitats of the Assessment Areas as part of a wider foraging range.	Yes (see Appendices D and E)

Species	Legal Status	Specific Habitat	Distribution in relation to Assessment Areas	Reservation in the Region	Occurrence in Assessment Areas and Potential for Significant Impact	Detailed Assessment of Significance Required?
eastern long-eared bat (SE form) <i>Nyctophilus timoriensis timoriensis</i>	V (TSC)	Inhabits a variety of vegetation types, including mallee, bull-oak and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.	Overall, the distribution of the south-eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. The Assessment Areas occur within the known range of this species.	This species is not known to occur within any conservation reserves within the region.	This species has not been recorded in the Mangoola project area despite extensive surveys over six years. There is very limited potential for this species to occur in the Assessment Areas.	No

Notes

CR:	Crown reserve
E:	endangered
EPBC:	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
LGA:	Local Government Area
MAR	marine
MIG	migratory
NR:	Nature Reserve
NP:	National Park
PD:	preliminary determination
SCA:	state conservation area
TSC:	<i>Threatened Species Conservation Act 1995</i>
V:	vulnerable

Table 5 – EPBC Act Listed Migratory Species

Species	Status	Potential to Occur in Assessment Areas
white-bellied sea-eagle <i>Haliaeetus leucogaster</i>	Migratory Marine	High
white-throated needletail <i>Hirundapus caudacutus</i>	Migratory Marine	Moderate
malleefowl <i>Leiopa ocellata</i>	Migratory	None
rainbow bee-eater <i>Merops ornatus</i>	Migratory Marine	High
black-faced monarch <i>Monarcha melanopsis</i>	Migratory Marine	Low
satin flycatcher <i>Myiagra cyanoleuca</i>	Migratory Marine	High
regent honeyeater <i>Anthochaera phrygia</i>	Migratory	Low
great egret <i>Ardea alba</i>	Migratory Marine	None
cattle egret <i>Ardea ibis</i>	Migratory Marine	None
Latham's snipe <i>Gallinago hardwickii</i>	Migratory Marine	None
painted snipe <i>Rostratula benghalensis s. lat</i>	Migratory Marine	None
fork-tailed swift <i>Apus pacificus</i>	Migratory Marine	Moderate
swift parrot <i>Lathamus discolor</i>	Marine	Low

APPENDIX D

Assessment of Significance - Part 3A of the EP&A Act

Appendix D – Assessment of Significance - *Environmental Planning and Assessment Act 1979* (EP&A Act) Assessment

Threatened species, endangered populations, or threatened ecological communities (TECs) recorded during surveys and known to occur in the local area are listed in **Appendix C**, as are the results of the searches of the relevant ecological databases. These database searches provided lists of species, populations or TECs previously recorded within a 20 kilometre radius of the Assessment Areas, or with potential habitat within that radius.

Appendix C provides information on each threatened species (including specific habitat, distribution and reservation) and provides assessments of the potential for an impact from the project. Those species considered to have reasonable potential to occur within the Assessment Areas (based on known distribution and habitat requirements) and with reasonable potential to be impacted by the project are addressed in more detail in the 'Assessment of Significance' included in this appendix.

Part 3A of the EP&A Act requires an assessment of significance be prepared relating to the potential impacts of the project on listed threatened species, endangered populations or TECs. As a formal assessment method format is yet to be established for the Part 3A pathway, an assessment that applies the key principles of the Part 5A assessment is used here to assess the potential for the project to impact on threatened species, endangered populations or TECs within the Assessment Areas.

An assessment of significance is provided below for those identified threatened species, endangered populations or TECs considered (within **Appendix C**) to have the potential to be impacted by the project. The list includes species which are the subject of recent Preliminary Determinations by the NSW Scientific Committee to list as threatened species under the TSC Act. A precautionary approach is taken in this report, and these entities have been assessed as though they are formally listed.

The following species, populations and TECs are assessed:

- Hunter Floodplain Red Gum Woodland – EEC;
- Central Hunter Grey Box – Ironbark Woodland – EEC;
- tricolor diuris (*Diuris tricolor*) – vulnerable species and endangered population;
- tiger orchid (*Cymbidium canaliculatum*) – endangered population;
- glossy black-cockatoo (*Calyptorhynchus lathami*) – vulnerable species;
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) – vulnerable species;
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) – vulnerable species;
- turquoise parrot (*Neophema pulchella*) - vulnerable species;
- little lorikeet (*Glossopsitta pusilla*) – vulnerable species;
- scarlet robin (*Petroica boodang*) – vulnerable species;

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- speckled warbler (*Chthonicola sagittata*) – vulnerable species;
 - masked owl (*Tyto novaehollandiae*) – vulnerable species;
 - powerful owl (*Ninox strenua*) – vulnerable species;
 - squirrel glider (*Petaurus norfolcensis*) – vulnerable species;
 - eastern freetail-bat (*Mormopterus norfolkensis*) – vulnerable species;
 - eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) – vulnerable species;
 - eastern false pipistrelle (*Falsistrellus tasmaniensis*) – vulnerable species;
 - large-footed myotis (*Myotis adversus*) – vulnerable species;
 - eastern cave bat (*Vespadelus troughtoni*) – vulnerable species;
 - large-eared pied bat (*Chalinolobus dwyeri*) – vulnerable species; and
 - greater broad-nosed bat (*Scoteanax rueppellii*) – vulnerable species.

All species listed under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* requiring further assessment are considered in a separate assessment provided in **Appendix E**.

Hunter Floodplain Red Gum Woodland

a) *In relation to the regional distribution of the habitat of the endangered ecological community, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

Approximately 0.5 hectares of this EEC has been recorded along Big Flat Creek, within the Assessment Areas. Modifications to the initial project design have altered the locations of the towers in the vicinity of this EEC to ensure no vegetation will require removal as part of their construction. The method of stringing the cables for the ETL has also been revised for this area, to negate the need for heavy machinery to enter this EEC, therefore excluding the potential for impact. Maintenance works in this area will require the removal or lopping of trees with a mature height of over 4 metres. Such trees are likely to be cut off at the stump, and treated to prevent re-sprouting. While such an impact will be selective (i.e. removal of only those trees above 4 metres), the lower strata of this community will remain unimpacted by these maintenance works. While removing trees, retained vegetation will maintain part of the diversity of species in this community, and will also serve to maintain contiguity of riparian vegetation in this area. However, the maintenance works will modify the composition of this community along its 0.5 hectare extent.

Despite the need to impact on trees in this community for maintenance purposes, the remaining vegetation will retain some of the integrity of this EEC. A significant area of known habitat for this community will not be modified or removed, or isolated from currently interconnecting or proximate areas.

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- b) Whether the endangered ecological community, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.***

A very small area of this community is known to occur in Towarri NP near Scone and from the Singleton Military Area (ERM 2005). This is not likely to comprise adequate representation of this EEC in the conservation reserves of the region.

- c) Whether the endangered ecological community is at the limit of its known distribution.***

The community is known from the Maitland, Muswellbrook, Singleton and Upper Hunter LGAs but is predicted to occur in other areas of the Sydney Basin and NSW North Coast bioregions. The Assessment Areas are not at the limit of the known distribution of this EEC.

Central Hunter Grey Box – Ironbark Woodland

- a) In relation to the regional distribution of the habitat of the endangered ecological community, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.***

Approximately 8.8 hectares of this EEC has been recorded within the Assessment Areas. Of this, 3.7 hectares of this vegetation will require removal for construction purposes. The remainder of the vegetation falling within the easement is likely to experience disturbance from maintenance works, which will require the removal of trees with a mature height of over 4 metres. Vegetation below this height will remain, and thus maintain the diversity of species in this community, as well as vegetation connectivity in the area. Attempts will be made to minimise the loss of vegetation from these impacts, however this assessment assumes that 8.8 hectares will be disturbed to some degree.

In relation to the regional distribution of this EEC, it is not likely that a significant area of known habitat will not be modified or removed, or isolated from currently interconnecting or proximate areas.

- b) Whether the endangered ecological community, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.***

This community is not known from any conservation reserves in the region. This is not likely to comprise adequate representation of this EEC in the conservation reserves of the region.

- c) Whether the endangered ecological community is at the limit of its known distribution.***

This community occurs in the NSW North Coast and Sydney Basin Bioregions. It has been recorded from the LGAs of Muswellbrook, Singleton and Cessnock, but may occur elsewhere in the Sydney Basin Bioregion. The Assessment Areas are near to the western limit of the known distribution of this EEC.

Tricolour diuris (*Diuris tricolor*)

Tricolour diuris (*Diuris tricolor*) is listed as a vulnerable species under the TSC Act, while the population within the Muswellbrook Local Government Area (in which the Assessment Areas occur) is listed under the TSC Act as an Endangered Population. Two individuals of this species were recorded within Assessment Area B during surveys, near Tower 29. There is potential habitat for this species in other grassland and open woodland habitats in the Assessment Areas. This species was recorded in the Mangoola Mine as part of the Anvil Hill Project EA (Umwelt 2006) and from Eastcoast Flora Survey (2009a).

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

Tricolour diuris (*Diuris tricolor*) was recorded during surveys of the Assessment Areas, and potential habitat for this species exists within very open woodland areas and Disturbed Grassland habitats within the Assessment Areas. The project will result in the permanent disturbance to 14.9 hectares of known and potential habitat for this species. There will also be temporary disturbance to 4.6 hectares of habitat for this species, however the grassland areas are expected to fully recover from this impact. There are no known records of this species at any of the proposed tower locations.

As this species grows to less than 30 centimetres and generally occurs in a Disturbed Grassland community, it is not likely that this species will be impacted by ongoing maintenance requirements for the ETL. Given that the disturbance to *Diuris tricolor* is not likely to be long-term, and individual plants would be able to persist within the easement, the project is not likely to impact the life cycle of this species such that a local viable population of the species is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

The project will result in permanent disturbance to 14.9 hectares of known and potential habitat for this species. There will also be temporary disturbance to 4.6 hectares of habitat for this species, however the grassland areas are expected to fully recover from this impact. In relation to the regional distribution of habitat for this species, it is not likely that this impact will comprise a significant area. As this species grows to less than 30 centimetres and generally occurs in a Disturbed Grassland community, it is not likely that this species will be impacted by ongoing maintenance requirements for the ETL.

The project will not result in the fragmentation or isolation of currently connected habitats for this species, and it is not expected to provide a barrier to the transfer of the genetic material of any local population of *Diuris tricolor* within the Assessment Areas or between other local populations.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

This species has been recorded within a conservation reserve(s) within the region (Briggs and Leigh 1996), however there are no records stating which reserve(s) the species occurs in.

d) Whether the species is at the limit of its known distribution.

The Muswellbrook LGA is the eastern limit of the known range and the only recorded occurrence in the Sydney Basin Bioregion. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), to the north and east of the current Assessment Areas. This species is also known from the existing Biodiversity Offset Areas, and the approved project disturbance area (Eastcoast Flora Surveys 2009a, Umwelt 2009, Umwelt 2006).

Tricolour diuris (*Diuris tricolor*) – Endangered Population in Muswellbrook LGA

Tricolour diuris (*Diuris tricolor*) is listed as an endangered population within the Muswellbrook Local Government Area (in which the Assessment Areas occur) under the TSC Act. Two individuals of this population were recorded within Assessment Area B during surveys, near Tower 29. There is potential habitat for this population in other grassland and open woodland habitats in the Assessment Areas. This population was recorded in the Mangoola Mine as part of the Anvil Hill Project EA (Umwelt 2006) and from Eastcoast Flora Survey (2009a).

a) Whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Tricolour diuris (*Diuris tricolor*) was recorded during surveys of the Assessment Areas, and potential habitat for this species exists within very open woodland areas and Disturbed Grassland habitats within the Assessment Areas. The project will result in the permanent disturbance to 14.9 hectares of known and potential habitat for this species. There will also be temporary disturbance to 4.6 hectares of habitat for this species, however the grassland areas are expected to fully recover from this impact. There are no known records of this species at any of the proposed tower locations, however there is the potential that the two known records could be disturbed by construction activities.

As this species grows to less than 30 centimetres and generally occurs in a Disturbed Grassland community, it is not likely that this species will be impacted by ongoing maintenance requirements for the ETL. Given that the disturbance to *Diuris tricolor* is not likely to be long-term, and individual plants would be able to persist within the easement, the project is not likely to impact the life cycle of this species such that the endangered population is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the endangered population, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

The project will result in disturbance to a maximum of 36 hectares of known and potential habitat for this species. In relation to the regional distribution of habitat for this endangered population, it is not likely that this impact will comprise a significant area. As this species grows to less than 30 centimetres and generally occurs in a Disturbed Grassland community, it is not likely that this species will be impacted by ongoing maintenance requirements for the ETL.

The project will not result in the fragmentation or isolation of currently connected habitats for this endangered population, and it is not expected to provide a barrier to the transfer of the genetic material of any local sub-population (comprising the endangered population) within the Assessment Areas or between other local sub-populations.

c) Whether the endangered population, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species that constitutes this endangered population has been recorded within a conservation reserve(s) within the region (Briggs and Leigh 1996), however there are no records stating which reserve(s) the species occurs in.

d) Whether the endangered population is at the limit of its known distribution.

The Muswellbrook LGA is the eastern limit of the known range and the only recorded occurrence of tricolor diuris in the Sydney Basin Bioregion. This species was recorded in the Anvil Hill Project EA (Umwelt 2006), to the north and east of the current Assessment Areas. This species is also known from the existing Biodiversity Offset Areas, and the approved project disturbance area (Eastcoast Flora Surveys 2009a, Umwelt 2009, Umwelt 2006).

Tiger orchid (*Cymbidium canaliculatum*) – Endangered Population in Muswellbrook LGA

Tiger orchid (*Cymbidium canaliculatum*) is listed as an endangered population within the Hunter Catchment (in which the Assessment Areas occur) under the TSC Act. Two individuals comprising part of this population were recorded within Assessment Area A during surveys, near to Towers T9 and T10. There is potential habitat for this population throughout the Assessment Areas, wherever suitable host trees are present. This population was recorded in the Mangoola Mine as part of the Anvil Hill Project EA (Umwelt 2006) as well as from ongoing monitoring (Forest Fauna Survey/Eastcoast Flora Surveys 2008/9) and ongoing pre-clearing surveys. The ROMP (Umwelt in prep.) discusses the development of a translocation program for this species, where it is identified from trees that require clearing from the approved project disturbance area. The ecology of this species makes it amenable to such a program, and if successful will assist in greatly minimising impact on this endangered population.

a) Whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

Tiger orchid (*Cymbidium canaliculatum*) was recorded from two individual plants during surveys of the Assessment Areas, and potential habitat for this species exists wherever suitable host species occur in the Assessment Areas. The project will result in the disturbance to 14.9 hectares of known and potential habitat for this species. There are no known records of this species at any of the proposed tower locations. Detailed pre-clearing surveys and translocation programs have been committed to as part of the ROMP, and implementation of these will assist in mitigating impacts on this endangered population.

The project is not likely to impact the life cycle of this species such that the endangered population is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the endangered population, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

The project will result in disturbance to a maximum of 14.9 hectares of known and potential habitat for this species. In relation to the regional distribution of habitat for this endangered population, it is not likely that this impact will comprise a significant area.

The project will not result in the fragmentation or isolation of currently connected habitats for this endangered population, and it is not expected to provide a barrier to the transfer of the genetic material of any local sub-population (comprising the endangered population) within the Assessment Areas or between other local sub-populations.

c) Whether the endangered population, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The species which constitutes this endangered population is known from Wollemi and Goulburn River National Parks. This is not likely to comprise adequate representation of the endangered population within the conservation reserves of the Hunter catchment.

d) Whether the endangered population is at the limit of its known distribution.

Regionally, tiger orchid (*Cymbidium canaliculatum*) occurs throughout the Hunter Valley west of Jerrys Plains and Gresford, with an estimated 200 to 500 individuals (Peake *et al.* in prep.

c). The population of this species occurring within the Hunter Catchment is the most southerly known distribution for this species. The most southern record of this species is located at Jerrys Plains, about 40 kilometres from the Assessment Areas. Therefore, the population within the Assessment Areas is not at the species' distributional limit.

Glossy black-cockatoo (*Calyptorhynchus lathamii*)

The glossy black-cockatoo (*Calyptorhynchus lathamii*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential habitat, including hollow-bearing trees that could be used by this species for nesting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

This species has not been recorded within the Assessment Areas, however has the potential to be impacted by loss of foraging habitat and hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing only small amounts of foraging resources for this species. The project could result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Goulburn River NP, Wollemi NP, Yengo NP, Barrington Tops NP, and Mount Royal NP. This is likely to comprise adequate representation in the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

This species has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith. The Assessment Areas are not at the limit of the known distribution of this species.

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

The grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) is listed as a vulnerable species under the TSC Act. This species was recorded within the Assessment Areas during surveys, and the woodland habitats of the Assessment Areas support potential foraging and nesting habitat for this species. This species was also recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has been recorded within the Assessment Areas. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging and potential nesting resources for this species. The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of adjoining grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Belford NP, Goulburn River NP, Wollemi NP and Yengo NP. This is likely to comprise adequate representation within the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

The grey-crowned babbler (eastern subspecies) occurs throughout northern and south-eastern Australia. In NSW, this species occurs on the western slopes of the Great Dividing Range and on the western plains reaching as far west as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. The Assessment Areas are not at the limit of the known distribution for this species.

Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)

The brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential habitat, including hollow-bearing trees that could be used by this species for nesting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has not been recorded within the Assessment Areas, however it has the potential to be impacted by loss of foraging habitat and hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas are not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Goulburn River NP, Wollemi NP and Yengo NP. This is likely to comprise adequate representation within the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the divide in drier areas such as the Cumberland Plain of Western

Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. The Assessment Areas are not at the limit of the known distribution of this species.

Turquoise parrot (*Neophema pulchella*)

The turquoise parrot (*Neophema pulchella*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential habitat, including hollow-bearing trees that could be used by this species for nesting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has not been recorded within the Assessment Areas, however has the potential to be impacted by loss of foraging habitat and hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas are not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Goulburn River NP, Wollemi NP and Yengo NP. This is likely to comprise adequate representation within the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

The turquoise parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. The Assessment Areas are not at the limit of the known distribution of this species.

Little lorikeet (*Glossopsitta pusilla*)

The little lorikeet (*Glossopsitta pusilla*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential habitat, including hollow-bearing trees that could be

used by this species for nesting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has not been recorded within the Assessment Areas, however has the potential to be impacted by loss of foraging habitat and hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Wallabadah NR, Mt Royal NP and Tuggolo SF. This is not likely to comprise adequate representation within the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

This species is distributed from just north of Cairns, around the east coast of Australia down to Adelaide. In NSW this species is found from the coast to the western slopes of the Great Dividing Range, extending as far west as Albury, Dubbo, Parkes and Narrabri. The Assessment Areas are not at the limit of the known distribution of this species.

Scarlet robin (*Petroica boodang*)

The scarlet robin (*Petroica boodang*) is a vulnerable species under the TSC Act. This species was recorded within the Assessment Areas during surveys, and the Assessment Areas support potential foraging and nesting habitat for this species. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has been recorded within the Assessment Areas. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging and potential

nesting resources for this species. The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of adjoining grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Wollemi NP. This is not likely to comprise adequate representation within conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

The scarlet robin can be found in south-eastern Australia, from Tasmania to the southern end of Queensland, to western Victoria and south SA. In NSW it is found throughout the eastern areas of the state, no further than 500 kilometres from the coast. The Assessment Areas are not at the limit of the known distribution for this species.

Speckled warbler (*Chthonicola sagittata*)

The speckled warbler (*Chthonicola sagittata*) is listed as a vulnerable species under the TSC Act. This species was recorded within the Assessment Areas during surveys, and the Assessment Areas support potential foraging and nesting habitat for this species. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has been recorded within the Assessment Areas. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging and potential nesting resources for this species. The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of adjoining grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Goulburn River NP, Wollemi NP and Yengo NP. This is likely to comprise adequate representation within conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

This species has a patchy distribution throughout south-eastern Queensland, eastern half of NSW and into Victoria, as far west as the Grampians. The Assessment Areas are not at the limit of the known distribution for this species.

Masked owl (*Tyto novaehollandiae*)

The masked owl (*Tyto novaehollandiae*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential habitat, including hollow-bearing trees that could be used by this species for nesting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has not been recorded within the Assessment Areas, however it has the potential to be impacted by loss of hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Goulburn River NP, Wollemi NP, Yengo NP, Barrington Tops NP and Mount Royal NP. This is likely to comprise adequate representation within the conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea. The Assessment Areas are not at the limit of the known distribution for this species.

Powerful owl (*Ninox strenua*)

The powerful owl (*Ninox strenua*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential habitat, including hollow-bearing trees that could be used by this species for nesting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has not been recorded within the Assessment Areas, however it has the potential to be impacted by loss of hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Goulburn River NP, Wollemi NP, Yengo NP, Barrington Tops NP and Mount Royal NP. This is likely to comprise adequate representation within the conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

The powerful owl occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south-western Victoria to Bowen in Queensland. The Assessment Areas are not at the limit of the known distribution for this species.

Squirrel glider (*Petaurus norfolcensis*)

The squirrel glider (*Petaurus norfolcensis*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential habitat, including hollow-bearing trees that could be used by this species for nesting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has not been recorded within the Assessment Areas, however it has the potential to be impacted by loss of hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Wollemi NP, Yengo NP and Mount Royal NP. This is likely to comprise adequate representation within the conservation reserves within the region.

d) *Whether the species is at the limit of its known distribution.*

The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. The Assessment Areas are not at the limit of the known distribution for this species.

Eastern freetail-bat (*Mormopterus norfolkensis*)

The eastern freetail-bat (*Mormopterus norfolkensis*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential foraging habitat, including hollow-bearing trees that could be used by this species for roosting and breeding. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has not been recorded within the Assessment Areas, however it has the potential to be impacted by loss of hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

This species is known to occur in Wollemi NP, Yengo NP and Barrington Tops NP. This is likely to comprise adequate representation in the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

The eastern freetail-bat is found along the east coast from south Queensland to southern NSW. The Assessment Areas are not at the limit of the known distribution of this species.

Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)

The eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) is listed as a vulnerable species under the TSC Act. This species was recorded within the Assessment Areas during surveys, however the Assessment Areas support only potential foraging habitat for this species. There is no cave or escarpment habitat (particularly limestone formations) within the Assessment Areas that could provide potential roosting or breeding habitat for this species. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has been recorded within the Assessment Areas, and has the potential to be impacted by the loss of foraging habitat. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project will not impact on potential roosting or breeding habitat for this cave-dependent species.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The Assessment Areas will not impact on potential breeding or roosting habitat for this cave-dependent species. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.

This species is known to occur in Goulburn River NP, Wollemi NP, Yengo NP, Barrington Tops NP and Mount Royal NP. This is likely to comprise adequate representation in the conservation reserves of the region.

d) Whether the species is at the limit of its known distribution.

Eastern bentwing-bats occur along the east and north-west coasts of Australia. The Assessment Areas are not at the limit of the known distribution of this species.

Eastern false pipistrelle (*Falsistrellus tasmaniensis*)

The eastern false pipistrelle (*Falsistrellus tasmaniensis*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential foraging habitat, including hollow-bearing trees that could be used by this species for roosting and breeding. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.

This species has not been recorded within the Assessment Areas, however it has the potential to be impacted by loss of hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a

significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The species is known to occur in Goulburn River NP, Wollemi NP, Yengo NP and Barrington Tops NP. This is likely to comprise adequate representation in the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

This species has a range from south-eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast. The Assessment Areas are not at the limit of the known distribution of this species.

Large-footed myotis (*Myotis adversus*)

The large-footed myotis (*Myotis adversus*) is listed as a vulnerable species under the TSC Act. This species was recorded within the Assessment Areas during surveys, and the Assessment Areas support potential foraging habitat, as well as hollow-bearing trees that could be used by this species for breeding and roosting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has been recorded within the Assessment Areas, and has the potential to be impacted by loss of hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide nesting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The species is known to occur in Wollemi NP. This is not likely to comprise adequate representation in the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

The large-footed myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 kilometres inland, except along major rivers. The Assessment Areas are not at the limit of the known distribution of this species.

Eastern cave bat (*Vespadelus troughtoni*)

The eastern cave bat (*Vespadelus troughtoni*) is listed as a vulnerable species under the TSC Act. This species was recorded within the Assessment Areas during surveys, however the Assessment Areas support only potential foraging habitat for this species. There is no cave or escarpment habitat within the Assessment Areas that could provide potential roosting or breeding habitat for this species. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has been recorded within the Assessment Areas, and has the potential to be impacted by the loss of foraging habitat. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project will not impact on potential roosting or breeding habitat for this cave-dependent species.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The Assessment Areas will not impact on potential breeding or roosting habitat for this cave-dependent species. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The species is known to occur in Goulburn River NP and Wollemi NP. This is not likely to comprise adequate representation within the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

The eastern cave bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. The Assessment Areas are not at the limit of the known distribution for this species.

Large-eared pied-bat (*Chalinolobus dwyeri*)

The large-eared pied bat (*Chalinolobus dwyeri*) is listed as a vulnerable species under the TSC Act. This species was recorded within the Assessment Areas during surveys, however the Assessment Areas support only potential foraging habitat for this species. There is no cave or escarpment habitat within the Assessment Areas that could provide potential roosting or breeding habitat for this species. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has been recorded within the Assessment Areas, and has the potential to be impacted by the loss of foraging habitat. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project will not impact on potential roosting or breeding habitat for this cave-dependent species.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The Assessment Areas will not impact on potential breeding or roosting habitat for this cave-dependent species. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The species is known to occur in Goulburn River NP, Wollemi NP and Yengo NP. This is not likely to comprise adequate representation within the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

This species has a distribution from south-western Queensland to NSW from the coast to the western slopes of the Great Dividing Range. The Assessment Areas are not at the limit of the known distribution for this species.

Greater broad-nosed bat (*Scoteanax rueppellii*)

The greater broad-nosed bat (*Scoteanax rueppellii*) is listed as a vulnerable species under the TSC Act. This species was not recorded within the Assessment Areas during surveys, however the Assessment Areas support potential habitat, including hollow-bearing trees that could be used by this species for breeding and roosting. This species was recorded in the general area as part of the Anvil Hill Project EA (Umwelt 2006).

a) *Whether the life cycle of the species is likely to be disrupted such that a local viable population of the species is likely to be placed at risk of extinction.*

This species has not been recorded within the Assessment Areas, however has the potential to be impacted by loss of hollow-bearing trees. The project is expected to result in the loss of 10.3 hectares of woodland habitat containing foraging resources for this species. The project is also likely to result in the loss of up to 22 hollow-bearing trees that may provide breeding and roosting resources for this species. Avoidance of the loss of hollow-bearing trees will occur wherever possible, and all removed hollows will be replaced as part of the nest box program.

The project is not likely to impact in a local viable population of the species, such that it is likely to be placed at risk of extinction.

b) *In relation to the regional distribution of the habitat of the threatened species, whether a significant area of known habitat is to be modified or removed, or isolated from currently interconnecting or proximate areas.*

The loss of 10.3 hectares of woodland vegetation and 4.6 hectares of grassland habitat within the Assessment Areas is not likely to comprise the modification or removal of a significant area of known (or potential) habitat for this species. The loss of up to 22 hollow-bearing trees is not considered to be significant, given the similar resources likely to be present in the local area, and the commitment to replace these hollows. The project is not of a nature that will isolate potential habitat for this species from currently interconnecting or proximate areas, particularly given the existing highly fragmented nature of the majority of the vegetation in the Assessment Areas and surrounding area.

c) *Whether the species, or its habitat, are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The species is known to occur in Wollemi NP, Yengo NP and Barrington Tops NP. This is likely to comprise adequate representation within the conservation reserves of the region.

d) *Whether the species is at the limit of its known distribution.*

The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however it does not occur at altitudes above 500 metres. The Assessment Areas are not at the limit of the known distribution for this species.

APPENDIX E

Assessment of Significance - EPBC Act

Appendix E – Assessment of Significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the completion of an Assessment of Significance relating to the potential impacts of a project on listed matters of National Environmental Significance (NES). A search of the Department of Environment, Water, Heritage and the Arts (DEWHA) Protected Matters Database identified threatened and migratory species (EPBC Act listed) known to occur or considered likely to occur, on the basis of habitat modelling, within 20 kilometres of the Assessment Areas. No EPBC Act listed endangered populations or threatened ecological communities (TECs) are known or have potential to occur within the Assessment Areas.

Bothriochloa biloba and the large-eared pied bat (*Chalinolobus dwyeri*) have been recorded within the Assessment Areas. In addition to this, *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) has the potential to occur in the Assessment Areas (despite not being recorded).

Of the 13 migratory species identified from the database search, four species were found to have moderate to high potential to occur within the Assessment Areas, and therefore were worthy of further assessment to determine the significance of any impacts associated with the project. Of these, only the rainbow bee-eater (*Merops ornatus*) was recorded within the Assessment Areas. Those species with low or no potential to occur within the Assessment Areas have not been assessed.

An Assessment of Significance (according to the significant impact criteria for each matter of NES) is provided below for those matters of NES identified within the Assessment Areas, or considered to be potentially impacted by the project (as assessed within **Appendix C**).

Critically Endangered Species

The critically endangered *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) has not been recorded within the Assessment Areas, however it has been considered in this assessment. An assessment in accordance with the DEWHA principal significant impact guidelines is provided below for this species.

A ‘population of a species’ is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered species, occurrences include, but are not limited to:

- **A geographically distinct regional population, or collection of populations; or**
- **A population, or collection of local populations, that occur within a particular bioregion.**

Prasophyllum sp. Wybong (C. Phelps ORG 5269) has not been recorded within the Assessment Areas, however it has been recorded within the nearby approved project disturbance area for the Mangoola Mine (Rush, M. Pers. Comm.; Eastcoast Flora Survey 2009a). There is potential habitat for the species within the Assessment Areas, however it was not recorded during field surveys, despite these occurring within its known flowering period.

An action is likely to have a significant impact on a critically endangered species if there is a real chance or possibility that it will:

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

The project will not lead to a long-term decrease in the size of a population of *Prasophyllum* sp. Wybong (C. Phelps ORG 5269). This species has not been recorded within the Assessment Areas, however it has been recorded within the nearby approved project disturbance area for the Mangoola Mine site.

- **Reduce the area of occupancy of the species;**

The project will not reduce the area of occupancy of *Prasophyllum* sp. Wybong (C. Phelps ORG 5269).

- **Fragment an existing population into two or more populations;**

The project will not fragment a population of *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) into two or more populations.

- **Adversely affect habitat critical to the survival of a species;**

The project will not adversely affect habitat critical to the survival of *Prasophyllum* sp. Wybong (C. Phelps ORG 5269).

- **Disrupt the breeding cycle of a population;**

The project will not disrupt the breeding cycle of a population of *Prasophyllum* sp. Wybong (C. Phelps ORG 5269).

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

The project will not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) is likely to decline.

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

The project will not result in invasive species that are harmful to *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) becoming established in its habitat.

- **Introduce disease that may cause the species to decline; or**

The project will not introduce disease that may cause *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) to decline.

- **Interfere with the recovery of the species.**

The project is unlikely to interfere with the recovery of *Prasophyllum* sp. Wybong (C. Phelps ORG 5269).

Vulnerable Species

The following EPBC Act listed vulnerable species are considered in this assessment:

- large-eared pied bat (*Chalinolobus dwyeri*); and
- *Bothriochloa biloba*.

An assessment in accordance with the DEWHA principal significant impact guidelines is provided below for these species.

The large-eared pied bat (*Chalinolobus dwyeri*) has been recorded on a number of occasions within the Assessment Areas, as well as from the Mangoola Mine (Umwelt 2006, Umwelt 2009, Forest Fauna Surveys/Eastcoast Flora Survey 2008-9). There is the potential that the escarpment areas in the local area (such as Wallaby Rocks, Anvil Hill and Limb of Addy Hill) have suitable habitat for breeding/roosting for this species, however there has been no evidence of such roosts or breeding caves recorded from surveys of the area.

While there is the potential for roosting/breeding caves in the local area, it is not likely that such caves would support an *important population* of this species. If a population was recorded roosting or breeding in the escarpments of the local area, it is not likely that this would be a key source population for breeding or dispersal in the region. This species has been recorded from a number of large conservation reserves in the region (see **Appendix 3**), all of which contain significant escarpment areas that are likely to support breeding/roosting habitat for this species. If this species was breeding in the local area, it is also unlikely that population would be necessary for maintaining genetic diversity for this species. The species is not at the limit of its known range in the Assessment Areas, or local area. As such, it is not likely that the potential population of this species occurring in the Assessment Areas (and broader local area) is an *important population*, being necessary for a species' long-term survival and recovery.

Bothriochloa biloba has been recorded within the Assessment Areas, as well as extensively in the broader local area. This species is likely to be relatively common within suitable grassland habitats of the local area. This species is moderately widespread, although uncommon, in the Hunter Valley. A population of this species within the Assessment Areas would not represent a key source population for breeding or dispersal, nor would it be necessary for maintaining genetic diversity for the species. The Wybong area is not at the limit of the range of this species. As such, it is not likely that the *Bothriochloa biloba* within the Assessment Areas comprises an *important population* of this species.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

- **lead to a long-term decrease in the size of an important population of a species;**

The records of the large-eared pied bat (*Chalinolobus dwyeri*) from the Assessment Areas (and local area) are not likely to comprise an *important population* of this species.

The records of *Bothriochloa biloba* from the Assessment Areas (and local area) are not likely to comprise an *important population* of this species.

- **reduce the area of occupancy of an important population, or;**

The records of the large-eared pied bat (*Chalinolobus dwyeri*) from the Assessment Areas (and local area) are not likely to comprise an *important population* of this species.

The records of the *Bothriochloa biloba* from the Assessment Areas (and local area) are not likely to comprise an *important population* of this species.

- **fragment an existing important population into two or more populations, or;**

The records of the large-eared pied bat (*Chalinolobus dwyeri*) from the Assessment Areas (and local area) are not likely to comprise an *important population* of this species.

The records of *Bothriochloa biloba* from the Assessment Areas (and local area) are not likely to comprise an *important population* of this species.

- **adversely affect habitat critical to the survival of a species, or;**

The project will not adversely affect habitat critical to the survival of the large-eared pied bat (*Chalinolobus dwyeri*).

The project will not adversely affect habitat critical to the survival of *Bothriochloa biloba*.

- **disrupt the breeding cycle of an important population, or;**

The records of the large-eared pied bat (*Chalinolobus dwyeri*) from the Assessment Areas (and local area) are not likely to comprise an *important population* of this species.

The records of *Bothriochloa biloba* from the Assessment Areas (and local area) are not likely to comprise an *important population* of this species.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or;**

The project will not modify, destroy, remove, isolate, or decrease the availability or quality of habitat for *Bothriochloa biloba* or the large-eared pied bat (*Chalinolobus dwyeri*), such that these species are likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat, or;**

The project will not result in invasive species that are harmful to *Bothriochloa biloba* or the large-eared pied bat (*Chalinolobus dwyeri*) becoming established in their habitat.

- **interferes substantially with the recovery of the species.**

The project will not interfere substantially with the recovery of *Bothriochloa biloba* or the large-eared pied bat (*Chalinolobus dwyeri*).

Conclusion

The project will not result in a significant impact on the large-eared pied bat (*Chalinolobus dwyeri*).

The project will not result in a significant impact on *Bothriochloa biloba*.

Migratory Species

The rainbow bee-eater (*Merops ornatus*) is the only EPBC listed migratory species that has been recorded from the Assessment Areas. The white-throated needletail (*Hirundapus caudacutus*), satin flycatcher (*Myiagra cyanoleuca*) and fork-tailed swift (*Apus pacificus*) are considered to have a reasonable likelihood of occurrence within the Assessment Areas, as such have been included in this assessment. An assessment in accordance with the DEWHA principal significant impact guidelines is provided below for these species.

An area of *important habitat* is:

- **habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; or**
- **habitat utilised by a migratory species which is at the limit of the species range; or**
- **habitat within an area where the species is declining.**

The Assessment Areas are not regarded to comprise important habitat for the rainbow bee-eater (*Merops ornatus*) or any of the potentially-occurring listed migratory species, based on the criteria described above. As such, no further assessment is required for any EPBC Act listed migratory species.

Conclusion

The project will not result in a significant impact on any EPBC Act listed threatened species or migratory species.