

p r o p o s e d

Mt Arthur

UNDERGROUND PROJECT

Appendix 6



Ecological Assessment

Mt Arthur Coal

Ecological Assessment Proposed Mt Arthur Underground Project

December 2007

Ecological Assessment Proposed Mt Arthur Underground Project

**Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mt Arthur Coal**

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Executive Summary

Mt Arthur Coal proposes an underground coal mining operation beneath its existing open cut mining areas and adjacent exploration licence (EL) to the west. The project is known as the Mt Arthur Underground Project.

Umwelt (Australia) Pty Limited (Umwelt) has prepared an Environmental Assessment (EA) for the Mt Arthur Underground Project, with this Ecological Assessment forming part of the EA. This Ecological Assessment is based on detailed ecological surveys completed in autumn and summer 2005 covering a Survey Area of approximately 3800 hectares. The ecological survey resulted in the identification of a number of ecological features, which are discussed below.

Flora

The floristic diversity of the Survey Area is regarded as moderate, and is substantially affected by the history of clearing for agriculture. The recorded floristic diversity is representative of similar disturbed woodlands and derived grasslands occurring widely across the Hunter Valley. The flora surveys identified the following key features:

- 220 flora species, 74 per cent of which are native to the Survey Area;
- seven vegetation communities, namely:
 - Hunter Valley Weeping Myall Woodland;
 - Central Hunter Bulloak Forest Regeneration;
 - Central Hunter Box – Ironbark Woodland;
 - Hunter Floodplain Red Gum Woodland Complex;
 - Narrabeen Foothills Slaty Box Woodland;
 - Derived Grassland; and
 - Aquatic Vegetation;
- one Endangered Ecological Community (EEC) (Hunter Valley Weeping Myall Woodland);
- Weeping Myall (*Acacia pendula*) Endangered Population;
- Tiger Orchid (*Cymbidium canaliculatum*) Endangered Population; and
- *Bothriochloa biloba*, a grass listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Fauna

The fauna surveys identified the following key features:

- 97 fauna species, including 58 birds, eight reptiles, four amphibians and 27 mammals;
- eight threatened fauna species, namely:

- speckled warbler (*Pyrrholaemus saggitata*);
 - grey-crowned babbler (*Pomatostomus temporalis temporalis*);
 - squirrel glider (*Petaurus norfolcensis*);
 - eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
 - large-footed myotis (*Myotis adversus*);
 - greater broad-nosed bat (*Scoteanax rueppellii*);
 - eastern freetail-bat (*Mormopterus nofolkensis*); and
 - eastern cave bat (*Vespadelus troughtoni*); and
- two EPBC Act listed migratory species, the white throated needletail (*Hirundapus caudacutus*) and the rainbow bee-eater (*Merops ornatus*).

Impact Assessment

As the project involves underground mining and the majority of major surface infrastructure associated with the project is proposed to be established in open cut mining areas, the potential for the project to impact on ecological values is reduced. The majority of impacts of the Underground Project on ecological values will arise from potential subsidence cracking, subsidence remediation works to repair areas of cracking, the construction of surface infrastructure and from stream remediation works completed to rectify changes to drainage lines due to subsidence.

Approximately 93 per cent of predicted subsidence remediation works are expected to occur within the Derived Grassland vegetation community, with the remaining approximately 7 per cent occurring within woodland vegetation communities. This consists of approximately 24 hectares of Central Hunter Bullock Forest Regeneration (44 per cent of extent in Survey Area) and approximately 24 hectares of Central Hunter Box – Ironbark Woodland (10 per cent of extent in Survey Area). The predicted level of subsidence in these woodland and forest communities is not expected to cause tree failure or tree death.

As subsidence remediation works will only occur where it is necessary to repair areas of cracking, the majority of vegetation will remain largely undisturbed and clearing of canopy vegetation is unlikely to be required. The predicted impact of the project is therefore not expected to result in a significant loss of floristic diversity in the Survey Area, Mt Arthur Coal operations area or the region.

The majority of surface infrastructure required for the project will be located within areas that have been disturbed by past mining operations or that have been subject to past ecological survey and assessment. The construction of an overland conveyor and associated services corridor and access road will require clearing of approximately 0.66 hectares of Hunter Floodplain Red Gum Woodland Complex (representing approximately 0.9 per cent of the extent of this community within the Survey Area).

The precise location of minor infrastructure such as ventilation fans, borehole facilities and associated access tracks and power lines will not be known until detailed mine planning in each area has commenced. Minor surface infrastructure will be located wherever possible within disturbed or grassland areas. It is considered that these facilities can be constructed

without a significant impact on vegetation communities and fauna habitats, and a detailed ecological due diligence inspection process will be implemented. Further detailed assessment is not required prior to the construction of these facilities, however sites containing weeping myall (*Acacia pendula*) will be avoided (with appropriate disturbance setbacks implemented) to minimise impact on this listed Endangered Population and EEC which occurs within the proposed mining area.

An assessment of significance has been used to determine the potential impact of the Underground Project on threatened species, Endangered Populations and EECs recorded, or considered likely to occur in the project area. The assessment concludes that the Underground Project will not have a significant impact on State or Commonwealth listed threatened species, Endangered Populations, EECs or their habitats recorded within the project area. The assessment of significance also concludes that the Underground Project would not result in a significant impact on threatened species, Endangered Populations or EECs that have the potential to occur within the project area.

Ecological Management Strategies

A range of management strategies will be used by Mt Arthur Coal to limit impacts on native flora and fauna in the project area. The strategies will include:

- dust and noise minimisation;
- weed and feral animal control;
- rehabilitation of disturbed areas;
- linkage and integration of rehabilitation areas with existing vegetated areas to improve ecological function and provide habitat;
- management of surface water, erosion and sedimentation;
- ongoing monitoring and maintenance of all revegetation works and habitat enhancement activities;
- pre-clearance inspections and tree felling procedures;
- relocation of salvaged tree hollows and (where required) the establishment of nest boxes in adjacent vegetation communities. Tree hollows lost during clearing activities will be replaced at a ratio of approximately 1:1 using salvaged tree hollows and nest boxes;
- due diligence inspections for surface infrastructure;
- ongoing monitoring of native flora and fauna across the Mt Arthur Coal site; and
- creation of habitat corridors linking isolated remnant vegetation stands.

Offset Strategy

As part of the Aboriginal Archaeological Assessment for the Underground Project (Umwelt 2007), Mt Arthur Coal has made a commitment to establish the Saddlers Creek Conservation Area, and to conserve it in perpetuity. This area has been established to offset the impacts of the proposed Underground Project on Aboriginal cultural heritage, however, it

also provides the opportunity to conserve and enhance significant ecological features, and to offset the impacts of the Underground Project on ecological values.

The proposed Saddlers Creek Conservation Area is approximately 295 hectares in size, includes the main channel of Saddlers Creek and runs along the southern and south-eastern boundaries of the project area. The vegetation of the proposed Saddlers Creek Conservation Area is dominated by Derived Grassland (approximately 212 hectares), Hunter Floodplain Red Gum Woodland Complex (approximately 53 hectares) and Central Hunter Box – Ironbark Woodland (approximately 29 hectares). There are also small areas of Aquatic Vegetation located along Saddlers Creek.

Saddlers Creek riparian vegetation provides known habitat for a number of threatened fauna species and the tiger orchid (*Cymbidium canaliculatum*), which is listed as an Endangered Population in the Hunter catchment. To assist in further offsetting the impacts of the project on the threatened species recorded in the Survey Area, the following habitat enhancement and protection recommendations will be implemented along Saddlers Creek:

- fencing to protect the riparian corridor and encourage natural regeneration; and
- cattle grazing will cease along Saddlers Creek, to promote natural regeneration and improve habitat quality for a range of threatened species.

The proposed Saddlers Creek Conservation Area is of ecological significance for a number of reasons, namely:

- known threatened species records;
- known regionally significant species;
- presence of a substantial number of tree hollows;
- known examples of the tiger orchid (*Cymbidium canaliculatum*) Endangered Population;
- it is a riparian Corridor; and
- it contains a regionally significant vegetation community.

The combined value of the significant ecological features of the proposed Saddlers Creek Conservation Area identifies it as an ideal area for the offsetting of the ecological impacts of the Underground Project.

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1.0 Introduction

Mt Arthur Coal Pty Limited (Mt Arthur Coal) operates the Mt Arthur Coal open cut coal mine south of Muswellbrook in the upper Hunter Valley of NSW (refer to **Figure 1.1**). The existing operations consist of three mining areas: the Bayswater No. 2 mining area (extraction complete), the Bayswater No. 3 mining area and the Mount Arthur North (MAN) mining area (refer to **Figure 1.2**). Mt Arthur Coal has also been investigating a potential underground coal mining resource in the Bayswater No. 3 mining area and the adjacent EL 5965 (refer to **Figure 1.2**) held since 1996, with development of an underground exploration adit approved in 2006. These investigations have identified a substantial underground mining resource, and the company is now seeking approval for an underground coal mining operation in this area. The proposed Mt Arthur Underground Project will access the coal reserve through approved open cut pits and will build on Mt Arthur Coal's existing infrastructure, including the coal handling and preparation plant (CHPP) and rail loading facility.

Umwelt has been commissioned by Mt Arthur Coal to prepare an Environmental Assessment (EA) to accompany the project application for the Underground Project. This Ecological Assessment has been undertaken as part of the overall EA for the project.

1.1 Survey Area

The project area for the Underground Project includes existing open cut mining areas, existing infrastructure areas, undisturbed areas within existing mining leases and land within the EL (refer to **Figure 1.2**). Within the total project area there is land that has been previously disturbed by mining activity and land with potential ecological values that has not been previously disturbed. Part of this area was surveyed for the Bayswater No. 3 Environmental Impact Statement (EIS) (Resource Planning 1993), however much of the land within the EL has not been previously surveyed. Within the project area, the ecological Survey Area (hereafter referred to as the Survey Area) for this project was designed to survey all parts of the project area that have not been previously surveyed, and to resurvey those areas covered for the Bayswater No. 3 EIS not approved for mining activities. The Survey Area incorporates all land potentially impacted by the Underground Project, excluding previously disturbed areas, or areas approved for disturbance as part of existing open cut mining approvals.

The Survey Area for the Underground Project is shown on **Figure 1.2** and covers approximately 3800 hectares.

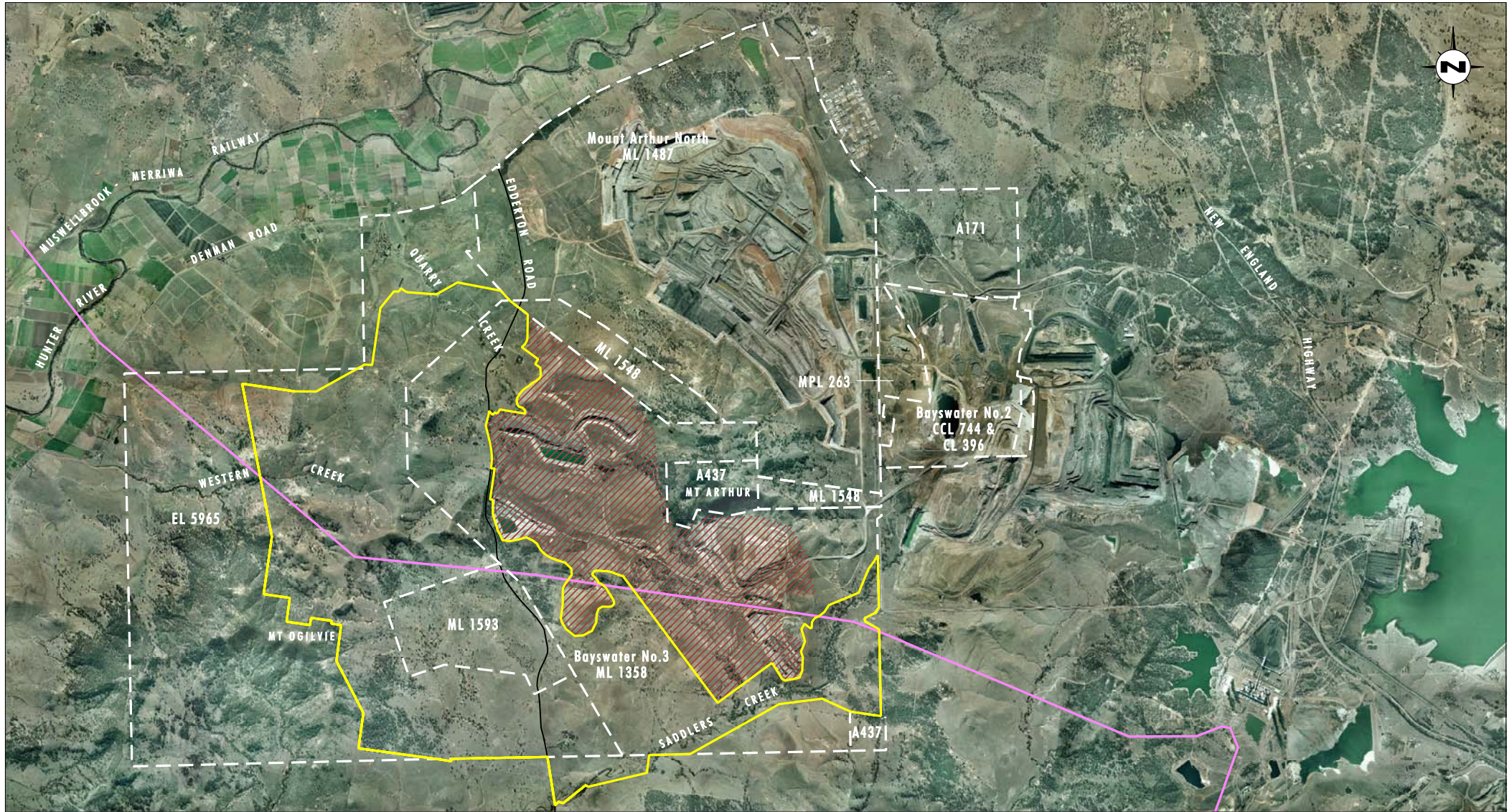
1.2 Proposed Mining Operations

The Underground Project will involve longwall mining operations in five coal seams over the initial 21 year approval life. It is expected that further resources will remain within the Survey Area after the first 21 years of mining, and Mt Arthur Coal intend to continue mining beyond this period, should future approvals be granted. The five target seams for the initial 21 year period are the:

- Woodlands Hill seam;
- Glen Munro seam;
- Arrowfield seam;
- Bowfield seam; and



FIGURE 1.1
Locality Plan



Base Source: Mt Arthur Coal, 2006

0 1 2 4 km
1:90 000

Legend

- Mining and Exploration Lease Boundary
- Survey Area
- Bayswater No.3 Mining Area
- Existing Transmission Line

FIGURE 1.2

**Mt Arthur Coal Operations,
Project Area and Survey Area**

- Piercefield seam.

'Punch longwall' mining techniques will be the primary underground mining method used in the Woodlands Hill and Glen Munro seams, meaning that the gate roads (mine access tunnels) for longwall blocks will have access directly into the coal seam from open cut voids. Some conventional main heading (underground roadways) access will also be provided from the Saddlers Pit highwall. Further open cut works will be required in both the Saddlers Pit and Belmont Pit in the Bayswater No. 3 mining area to set up for underground mining. These works will be completed in accordance with the existing Bayswater No. 3 development consent.

The Arrowfield, Bowfield and Piercefield coal seams are deeper and cannot be accessed directly from the open cut mining pits. A drift will therefore be established from the base of the North Saddlers pit to provide access into these seams. The concept mine plans for the Woodlands Hill and Glen Munro seams are shown on **Figure 1.3**, with the concept mine plans for the Arrowfield, Bowfield and Piercefield seams shown on **Figure 1.4**.

A range of ancillary mining infrastructure will be required above the underground mining area including ventilation fan facilities, access tracks, service boreholes (power etc.), gas drainage facilities, dewatering boreholes and other similar mining infrastructure. The exact locations in which these facilities are required to be located will be determined as the Underground Project progresses, depending on mining operation needs. Conceptual localities for some of the surface facilities are shown on **Figures 1.3** and **1.4**.

The 21 year concept mine plan will result in the extraction of up to approximately 160 million tonnes of coal at a production rate of approximately 8 million tonnes per annum (Mtpa). The annual production rate is expected to vary between 6 and 8 Mtpa depending on the seam, mining conditions and the timing of longwall panel changeovers.

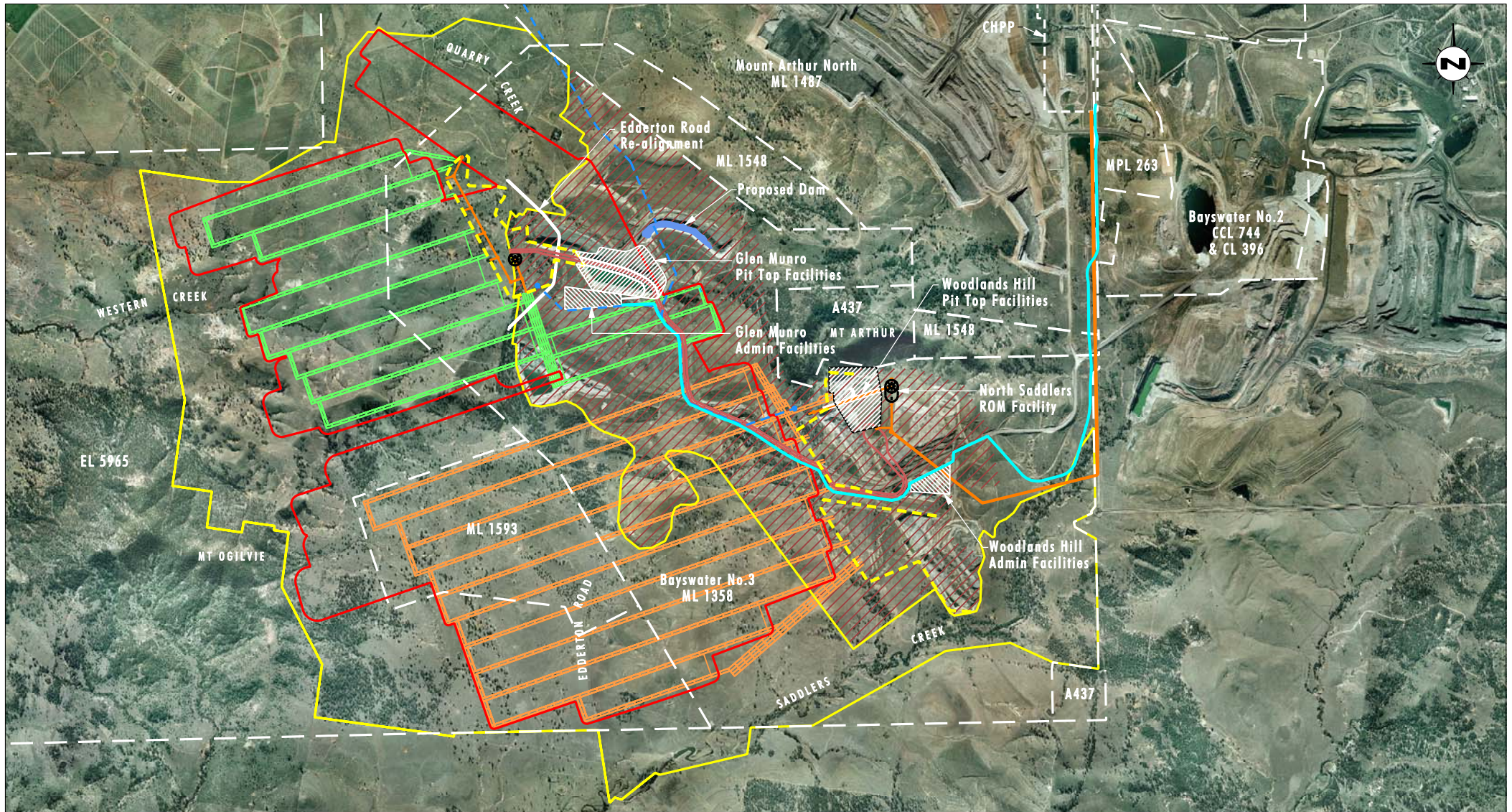
1.3 Mine Infrastructure

The Underground Project has been designed to maximise the use of existing Mt Arthur Coal infrastructure, including the existing CHPP and rail facility. Some upgrade works and extensions will be required to these existing facilities, with some new Underground Project specific infrastructure also required.

The pit-top (surface) facilities required for the Underground Project will include office, workshop, store and bathhouse facilities. These facilities will be constructed primarily in previously mined areas as shown on **Figures 1.3** and **1.4**.

Coal from the underground mining operations will be crushed and sized at a new ROM coal facility to be constructed on previously mined land in the Saddlers Pit surface facility area as shown on **Figure 1.3**. After passing through this facility, coal will be delivered by overland conveyor (to be constructed) to the existing Mt Arthur Coal CHPP (refer to **Figure 1.3**). The CHPP will require some upgrade works (including a new plant module, additional stockpiling areas and associated handling facilities) to provide sufficient capacity for the coal from the Underground Project, however this will not result in disturbance of any previously undisturbed land.

Coal from the Underground Project will be transported from the site via Mt Arthur Coal's existing rail facility or existing conveyor to Bayswater Power Station. The existing rail loading facility will be used to load coal onto trains and will not require any major upgrade works. Although no major upgrades are required to the rail facility for the Underground Project, it is proposed to extend an existing passing lane on the Antiene rail spur to provide additional



Source: Mt Arthur Coal

0 1 2 3 km
1:60 000

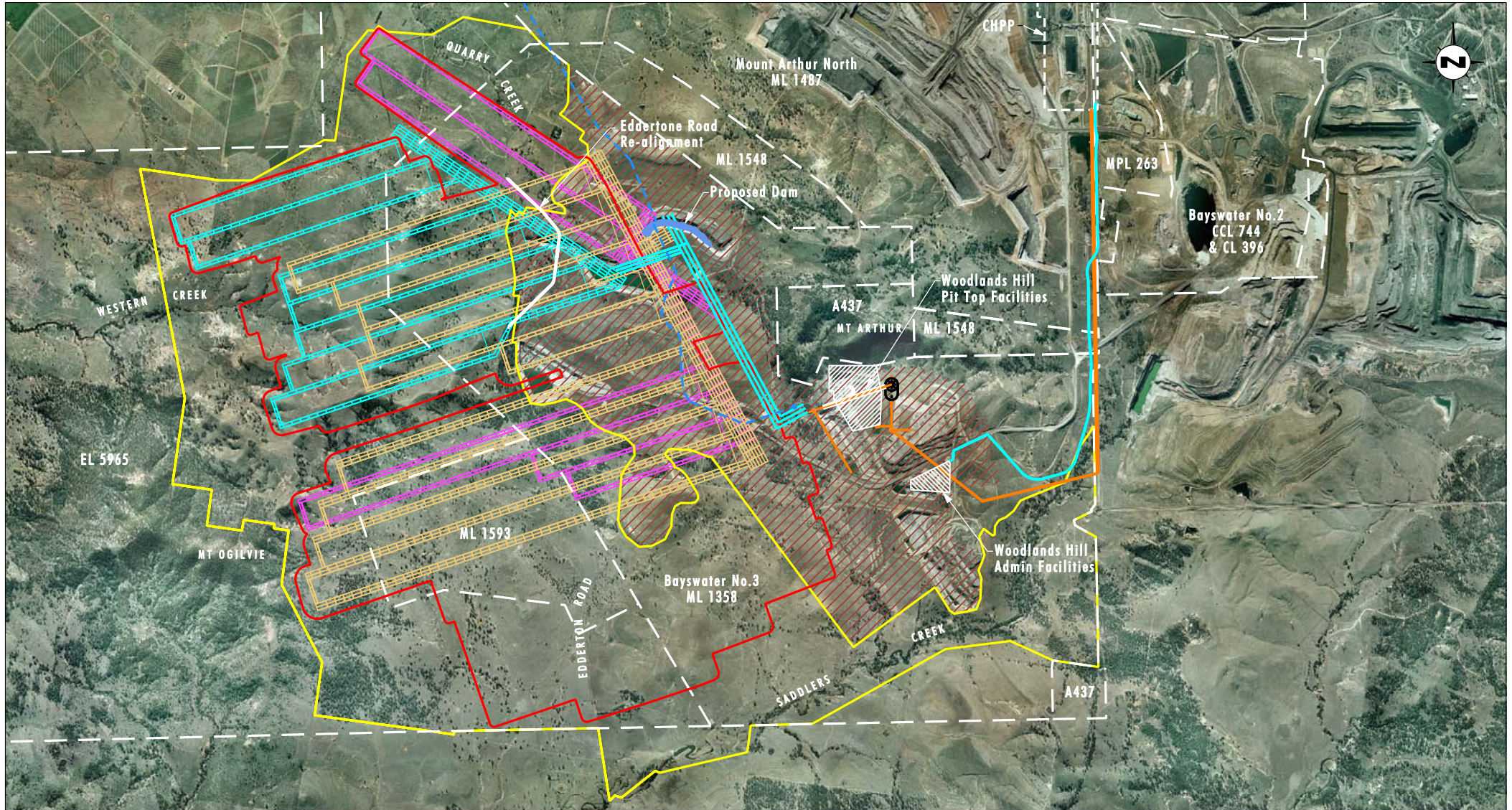
Legend

- | | | |
|--|--|---|
| Mining and Exploration Lease Boundary | Glen Munro Seam Concept Mine Layout | Clean Water Supply |
| Survey Area | Approved Open Cut | |
| Subsidence Affactation Area | Mine Access Road | |
| Bayswater No.3 Mining Area | Surface Conveyor | |
| Woodlands Hill Seam Concept Mine Layout | Haul Road | |

File Name (A4): R17_V1/2051_196.dgn

FIGURE 1.3

**Woodlands Hill and Glen Munro
Mine Plan and Surface Facilities**



Source: Mt Arthur Coal

0 1 2 3km
1:60 000

Legend

- | | | |
|---------------------------------------|--------------------------------------|--------------------|
| Mining and Exploration Lease Boundary | Bowfield Seam Concept Mine Layout | Clean Water Supply |
| Survey Area | Piercefield Seam Concept Mine Layout | |
| Subsidence Affactation Area | Mine Access Road | |
| Bayswater No.3 Mining Area | Surface Conveyor | |
| Arrowfield Seam Concept Mine layout | Haul Road | |

File Name (A4): R17_V1/2051_197.dgn

FIGURE 1.4

**Arrowfield, Bowfield and Piercefield
Mine Plan and Surface Facilities**

train movement capacity. The extended passing lane will be located to the east of the New England Highway near the intersection of the Antiene spur with the Main Northern Railway. The passing lane is planned to be constructed within the existing rail corridor.

Vehicular access to the Underground Project will be via the existing Mt Arthur Coal site access, with an additional section of internal access road constructed to connect this road to the Underground Project facilities. The location of this access road is shown on **Figure 1.3**.

A number of other site services will also be required for the Underground Project, including power lines, water pipe lines, a Hunter River water extraction point and minor internal access roads. The proposed locations of some of these services are shown on **Figures 1.3** and **1.4**, with further services to be established during the life of the Underground Project as the need arises.

1.4 Objectives of Ecological Assessment

The objectives of the Ecological Assessment report are to:

- record and describe the flora and fauna species, vegetation communities and fauna habitat within the Survey Area;
- identify any threatened flora and fauna species, Endangered Populations, Endangered Ecological Communities (EECs), or their habitats, within the Survey Area, particularly those listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth EPBC Act;
- identify any regionally significant vegetation communities within the Survey Area;
- assess the potential impact that the Underground Project would have on any ecological values, threatened flora and fauna species, Endangered Populations, EECs, or their habitats, recorded in the project area; and
- provide management options to minimise ecological impacts associated with the Underground Project.

2.0 Survey Methodology

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the ecological features of the Survey Area. The methods consisted of a literature review (including searches of relevant ecological databases), and detailed field survey. The ecological databases searched were the Department of Environment and Conservation (DEC) Atlas of NSW Wildlife and the Commonwealth Department of Environment and Heritage (DEH) Protected Matters database. Information gathered from the literature reviews and database searches was used to design an extensive field survey program to map and survey vegetation communities and flora species, to identify the fauna species using the habitats of the Survey Area and to target threatened species, Endangered Populations, EECs, or their habitats within the Survey Area.

2.1 Literature Review

The literature review completed as part of the survey methodology involved reviewing the considerable literature base for the wider Mt Arthur Coal operations area, including numerous EAs, ecological monitoring reports and regional studies. Such documents include a detailed regional vegetation assessment, site-specific surveys completed within the Survey Area, and further surveys undertaken next to, or close to the Survey Area. Those documents assessed as part of this literature review include:

- Bayswater No. 3 Coal Mine Project Environmental Impact Statement (Resource Planning 1993);
- The Mt Arthur North Coal Project Environmental Impact Statement (URS 2000);
- Flora and Fauna Assessment Proposed Antienne Joint User Rail Facility. Volume 2, Appendix 3 of the EIS (Umwelt 2000);
- Mt Arthur Coal 2003 Ecological Monitoring Report (Umwelt 2003);
- Mt Arthur Coal 2004 Ecological Monitoring Report (Umwelt 2005);
- Mt Arthur Coal 2005 Ecological Monitoring Report (Umwelt 2006a);
- Ecological Assessment – Proposed South Pit Extension Project (Umwelt 2006b); and
- The Vegetation of the Central Hunter Valley, New South Wales: A report on the findings of the Hunter Remnant Vegetation Project (Peake 2006).

Relevant information from these documents pertaining to the Survey Area has been used within the assessment, particularly records of threatened species, Endangered Populations or EECs. The information gathered from these surveys has also been used in survey design, the compilation of potential threatened species lists and habitat assessments.

2.2 Flora Survey

2.2.1 Systematic Plot-based Sampling

Prior to the field survey, broad vegetation mapping using aerial photography was undertaken to determine the broad vegetation community types occurring within the Survey Area.

Following this, a total of 40 systematic 400 m² vegetation survey plots were sampled across the Survey Area from 5 to 8 April 2005 and 5 to 7 December 2005 (refer to **Figure 2.1**). These systematic plots were used to ground truth the broad vegetation mapping, to describe vegetation communities and to develop a flora species list for the Survey Area.

Systematic plots were used to undertake semi-quantitative sampling of the vegetation of the Survey Area. Plots of 400 m² are used widely, including by the Royal Botanic Gardens Sydney and the Department of Environment and Climate Change (DECC). The typical dimensions of the plot are 20 metres by 20 metres, however some plots were 10 metres by 40 metres, particularly in riparian areas. Plot-based (or quadrat) surveys have distinct advantages over transects, as they:

- enable a quantitative examination of species distribution and abundance;
- are more likely to detect inconspicuous or threatened species (especially forbs and grasses) as a smaller area is sampled in a concentrated search; and
- provide a basis for any subsequent monitoring required.

At each vegetation survey plot, roughly 45 to 60 minutes was spent searching for all vascular flora species present. Species located outside the plot were marked as being present but were not assigned a cover-abundance value. Two ecologists were present at each sampled plot, and typically one searched while the other recorded and undertook complementary searching. Searches of each plot were generally undertaken through parallel transects from one side of the plot to the other. Most effort was spent on examining the groundcover, because at most sites this supported well over half of all species. However, plot surveys also thoroughly examined the shrub layer, mid-understorey, canopy and emergents. Effort was made to search the canopy and tree trunks for mistletoes, vines and epiphytes.

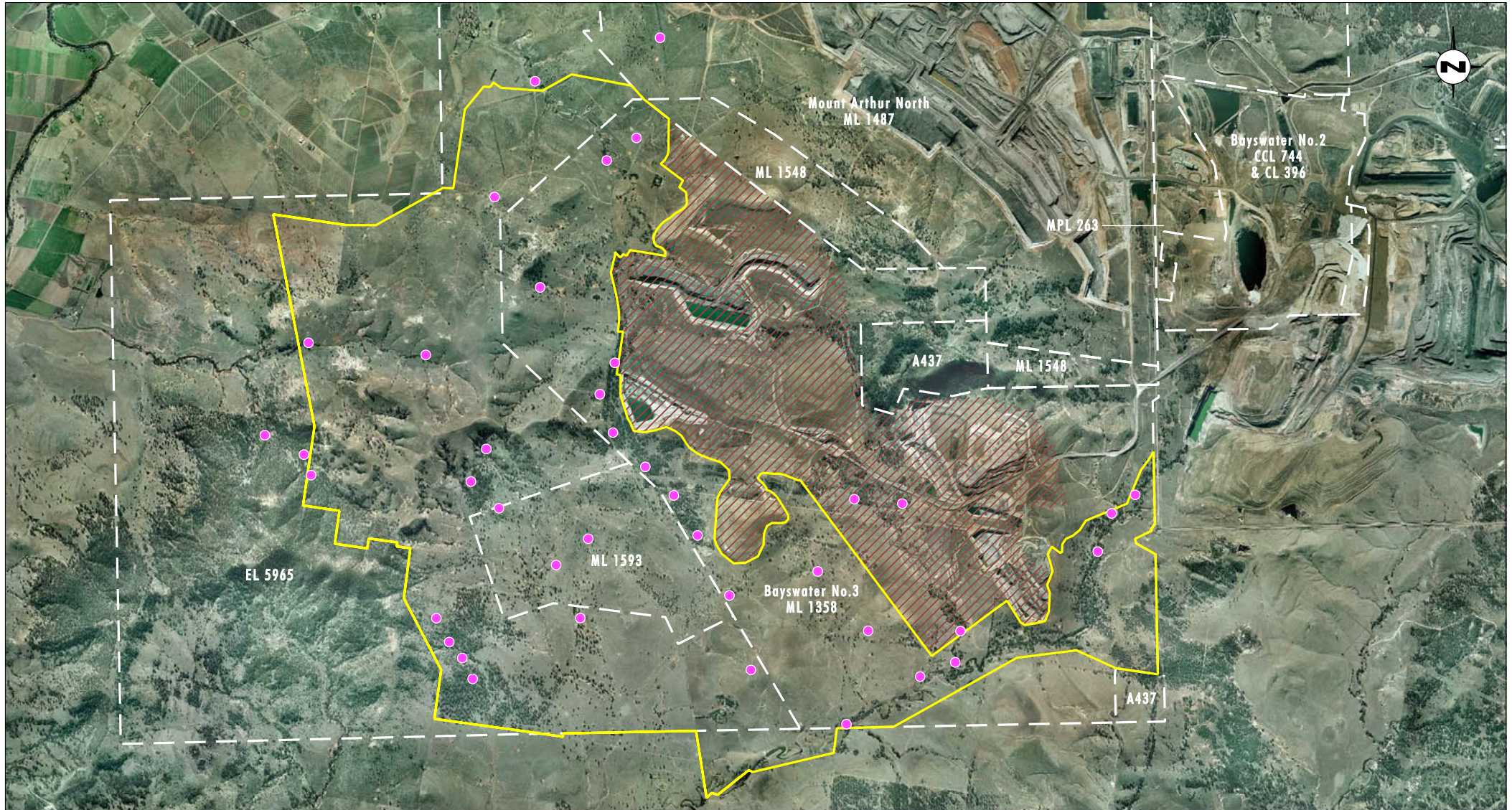
Species within the plot were assigned a value to reflect their relative cover and abundance within the plot. A modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore 1955 and Austin et al. 2000) was used to estimate cover-abundance of all vascular flora species recorded within each plot. **Table 2.1** provides the cover-abundance categories used.

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

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

Note: * Modified Braun-Blanquet scale (Poore 1955, Austin et al. 2000)

Any species observed outside the plot but within the vegetation community being sampled were recorded, but detailed systematic searches were not made outside the plot. A standard recording pro forma was used to record plant species cover-abundance data.



Base Source: Mt Arthur Coal, 2006

0 1 2 3 km
1:65 000

Legend

- Mining and Exploration Lease Boundary
- Survey Area
- Bayswater No.3 Mining Area
- Vegetation Survey Plot

FIGURE 2.1

Vegetation Survey Plots

Targeted flora walking transects were also undertaken across the Survey Area from 5 to 8 April 2005, 1 December and 5 to 7 December 2005. Transects were variable in length and location, and were tailored to suit the environment in which they occurred. Searches were made in all strata, above and below rock faces, and around dams and riparian areas. Targeted flora transects are useful for detecting threatened flora species across large areas, as they enable the surveyor to cover large proportions of the area under investigation, unlike plot-based surveys. General observations of the area were made, including the level of disturbance, vegetation community maturity, erosion and density of weed infestation.

2.2.2 Biases and Limitations

Field surveys are always affected by unavoidable biases. The placement of the quadrats and the transect routes resulted in some unavoidable bias. The floristic surveys were affected by limitations in time and by seasonal influences. The allocation of a number of specimens to species or infra-specific levels was limited by the availability of flowering or fruiting material, or both. This particularly occurred with herbaceous and graminoid species, such as those belonging to the families Asteraceae, Cyperaceae and Poaceae.

Some ephemeral species and early spring-flowering geophytes, such as terrestrial orchids, are unlikely to have been detected during summer and autumn sampling because of the absence of new growth or inflorescences. This meant that annual and rhizomatous or tuberous species which lack above-ground structures during dormancy are likely to have been under-represented.

Despite the above, an adequate level of survey was able to be completed to address the preparation of this Ecological Assessment.

2.2.3 Plant Identification and Taxonomic Convention

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 2006), 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.

2.2.4 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Survey Area and the general locality. This vegetation mapping involved the following key steps:

- import of licensed draft regional vegetation community mapping (Peake 2006) from the Hunter – Central Rivers Catchment Management Authority;
- ground-truthing of draft regional vegetation community mapping;
- revision of vegetation community floristic delineations based on plot data and walking transects; and
- revision of draft regional vegetation community mapping based on ground-truthing.

Vegetation communities were grouped into three vegetation formations in order to assist the assessment of the impact on general habitat types, particularly for fauna species. These formations were based solely on structural characteristics rather than floristic composition. Where scattered trees occurred within the grassland areas, these were included within the grassland communities. These comprised:

- woodland (dominated by trees of 10-40 per cent cover and typically 6-20 metres height, with or without a mid-understorey or understorey);
- riparian and floodplain woodland (dominated by trees of 10-80 per cent cover and typically 6-20 metres height, in a linear strip along waterways of dense vegetation, or restricted to floodplains of open vegetation, with or without a mid-understorey or understorey); and
- grassland (dominated by grasses, sedges and forbs, with trees and shrubs very sparse or absent).

2.3 Fauna Survey

During field survey for the Underground Project, eight fauna survey sites were established across the Survey Area (refer to **Figures 2.2** and **2.3**). Fauna sites were named as follows: Middle Site; Southern Site; Northern Site; Saddlers Creek Site; McDonalds Road Site; Drainage Line Site; Mt Ogilvie Site and Edderton Road Site.

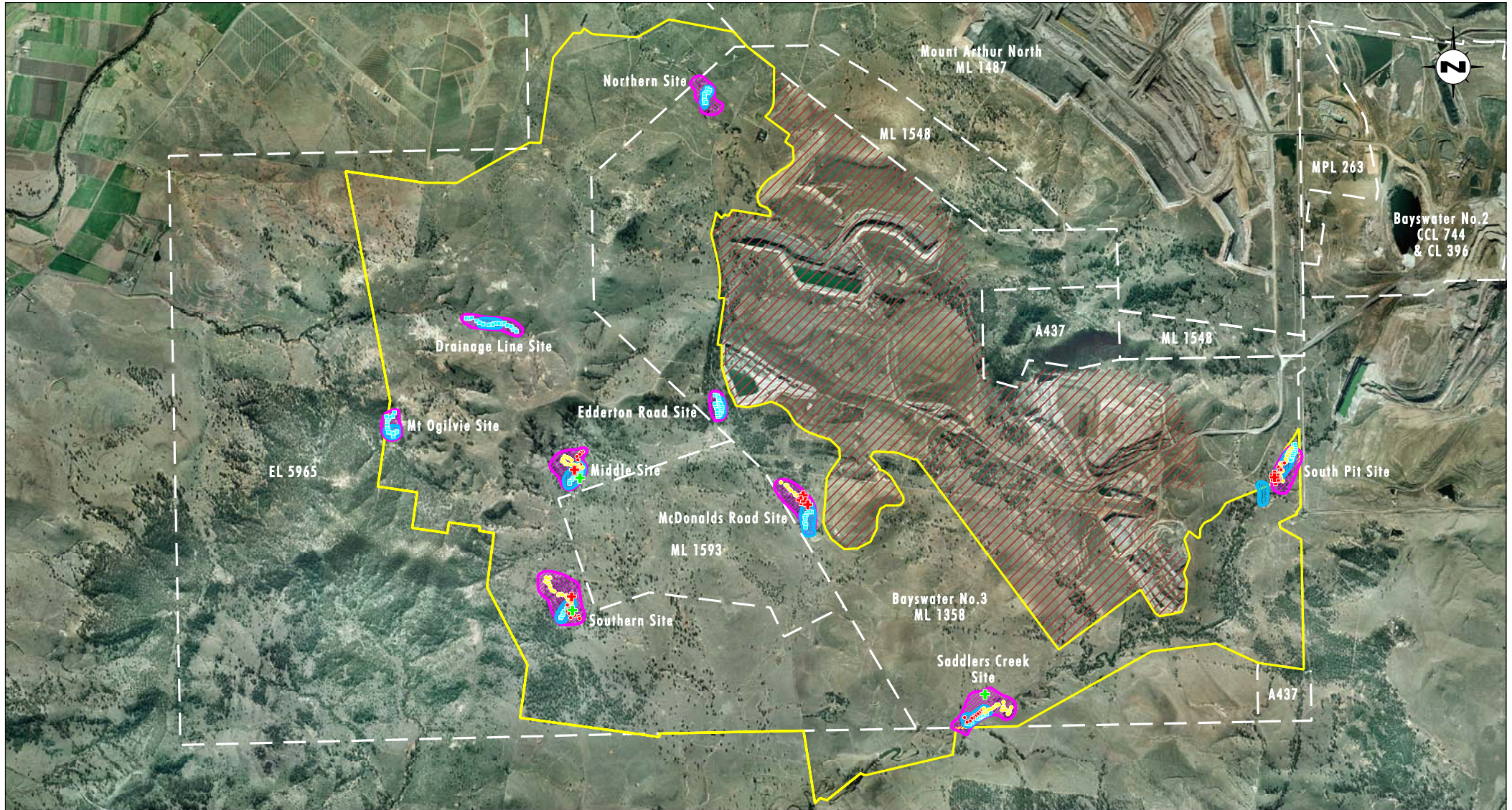
Fauna surveys were conducted from 7 to 11 March 2005 and from 5 to 7 December 2005. During both of these survey periods, weather conditions during the days were warm to very warm to hot and dry, with dry warm nights.

In addition to these eight fauna survey sites, one of the fauna survey sites completed for the proposed South Pit extension project (Umwelt 2006b) falls within the current Survey Area (refer to **Figures 2.2** and **2.3**). The results from this survey site have been included within this assessment, with the site referred to as the 'South Pit site'. The survey at the South Pit site was conducted between 21 and 25 February 2005. Weather conditions at this time were very warm to hot and dry days, with dry warm nights. Results from the other survey sites completed for the proposed South Pit extension project were assessed as part of the literature review.

2.3.1 General Habitat Assessment

Habitat characteristics which were assessed included:

- tree hollows;
- rocky outcrops;
- wetland, riverine, dam and wet soak areas;
- density of shrub and ground layers;
- canopy cover;
- soil type;



Base Source: Mt Arthur Coal, 2006

0 1 2 3km
1:60 000

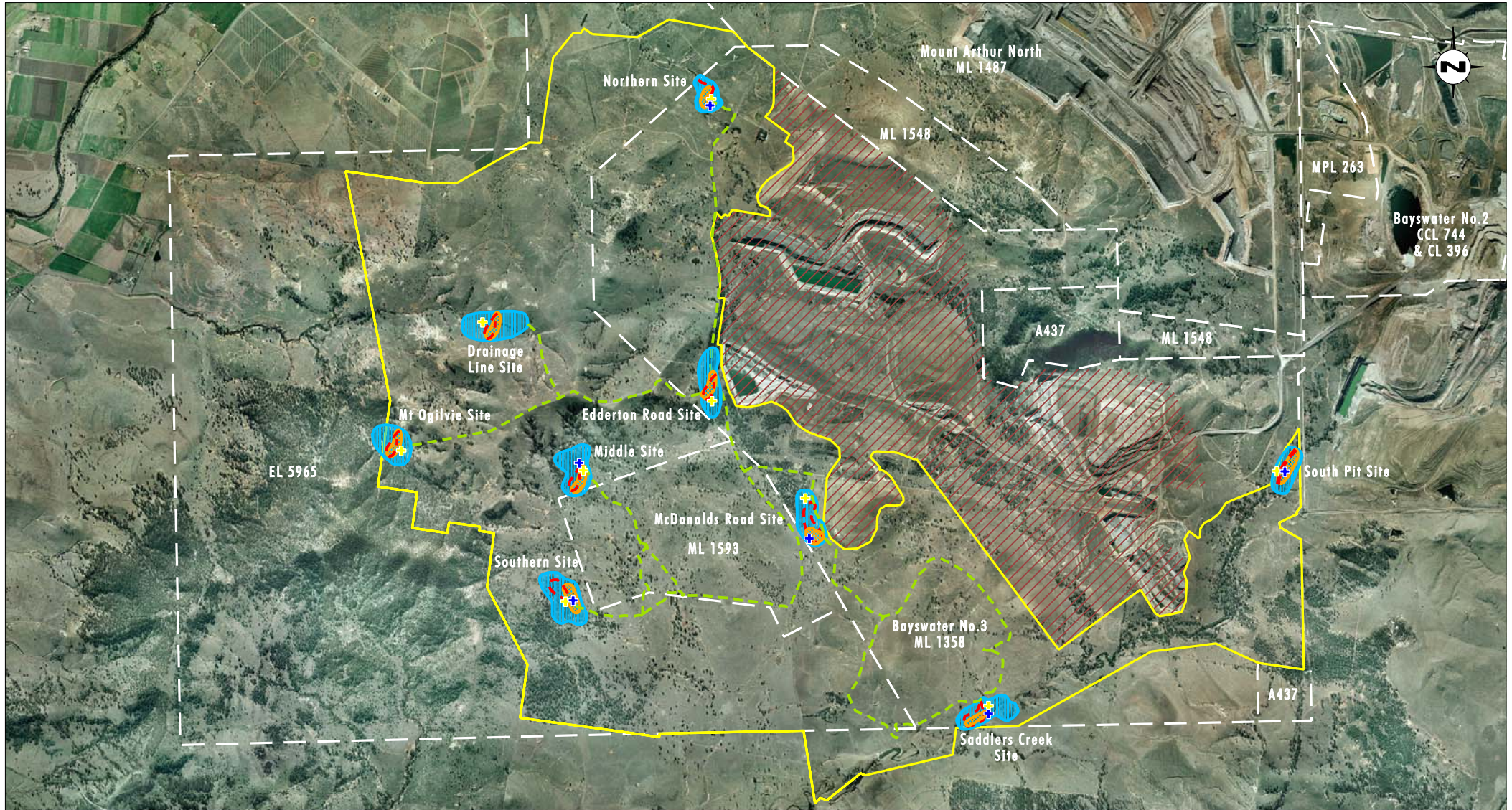
Legend

- | | |
|---------------------------------------|----------------------------------|
| Mining and Exploration Lease Boundary | Terrestrial Elliot A and B Traps |
| Survey Area | Arboreal Elliot B Traps |
| Bayswater No.3 Mining Area | Cage Traps |
| Bird Search Area | Paired Hair Tubes |
| Reptile and Amphibian Search Area | Harp Traps |

File Name (A4): R17_V1/2051_104.dgn

FIGURE 2.2

Diurnal Fauna Survey Effort



Base Source: Mt Arthur Coal, 2006

0 1 2 3 km
1:60 000

Legend

- | | |
|---------------------------------------|----------------------------|
| Mining and Exploration Lease Boundary | Overnight Anabat Recording |
| Survey Area | Nocturnal Call playback |
| Bayswater No.3 Mining Area | Vehicle Spotlight Transect |
| Amphibian and Reptile Search Area | Walking Anabat Transect |
| Spotlight Search Area | |

File Name (A4): R17_V1/2051_037.dgn

FIGURE 2.3

Nocturnal Fauna Survey Effort

- fallen logs;
- leaf litter;
- decorticating bark;
- winter flowering species; and
- stags.

An assessment of habitat quality was made, based on the relative abundance of fauna micro-habitats and the provision of the above habitat characteristics. The greater the diversity and abundance of micro-habitats and habitat characteristics, the greater the habitat value of the area.

2.3.2 Trapping

A variety of different types of traps were used during the survey for the Underground Project, targeting a wide range of mammal species. The trapping methods used across the Survey Area are detailed below, and **Figure 2.2** shows the locations of all fauna trapping sites.

2.3.2.1 Terrestrial Elliot Traps

Terrestrial Elliot A and Elliot B traps baited with a mixture of rolled oats and peanut butter were set in pairs approximately 20 metres apart. Three trap lines consisted of 20 Elliot A and 20 Elliot B traps, a fourth trap line consisted of 25 Elliot A and 20 Elliot B traps and a fifth trap line consisted of 12 Elliot A traps.

All terrestrial Elliot trap lines were positioned amongst habitat features such as logs, fallen bark, rocks and ground cover. They were covered with a plastic bag to prevent rain entering and lined with woollen wadding to provide insulation for captured animals. All terrestrial Elliot traps were positioned to avoid overheating in early morning sunlight, and were tilted towards the front to prevent rain from entering the plastic bag covering the trap.

A total of 615 terrestrial Elliot trap nights were completed across the Survey Area, comprising a total of 336 Elliot A trap nights and 279 Elliot B trap nights completed (refer to **Section 2.3.2.6**).

2.3.2.2 Arboreal Elliot B Traps

Arboreal Elliot B traps baited with a mixture of rolled oats, peanut butter and honey were set on platforms three to four metres above the ground on suitable large tree trunks approximately 20 metres apart. Large trees with hollows were targeted as trap sites, although traps were also set on trees without hollows. Each trap line consisted of ten Elliot B traps. The tree trunk and trap entrance were sprayed with a honey and water mixture to aid in attracting arboreal mammals. All Elliot traps were covered with a plastic bag to prevent rain entering and lined with woollen wadding to provide insulation for captured animals. Each trap was positioned to prevent overheating in early morning sunlight.

A total of 140 arboreal Elliot B trap nights were completed across the Survey Area.

2.3.2.3 Cage Traps

A total of 21 single-ended cage traps (600 mm (L) × 300 mm (H) × 300 mm (W)) baited with chicken necks were set across five trap sites. Half of the length of each trap was covered in 95 per cent shade cloth and a clear plastic bag to provide rain, wind and shade protection for

captured animals. All cage traps were positioned to avoid exposure to early morning sunlight, and were tilted to prevent rain from entering the trap. Traps were positioned on level ground or amongst vegetation where the trap was unable to roll away if a captured animal struggled within the trap.

A total of 68 terrestrial cage trap nights were completed across the Survey Area.

2.3.2.4 Hair Funnels and Tubes

Hair funnels and tubes were set in pairs approximately 20 metres apart. Each pair contained a Faunatech style hair funnel and a double ended 50 millimetre PVC hair tube. Half of the Faunatech style hair funnels were baited with chicken necks and the other half with a rolled oats and peanut butter mixture. All of the smaller PVC hair tubes were baited with a rolled oats and peanut butter mixture. Six transects consisted of 10 pairs of funnels and tubes and three transects consisted of 20 pairs of funnels and tubes. All terrestrial hair funnels and tubes were positioned amongst habitat features such as logs, fallen bark, rocks and ground cover. Faunatech style hair funnels were pegged in position with small tent pegs while PVC style hair tubes (large and small) were placed unrestrained on the ground amongst ground cover to prevent them rolling away. All hair funnels and tubes were set for 14 to 29 consecutive nights. All hair samples were identified by Barbara Triggs (a recognised expert in this field) of Dead Finish, Victoria.

A total of 3840 hair funnel or tube sampling nights were completed across the Survey Area.

2.3.2.5 Harp Traps

Harp traps were positioned along potential micro-bat flyways such as existing tracks and gaps in the vegetation. Traps were also positioned in areas protected from exposure to the morning sun. During the day, any captured micro-bats were kept individually in small calico bags and were hung inside a specifically designed animal holding box kept in a cool, sheltered position. Micro-bats were identified according to the taxonomic keys provided in Churchill (1998). All micro-bats were released at dusk on the day of capture, after they had awoken from daily torpor. Harp traps were also inspected during nocturnal surveys such as spotlighting, and any captured micro-bats were released immediately following identification.

Two harp trap nights were completed at three separate trapping sites, resulting in six harp trap nights.

2.3.2.6 Trapping Effort Summary

Table 2.2 shows the total trapping effort (as trap nights) completed as part of the survey. A trap night is equal to one trap set for one entire night.

Table 2.2 - Total Trapping Effort (Trap Nights)

Trap Type	Survey Site									
	Northern	Middle	Southern	Saddlers Creek	McDonalds Road	Edderton Road	Drainage line	Mt Ogilvie	South Pit Site	Total Combined Trap Nights
Elliot A Terrestrial	-	60	80	60	36	-	-	-	100	336
Elliot B - Terrestrial - Arboreal	-	60	80	59	-	-	-	-	80	279
		30	40	30	-	-	-	-	40	140
Cage Traps	-	12	12	12	12	-	-	-	20	68

Table 2.2 - Total Trapping Effort (Trap Nights) (cont)

Trap Type	Survey Site									
	Northern	Middle	Southern	Saddlers Creek	McDonalds Road	Edderton Road	Drainage line	Mt Ogilvie	South Pit Site	Total Combined Trap Nights
Hair Funnels										
- Meat									80	80
- Oats/	270	290	300	290	270	-	-	-	80	1500
Peanut	270	290	300	290	270	280	280	280		2340
Harp Traps		2	2	2					-	6
Total Effort (Trap Nights)	540	744	814	743	588	280	280	280	400	4669

2.3.3 Area Searches

A variety of area searches of differing duration and purpose were undertaken as part of the fauna survey. The area searches used across the Survey Area are detailed below. **Figures 2.2 and 2.3** provide the locations of all area searches.

2.3.3.1 Spotlighting

Spotlighting searches were undertaken both on foot and from a moving vehicle. Walking spotlighting searches were undertaken by two observers for a period of at least 30 minutes (total of one person hour) on each occasion. Vehicle spotlighting searches were undertaken by the passenger(s) from a slowly moving (first gear, low range) four wheel drive vehicle for a minimum of one kilometre. Spotlighting searches were undertaken using 30 watt Lightforce spotlights.

Each survey site was spotlit on two different nights, where possible. Spotlighting was undertaken between 7.30 pm and 12.30 am. Spotlight searches specifically targeted: flying mammals such as flying foxes; arboreal mammals such as possums and gliders; terrestrial mammals such as kangaroos, wallabies, quolls, foxes and cats; and nocturnal birds such as owls and nightjars. Spotlighting also included opportunistic searches for reptiles, amphibians and micro-bats.

A total of 14.5 person hours of spotlighting were conducted in the Survey Area comprising 12.5 person hours walking surveys and two person hours driving surveys, plus unmeasured opportunistic spotlighting during other nocturnal activities such as reptile and amphibian searches and call playback sessions (refer to **Figure 2.3**).

2.3.3.2 Reptile and Amphibian Searches

A one person hour diurnal reptile and amphibian search was completed at each trapping site (plus two person hours over two days at the South Pit site). Each search was undertaken by two ecologists for a period of at least 30 minutes between 11.00 am and 4.00 pm. Diurnal reptile and amphibian searches, specifically targeting reptiles and opportunistically targeting amphibians, were undertaken during warm (approximately 25 °C) to hot (approximately 35 °C) parts of the day. Nocturnal searches targeted amphibians and nocturnal reptile species. Nocturnal reptile and amphibian searches were undertaken using Petzel headlamps and/or 30 watt Lightforce spotlights.

Habitat features investigated during reptile and amphibian searches included water bodies, emergent vegetation, wet soak areas, logs, rocks, loose bark on tree trunks, exposed bedrock, leaf litter and open grassland areas. Amphibians not identifiable from their calls were captured for visual identification. All amphibians were handled according to the DECC hygiene protocol for the control of disease in frogs (DEC 2001). Non-venomous snake species and small lizards were captured for identification.

Seven person hours of nocturnal searches specifically targeting amphibians and opportunistically targeting reptiles were completed across five survey sites. Each search was undertaken by two ecologists for a period of at least 30 minutes in the first three hours of the night.

2.3.3.3 Bird Searches

A total of 11.75 person hours of diurnal bird searches were undertaken across the nine trapping sites. Bird surveys were undertaken primarily in early to mid morning, in a range of different habitat types. Opportunistic observations were recorded during all other aspects of the field survey, particularly while checking traps and travelling between sites. Individual bird species were identified from characteristic calls and by observation using a 15 - 45 × 50 spotting scope and 10 × 60 binoculars.

2.3.3.4 Area Search Survey Effort Summary

Table 2.3 shows the total area search effort (in person hours) undertaken across the Survey Area.

Table 2.3 - Total Area Search Effort (Person Hours)

	Survey Site									
	Northern	Middle	Southern	Saddlers Creek	McDonalds Road	Edderton Road	Drainage line	Mt Ogilvie	South Pit Site	Total Combined Hours
Walking Spotlight	-	1	2	2	1	1.5	1.5	1.5	2	12.5
Driving Spotlight	-	-	-	-	2	-	-	-	-	2
Diurnal Reptile and Amphibian	1	1	1	1	1	1	1	1	2	10
Nocturnal Reptile and Amphibian	-	1	1	1	2	-	-	-	2	7
Bird Searches	1	1.5	1.25	1	2	1	1	1	2	11.75
Total Effort (Person Hours)	2	4.5	5.25	5	8	3.5	3.5	3.5	8	43.25

2.3.4 Echolocation Recording

Micro-bat echolocation recordings were made using an 'Anabat II Bat Detector' and 'Anabat CF Storage ZCAIM'. Hereafter, the detector and storage unit will collectively be referred to as the 'Anabat detector'.

2.3.4.1 All Night Recordings

A total of four all night micro-bat echolocation recording were made across the Survey Area at the Middle, Southern, Saddlers Creek and South Pit sites (refer to **Figure 2.3**). At each

Anabat echolocation recording site an Anabat detector was attached to a tree trunk via a platform and positioned at approximately six metres in height with a clear view of possible micro-bat flyways. The Anabat detector was programmed to start recording one hour before dark and to stop recording one hour after sunrise each night. The Anabat detector was contained in a rain-proof housing and all-night recordings were made regardless of weather conditions.

2.3.4.2 Walking Transects

A total of five hours of echolocation recordings were made during walking spotlight searches and nocturnal reptile and amphibian searches at the Drainage line, Mt Ogilvie, Edderton Road and South Pit Sites (refer to **Figure 2.3**). These searches were completed for a minimum of 30 minutes each, however most ran for 45 minutes. The Anabat echolocation recorder was placed in a backpack, positioned vertically and given a clear view of the sky. All walking transects were completed within the first four hours after dusk.

2.3.4.3 Micro-bat Echolocation Identification

All Anabat detector recordings were analysed by Glenn Hoyer (a recognised expert in the field) of Fly by Night Surveys Pty Limited. The echolocation calls of species were identified to one of three levels of confidence:

- confident;
- probable; and
- possible.

For the purpose of this assessment, all three levels of identification confidence were treated as positive identifications.

2.3.5 Signs of Presence

Searches for evidence of animal presence were conducted opportunistically during all survey activities, particularly during habitat searches, and nocturnal and diurnal reptile and amphibian searches. Due to the opportunistic nature of signs of presence surveys, the level of survey effort was not recorded. Evidence of presence included scats, feathers, nests, footprints, burrows, bones, tufts of hair and scratch marks on trees. All hair, scat and bone samples were identified by Barbara Triggs (a recognised expert in the field) of Dead Finish, Victoria.

2.3.6 Call Playback

A total of seven call playback sessions were undertaken across seven trapping sites. No call playback was completed at the McDonalds Road or Northern site (refer to **Figure 2.3**). Call playback sessions included the calls of the:

- squirrel glider (*Petaurus norfolcensis*);
- koala (*Phascolarctos cinereus*);
- masked owl (*Tyto novaehollandiae*);
- barking owl (*Ninox connivens*); and

- powerful owl (*Ninox strenua*).

Call playback sessions commenced with a quiet listening period of approximately five minutes. The call of each species was played for a minimum of four minutes followed by a listening period of two minutes before the beginning of the next species call. Calls were broadcast using a 10 watt directional loud hailer and sessions were completed between dusk and midnight. Mammal calls were played prior to bird calls to prevent the calls of predators (such as large owls) decreasing the likelihood of prey species (such as gliders) responding to call playback.

3.0 Flora Survey Results

3.1 Vegetation of the Region

The upper Hunter Valley has been largely cleared of native vegetation, primarily for agricultural and other land uses, including urban development and mining. The valley floodplain areas have been subject to the most intensive agricultural use. Similar land use patterns occur in the vicinity of the Survey Area, which is surrounded by agricultural land, open cut coal mines, and patches of remnant vegetation.

Two large national parks occur to the south-west and south of the Survey Area (Wollemi and Yengo National Parks). Smaller, yet significant areas of national park also exist to the north-east (Mt Royal and Barrington Tops National Parks). These conserved areas are generally located on the edge or outside of the valley and connectivity to and from these conservation reserves is patchy due to the variety of land tenures and long history of land modification. Formally protected areas constitute about 1.9 per cent of the valley floor (Peake 2006).

Ravensthorpe State Forest (approximately 25 kilometres to the east of the Survey Area) represents a significant link and refuge area between remnant patches of vegetation in the central Hunter Valley. This area of State Forest forms an important and integral part in the preservation of the flora and fauna of the upper Hunter Valley (Bell & Russell 1993). Vegetated linkages to this remnant will be limited in the short to medium term by the expansion of mining and other developments in the central Hunter Valley.

The Survey Area contains a number of scattered vegetated fragments that would function broadly as 'stepping-stone' corridors for highly mobile fauna species able to travel across large areas of open country (such as larger birds, large terrestrial mammals and micro-bats). Although a lack of formal movement corridors within the Survey Area reduces the habitat potential of a number of these fragments, they remain significant on local and regional scale. Vegetation on Mt Arthur to the immediate north-west of the Survey Area is planned to be protected under a voluntary conservation agreement (VCA) (it is being managed as a conservation area whilst the VCA is finalised) and this vegetation represents a significant area of protected flora and fauna habitat in the locality. There is a tenuous vegetated corridor linkage from Mt Arthur through the riparian habitats associated with Saddlers Creek and adjacent woodland areas to Mt Ogilvie to the south-west. A highly fragmented, but significant corridor follows north-east from Mt Arthur, through spotted gum (*Corymbia maculata*) dominated woodland in the Antienne area to vegetated land to the east of the New England Highway. Potential may exist for fauna movement through this corridor from the Survey Area however, approved mining operations, Thomas Mitchell Drive and the New England highway constitute a barrier to movement for some species in this direction.

Areas of remnant vegetation also occur to the east of the Survey Area within the Macquarie Generation buffer zones. These habitats are not well linked via vegetation corridors to habitats within the Survey Area.

3.2 Vegetation Mapping for the Hunter Remnant Vegetation Project

The vegetation communities of the project area were previously mapped as part of the Hunter Remnant Vegetation Project (HRVP) (Peake 2006). Five natural vegetation communities were mapped by Peake (2006) as occurring within 2 kilometres of the Survey Area, with an additional community 'Planted Area' also mapped and described. These vegetation communities comprise:

- Narrabeen Footslopes Slaty Box Woodland;
- Central Hunter Box – Ironbark Woodland;
- Central Hunter Ironbark - Spotted Gum - Grey Box Forest;
- Mt. Arthur Forest Complex;
- Central Hunter Bulloak Forest Regeneration; and
- Plantations.

Full descriptions of these communities are provided in the HRVP (Peake 2006).

3.3 Flora of the Survey Area

3.3.1 Flora Species Recorded

A total of 220 flora species were recorded in the Survey Area as a result of systematic and opportunistic surveys. Of these, 163 (74 per cent) are native to the Survey Area, while 57 (26 per cent) are exotic or non-local natives. A flora species list for the Survey Area is included as **Appendix 1**.

Flowering plants comprised 216 of the total number of species (monocots 53 and dicots 163), with four fern species recorded.

The most abundant plant families recorded were Poaceae (grasses) – 36 species; Asteraceae (daisies) – 28 species; Fabaceae (peas and wattles) 24 species; Malvaceae – seven species; and Myrtaceae (myrtles and eucalypts) – 7 species.

Overall, the floristic diversity of the Survey Area is regarded as moderate. The overall number of plant species recorded is likely to be affected by the history of clearing for agriculture within the Survey Area. The floristic diversity recorded within the Survey Area is likely to be representative of similar disturbed woodlands and derived grasslands occurring widely across the Hunter Valley.

3.3.2 Vegetation Communities of the Survey Area

Seven vegetation communities were recorded across the Survey Area, with six of these being native communities, and one being non-native and derived through previous clearing. These communities were named consistently with the vegetation communities described in the HRVP (Peake 2006) where relevant. The following vegetation communities were recorded from the Survey Area:

- Hunter Valley Weeping Myall Woodland;
- Central Hunter Bulloak Forest Regeneration;
- Central Hunter Box – Ironbark Woodland;
- Hunter Floodplain Red Gum Woodland Complex;
- Narrabeen Footslopes Slaty Box Woodland;

- Derived Grassland; and
- Aquatic Vegetation.

The locations and extent of these vegetation communities is depicted on **Figure 3.1**. Due to the small size of the majority of the dams within the Survey Area, the Aquatic Vegetation community cannot be accurately mapped on this figure and so is not shown. Each of the vegetation communities identified are described below.

3.3.2.1 Hunter Valley Weeping Myall Woodland

This vegetation community was recorded from two locations, one within the road reserve along Edderton Road to the north-east of the Survey Area (outside the Survey Area), and the other in the southern parts of the Survey Area (refer to **Figures 3.1** and **3.2**). This community is listed as an EEC under the Schedules of the TSC Act. This vegetation community also relates to the weeping myall (*Acacia pendula*) Endangered Population within the Hunter Valley, as listed under the TSC Act. This vegetation community does not, however represent the Critically Endangered Ecological Community (CEEC) Weeping Myall – Coobah - Scrub Wilga Shrubland of the Hunter Valley as listed under the EPBC Act. This issue is discussed further in **Section 3.5.4**.

The first example of this community is located to the north-east of the Survey Area, covering an area of <0.1 hectares within the road reserve along Edderton Road. This occurrence is highly disturbed and consisted of a canopy, sparse shrub layer and a ground layer. The canopy reached a height of 15 metres and was dominated by weeping myall. A very sparse shrub layer was present consisting mostly of juvenile weeping myall and weed species including tall fleabane (*Conyza sumatrensis*) and *Verbena gaudichaudii*.

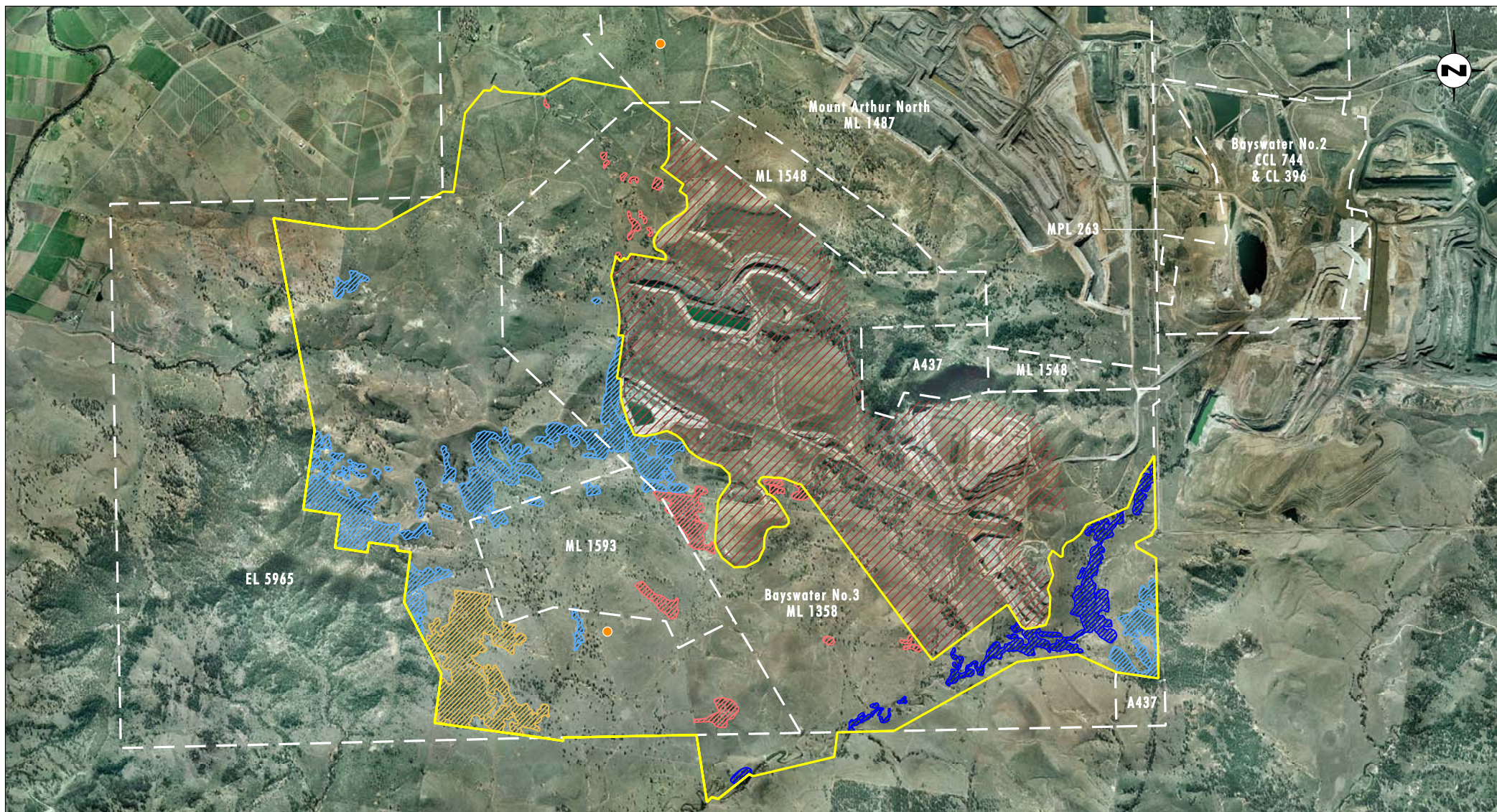
The ground cover was dominated by grasses including hairy panic (*Panicum effusum*), purple wiregrass (*Aristida ramosa*) and the introduced Rhodes grass (*Chloris gayana*). Other common species included winter apple (*Eremophila debilis*), *Phyllanthus virgatus* and the introduced species African boxthorn (*Lycium ferocissimum*), Paddy's lucerne (*Sida rhombifolia*), narrow-leaved cotton bush (*Gomphocarpus fruticosus*) and flatweed (*Hypochaeris radicata*).

The second example of this vegetation community is located within the southern parts of the Survey Area. This occurrence is approximately 0.1 hectare in size and consists of a dense, monospecific stand of 20 to 50 weeping myall trees. The stand generally consists of adult to sub-adult plants ranging from 6 to 8 metres high, with a small amount of juvenile suckers. No shrubs are present, and a sparse groundcover consists of native and introduced grasses and forbs.

Peake (2006) mapped the occurrence of this vegetation community along Edderton Road, to the north of the Survey Area, but did not map the southern stand. This vegetation community is commensurate with the Hunter Valley Weeping Myall Woodland community described in the HRVP, which has also been recorded at Jerrys Plains and Wybong.

3.3.2.2 Central Hunter Bulloak Forest Regeneration

This vegetation community is located along the northern drainage line and south of McDonalds Road (refer to **Figure 3.1**). The canopy ranged in height from 8 to 15 metres and was dominated by bulloak (*Allocasuarina luehmannii*). Two other less frequent tree species were noted within this vegetation community, being narrow-leaved ironbark (*Eucalyptus crebra*) and *Eucalyptus albens* x *moluccana*.



Base Source: Mt Arthur Coal, 2006

0 1 2 3 km
1:65 000

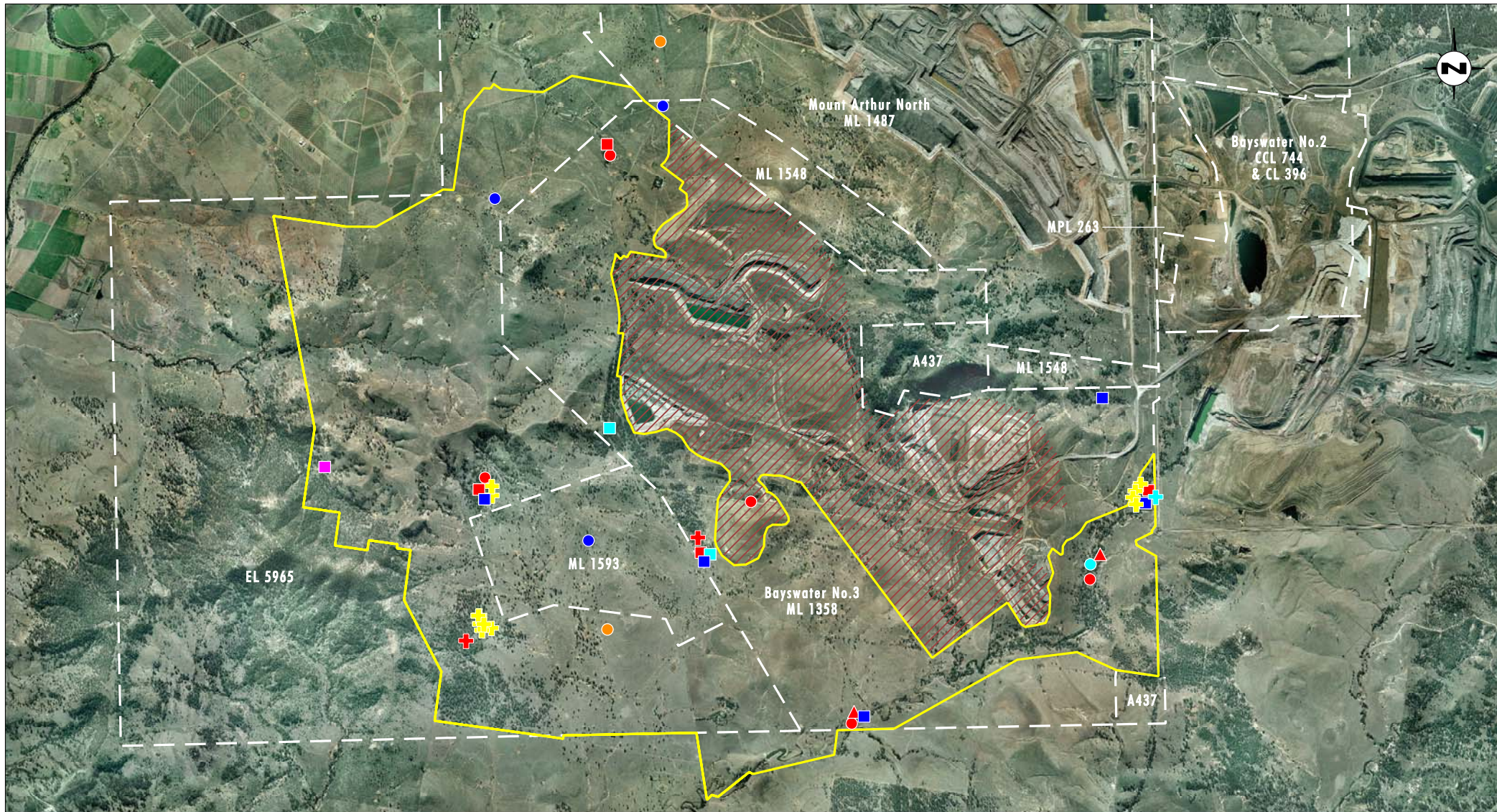
Legend

- Mining and Exploration Lease Boundary
- Survey Area
- Bayswater No.3 Mining Area
- Central Hunter Box-Ironbark Woodland
- Central Hunter Bullock Regeneration
- Hunter Floodplain Redgum Woodland
- Narrabeen Footslopes Slaty Box Woodland
- Location of Hunter Valley Weeping Myall Woodland

Note: Areas within the survey area not otherwise delineated constitute derived grassland (or aquatic vegetation if fringing dams)

File Name (A4): R17_V1/2051_107.dgn

FIGURE 3.1
Vegetation Communities



Base Source: Mt Arthur Coal, 2006

0 1 2 3 km
1:65 000

Legend

--- Mining and Exploration Lease Boundary

— Survey Area

▨ Bayswater No. 3 Mining Area

● *Bothriochloa biloba*

● *Acacia pendula* (Endangered Population)

● *Cymbidium canaliculatum* (Endangered Population)

● grey-crowned babbler

▲ grey-crowned babbler nest

✚ speckled warbler

✚ squirrel glider

✚ eastern bentwing-bat

■ eastern cave bat

■ greater broad-nosed bat

■ eastern freetail-bat

■ large-footed myotis

FIGURE 3.2

Current Threatened Species Records

The shrub layer was dominated by juvenile bulloaks and eucalypts to a height of three metres. Native olive (*Notelaea microcarpa* var. *microcarpa*) and the introduced white horehound (*Marrubium vulgare*) were also recorded.

The ground layer comprised those species under one metre in height and included slender rat's tail grass (*Sporobolus creber*), barbed-wire grass (*Cymbopogon refractus*), common couch (*Cynodon dactylon*), yellow buttons (*Chrysocephalum apiculatum*), creeping mint (*Mentha satereioides*), slender bamboo grass (*Austrostipa verticillata*), berry saltbush (*Einadia hastata*), purple wiregrass (*Aristida ramosa*) and red grass (*Bothriochloa macra*).

This vegetation community is commensurate with the Central Hunter Bullock Forest Regeneration vegetation community from the HRVP (Peake 2006).

3.3.2.3 Central Hunter Box – Ironbark Woodland

This vegetation community is located across the centre of the Survey Area, and in an area in the south-east corner of the Survey Area. The canopy ranged in height from 15 to 20 metres and extended up to 30 metres in height at the base of Mt Ogilvie. The dominant canopy species was grey box (*Eucalyptus moluccana*), *Eucalyptus albens* x *moluccana* and narrow-leaved ironbark (*Eucalyptus crebra*). Other canopy species include Blakely's red gum (*Eucalyptus blakelyi*), kurrajong (*Brachychiton populneus* subsp. *populneus*) and bullock (*Allocasuarina luehmannii*).

The shrub layer ranged from one to three metres in height and varied from low to medium density. Common shrub species included blackthorn (*Bursaria spinosa* var. *spinosa*), kangaroo thorn (*Acacia paradoxa*), coffee bush (*Breynia oblongifolia*), native olive (*Notelaea microcarpa* var. *microcarpa*), cooba (*Acacia salicina*), Australian indigo (*Indigofera australis*), broom bitter pea (*Daviesia genistifolia*) and dogwood (*Jacksonia scoparia*).

The ground layer comprised those species under one metre in height and included species such as mulga fern (*Cheilanthes sieberi* subsp. *sieberi*), many-flowered mat rush (*Lomandra multiflora* subsp. *multiflora*), climbing saltbush (*Einadia nutans*), yellow-burr daisy (*Calotis lappulacea*), slender rat's tail grass (*Sporobolus creber*), barbed-wire grass (*Cymbopogon refractus*), hairy panic (*Panicum effusum*) and tussock grass (*Poa labillardierei*).

Weed species were common throughout this community, the most common weeds encountered included *Richardia stellaris*, tall fleabane (*Conyza sumatrensis*), prickly pear (*Opuntia stricta* var. *stricta*), Paddy's lucerne (*Sida rhombifolia*), lamb's tongue (*Plantago lanceolata*), paspalum (*Paspalum dilatatum*), fireweed (*Senecio madagascariensis*) and cobbler's pegs (*Bidens pilosa*).

This vegetation community is commensurate with the Central Hunter Box – Ironbark Woodland vegetation community from the HRVP (Peake 2006).

3.3.2.4 Hunter Floodplain Red Gum Woodland Complex

A mixed variant of this vegetation complex was recorded along Saddlers Creek. The canopy ranged from 15-20 metres on the banks of the creek and 8-10 metres within the creek bed. The vegetation was highly disturbed, with the creekline suffering from severe erosion and impacts from continued grazing by cattle. The tree canopy was dense in places along the creek bank with a very sparse shrub layer. The ground layer was dense and included many introduced species.

Dominant canopy species along the creekline included narrow-leaved ironbark (*Eucalyptus crebra*), forest red gum (*Eucalyptus tereticornis*), grey box (*Eucalyptus moluccana*) and rough-barked apple (*Angophora floribunda*). The shrub layer was sparse along the creekline

and ranged in height from one to three metres. Dominant species included cooba (*Acacia salicina*), *Cassinia quinquefaria*, native olive (*Notelaea microcarpa* var. *microcarpa*) and small-leaved bluebush (*Maireana microphylla*).

The ground cover was diverse in species and ranged in height from 0 to 1 metre. Dominant species include slender rat's tail grass (*Sporobolus creber*), plump windmill grass (*Chloris ventricosa*), couch (*Cynodon dactylon*), hairy panic (*Panicum effusum*), kangaroo grass (*Themeda australis*), *Sida corrugata*, berry saltbush (*Einadia hastata*), scurvy grass (*Commelina ensifolia*), kidney weed (*Dichondra repens*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*) and yellow buttons (*Chrysocephalum apiculatum*).

Weed species were common throughout this vegetation community with dominant species being African boxthorn (*Lycium ferocissimum*), tall fleabane (*Conyza sumatrensis*), fireweed (*Senecio madagascariensis*) and paspalum (*Paspalum dilatatum*).

Peake (2006) did not map this vegetation community within a two kilometre radius of the Survey Area, however this vegetation community is commensurate with the Hunter Floodplain Red Gum Woodland Complex community described in the HRVP.

Tiger orchid (*Cymbidium canaliculatum*) was recorded at a single site within this community, as shown on **Figure 3.2**. This species is listed as an Endangered Population for the Hunter Valley on the Schedules of the TSC Act.

3.3.2.5 Narrabeen Foothills Slaty Box Woodland

This vegetation community was located in the south-western portion of the Survey Area. The dominant canopy species was slaty box (*Eucalyptus dawsonii*), which ranged between 20 to 30 metres in height. Other canopy species included grey box (*Eucalyptus moluccana*), kurrajong (*Brachychiton populneus* subsp. *populneus*) and bulloak (*Allocasuarina luehmannii*).

The shrub layer ranged in height from three to eight metres and was very sparse. Common shrub species included cooba (*Acacia salicina*), blackthorn (*Bursaria spinosa* subsp. *spinosa*), native olive (*Notelaea microcarpa* var. *microcarpa*) and hickory wattle (*Acacia implexa*).

The ground cover comprised those species less than one metre in height and was fairly dense. Common ground cover species included common couch (*Cynodon dactylon*), tall chloris (*Chloris ventricosa*), Queensland blue grass (*Dichanthium sericeum*), slender rat's tail grass (*Sporobolus creber*), barbed-wire grass (*Cymbopogon refractus*), mulga fern (*Cheilanthes sieberi* subsp. *sieberi*), winter apple (*Eremophila debilis*), *Vernonia cinerea* var. *cinerea* and common wheatgrass (*Elymus scaber* var. *scaber*).

Common weeds within this vegetation community included prickly pear (*Opuntia stricta* var. *stricta*), lamb's tongue (*Plantago lanceolata*), tall fleabane (*Conyza sumatrensis*), narrow-leaved cotton bush (*Gomphocarpus fruticosus*) and cobbler's pegs (*Bidens pilosa*).

This vegetation community is commensurate with the Narrabeen Foothills Slaty Box Woodland vegetation community from the HRVP (Peake 2006).

3.3.2.6 Aquatic Vegetation

Aquatic vegetation was recorded fringing some of the dams that occur within the Survey Area. The small size of these dams, and the small amount of aquatic vegetation meant that these locations could not be accurately represented on the mapping. Small amounts of this vegetation community also occurred along parts of Saddlers Creek. The dominant species

within this vegetation community was broad-leaf cumbungi (*Typha orientalis*). Other common species included slender flat sedge (*Cyperus gracilis*), many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*), swamp dock (*Rumex brownii*) and common fringe-sedge (*Fimbristylis dichotoma*).

Native grass species were also recorded within this community, including barbed wire grass (*Cymbopogon refractus*), tall chloris (*Chloris ventricosa*), common couch (*Cynodon dactylon*) and slender bamboo grass (*Austrostipa verticillata*). Scattered bulloak (*Allocasuarina luehmannii*) were also recorded within this community.

Several weed species were common within the aquatic vegetation, such as paspalum (*Paspalum dilatatum*), mother-of-millions (*Bryophyllum delagoense*), tall fleabane (*Conyza sumatrensis*), Scotch thistle (*Onopordum acanthium*) and sharp rush (*Juncus acutus* subsp. *acutus*).

This vegetation community was not described by Peake (2006).

3.3.2.7 Derived Grassland

This vegetation community covers the majority of the Survey Area. It is referred to as being “derived” as the likely previous tree and shrub strata have been almost entirely cleared. Despite this, the flora are dominated by native species, rather than exotic species. Common native species within this community included *Sida corrugata*, *Oxalis exilis*, kidney weed (*Dichondra repens*), *Glycine clandestina*, purple wiregrass (*Aristida ramosa*), wallaby grass (*Austrodanthonia fulva*), windmill grass (*Chloris truncata*), slender rat's tail grass (*Sporobolus creber*), tall chloris (*Chloris ventricosa*), yellow buttons (*Chrysocephalum apiculatum*), yellow burr-daisy (*Calotis lappulacea*) and the EPBC-listed Vulnerable species *Bothriochloa biloba* (refer to **Figure 3.2**).

Scattered trees occur at low densities throughout this community and included narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*Eucalyptus moluccana*) and *Eucalyptus albens* x *moluccana*.

Weed species varied from sparse to dense across this vegetation community, with common species including fireweed (*Senecio madagascariensis*), lamb's tongue (*Plantago lanceolata*), Paddy's lucerne (*Sida rhombifolia*), flatweed (*Hypochaeris radicata*), narrow-leaved cotton bush (*Gomphocarpus fruticosus*), Rhodes grass (*Chloris gayana*), paspalum (*Paspalum dilatatum*) and prickly pear (*Opuntia stricta* var. *stricta*).

The grass *Bothriochloa biloba* was recorded at two sites within this community, as shown on **Figure 3.2**. This species is listed as Vulnerable on the Schedules of the EPBC Act. It was previously listed on the TSC Act as Vulnerable but has now been removed as it is known to be more widely distributed than previously thought.

3.3.3 Conservation Status of Vegetation Communities Recorded in the Survey Area

Peake (2006) included an assessment of the conservation status of vegetation communities using the Commonwealth DEH (2006a) criteria (Peake 2006) listed in **Table 3.1**.

Table 3.1 - DEH (2006a) Criteria for Listing Threatened Species, Populations and EECs (as per Peake 2006)

DEH (2006a) Criteria	
1 (C)	Critically Endangered, very severe decline of 95% or more of original distribution.
1 (E)	Endangered, severe decline of 90-95% of original distribution.
1 (V)	Vulnerable, substantial decline of 70-90% of original distribution.
2 (V)	Very restricted with demonstrable threat; total area of occupancy is < 1,000 ha, or total extent of occurrence is < 10,000 ha or patch sizes generally < 10 ha.
2 (R)	Restricted with demonstrable threat; total area of occupancy is 1,000-10,000 ha, or total extent of occurrence is 10,000-100,000 ha or patch sizes generally 10-100 ha.
2 (L)	Limited with demonstrable threat; total area of occupancy is 10,000-100,000 ha, or total extent of occurrence is 100,000-1,000,000 ha.

The HRVP (Peake 2006) mapping and conservation assessment covered the extent of the project area. The vegetation communities recorded in the Survey Area by Umwelt were compared to the vegetation communities and conservation assessment described in the HRVP. This allowed a ready assessment of the current conservation status of vegetation in the Survey Area. The Derived Grassland and Aquatic Vegetation communities were not consistent with the vegetation communities of the HRVP and therefore the HRVP did not provide any information regarding the significance of these communities.

Of the vegetation communities recorded within the Survey Area, Hunter Valley Weeping Myall Woodland, Central Hunter Box - Ironbark Woodland, Hunter Floodplain Red Gum Woodland Complex and Narrabeen Foothills Slaty Box Woodland are considered to be of high conservation value and these were considered by Peake (2006) to warrant listing under either the TSC Act or EPBC Act. Peake (2006) found that most of the vegetation communities remaining in the upper Hunter Valley, where extensive regional clearing has been undertaken, warrant listing.

While there is some doubt as to whether Central Hunter Bullock Forest Regeneration is a naturally occurring community, the lack of strong evidence either way led Peake (2006) to precautionarily consider it a natural community. Central Hunter Bullock Forest Regeneration has been subject to substantial clearing, leading it to be considered high significance, although to a lesser extent than the other woodland communities in the Survey Area.

The Derived Grassland vegetation community is not of conservation significance, as it is not a naturally-occurring community, rather it is present as a result of previous disturbances such as clearing, cattle grazing and other agricultural activities. The Aquatic Vegetation is not considered to be of conservation significance, as it is dominated by the commonly occurring *Typha orientalis*, it supports a high level of weed species, and is very similar to other aquatic vegetation occurring across the region.

Although Central Hunter Box - Ironbark Woodland, Hunter Floodplain Red Gum Woodland Complex, and Narrabeen Foothills Slaty Box Woodland meet relevant criteria for listing as threatened at either State or national level, these communities are currently not listed and they are therefore considered to presently be of regional significance.

Hunter Valley Weeping Myall Woodland is currently listed as an EEC under the Schedules of the TSC Act. This vegetation community relates to the *Acacia pendula* Endangered Population within the Hunter Valley, as listed under the TSC Act. This vegetation community does not, however represent the CEEC Weeping Myall – Coobah - Scrub Wilga Shrubland of

the Hunter Valley as listed under the EPBC Act. This issue is discussed further in **Section 3.5.4**.

3.4 Significant Flora Species and Endangered Populations

The following section provides details about the significant flora species and Endangered Populations identified within the Survey Area or locality during surveys, or from database searches and literature reviews. A detailed assessment of the potential impact of the Underground Project on these significant ecological features is provided in **Section 5** of this report.

3.4.1 Threatened Flora Species

Bothriochloa biloba was recorded during flora surveys conducted within the Survey Area. This species is listed as Vulnerable on the Schedules of the EPBC Act, however is not listed under the Schedules of the TSC Act. This species was previously listed as Vulnerable under the Schedules of the TSC Act, however, it has since been removed and is no longer considered to be threatened at a State level. *Bothriochloa biloba* was recorded in two locations in the Survey Area and is also known from a site adjacent to Edderton Road and the MAN access road (Peake 2006). The locations at which *Bothriochloa biloba* was recorded are shown on **Figure 3.2**.

Tricolor diuris (*Diuris tricolor*) is known to occur within the Mt Arthur Coal operations area, in the A171 area, close to the Mt Arthur Coal access road (DEC Atlas of NSW Wildlife 2006a). This species was not recorded in any of the ecological surveys completed within, or near to the Survey Area. This species is listed as Vulnerable on both the TSC Act and EPBC Act. A preliminary determination under the TSC Act also exists for an Endangered Population of this species within the Muswellbrook LGA (which covers the Survey Area). Any record of this species within the Muswellbrook LGA would represent part of this population. The location of this species is not represented on **Figure 3.2** as the location of the record was provided on the Atlas of NSW Wildlife with only a low level of accuracy.

In addition to threatened species identified during current and previous surveys of the Survey Area and surrounds, a search of the DEC Atlas of NSW Wildlife (2006a) has identified 11 threatened flora species that have been recorded within a 20 kilometre radius of the Survey Area. These species are listed in Table 1 of **Appendix 3**, along with an assessment of their potential to occur within the Survey Area. None of these species were recorded in the Survey Area.

A search of the DEH Protected Matters database (2006) has identified a further seven threatened flora species which have either been recorded within a 20 kilometre radius of the Survey Area, or are considered to have potential habitat within this radius. These species are listed in Table 1 of **Appendix 3**, along with an assessment of their potential to occur within the Survey Area. None of these species were recorded in the Survey Area.

3.4.2 Endangered Flora Populations

3.4.2.1 *Eucalyptus camaldulensis* Population in the Hunter Catchment

The *Eucalyptus camaldulensis* Population in the Hunter Catchment is listed as an Endangered Population under the TSC Act. While the river red gum (*Eucalyptus camaldulensis*) was not recorded during flora surveys undertaken within the Survey Area (despite specific searches in potential habitat areas such as Saddlers Creek), the species has been previously recorded in a tributary of Saddlers Creek that is currently approved for

open cut mining (Resource Planning 1993). Surveys completed along this tributary in December 2005 did not relocate these records, nor identify any river red gum in this area.

3.4.2.2 *Acacia pendula* Population in the Hunter Catchment

The *Acacia pendula* Population in the Hunter Catchment is listed as an Endangered Population under the TSC Act. Weeping myall (*Acacia pendula*) was recorded at one location within the Survey Area with an additional population previously recorded immediately north of the Survey Area along Edderton Road. The location of both of these weeping myall populations are shown on **Figure 3.2**.

The weeping myall population identified within the Survey Area is approximately 0.1 hectare in size, containing 20-50 individuals. The population identified along Edderton Road (outside of the Survey Area) is less than 0.1 hectare in size. It contains approximately 400 individuals, however this consists of a single mature tree and many saplings/juveniles.

3.4.2.3 *Cymbidium canaliculatum* Population in the Hunter Catchment

The *Cymbidium canaliculatum* Population in the Hunter Catchment is listed as an Endangered Population under the TSC Act.

A single example of the tiger orchid (*Cymbidium canaliculatum*) was recorded along Saddlers Creek in the south-eastern portion of the Survey Area (refer to **Figure 3.2**). This single orchid was found in a grey box (*Eucalyptus moluccana*) and was located approximately three metres of the ground.

3.4.2.4 *Diuris tricolor* Population in the Muswellbrook LGA (Preliminary Determination)

The *Diuris tricolor* Population in the Muswellbrook LGA is proposed to be listed as an Endangered Population under the TSC Act. This species has not been recorded in any of the ecological surveys completed within, or near to the Survey Area, however it is known to occur close to the Mt Arthur Coal access road to the north of the Survey Area (DEC Atlas of NSW Wildlife 2006a).

The DEC Atlas of NSW Wildlife (DEC 2006a) has identified a record of tricolor diuris (*Diuris tricolor*) within the Mt Arthur Coal operations area, in the A171 area (refer to **Figure 1.2**), close to the Mt Arthur Coal access road. This species has not been recorded in any of the ecological surveys completed within, or near to the Survey Area. The known record of this species (DEC 2006a) would form part of the proposed Endangered Population of this species within the Muswellbrook LGA.

3.5 Assessment of Potential Endangered Ecological Communities (EECS)

An assessment of the EECs listed under the Schedules of the TSC Act and EPBC Act was undertaken to compile a list of EECs that may occur within the Survey Area. Three EECs listed under the TSC Act have distributions that include the Survey Area. In addition to these, one EEC listed under the EPBC Act is known to occur in the vicinity of the Survey Area. Each of the EECs with potential to occur within the Survey Area is described below.

3.5.1 White Box - Yellow Box - Blakelys Red Gum Woodland

When considering the recorded presence of this EEC within the Hunter Valley, as well as professional knowledge of the Survey Area and surrounds, it was considered possible that the EEC could be present in the Survey Area. The White Box - Yellow Box - Blakelys Red Gum Grassy Woodland and Derived Native Grasslands CEEC (listed under the EPBC Act), was considered not to be present based on the general structure and floristic composition of the relevant vegetation communities in the Survey Area, and was excluded from further analysis.

An initial examination of the floristic data collected through systematic sampling indicated that the presence of White - Box Yellow - Box Blakelys Red Gum Woodland in the Survey Area was possible but unclear. The initial analysis showed no clear floristic similarity between the vegetation of the Survey Area and the EEC based on the definitions of the NSW Scientific Committee (2002). Likewise, there was no clear distributional similarity, as the Survey Area occurs at the extreme eastern range of the known distribution of the EEC, where there is extensive floristic overlap with adjoining vegetation communities (Peake 2006).

In order to determine if White - Box Yellow - Box Blakelys Red Gum Woodland was present, the following steps were used:

- identification of all plants recorded by plot-based sampling from the Survey Area, including specific identification by the National Herbarium of NSW;
- creation of a database of sites including all sites from the Survey Area (40 plots), and all HCRCMA sites that were used to delineate vegetation communities for the HRVP (total of 146) of Peake (2006), under licence from the HCRCMA;
- all non-native plants were removed from the analysis;
- data from the plots were subjected to an agglomerative cluster analysis using the Two-Step procedure and the Bray-Curtis association measure; and
- an abbreviated dendrogram, showing the grouping of like vegetation types (draft communities) resulting from the association of plots, was derived by UPGMA cluster analysis of the Bray-Curtis association matrix.

An interrogation of the dendrogram and supporting two-way table showed that there was no strong association between plots sampled in the Survey Area and plots that assisted the delineation of Upper Hunter White Box – Ironbark Woodland for the HRVP. This latter community was derived by Peake (2006) and represents the local occurrence of both White Box - Yellow - Box Blakely's Red Gum Woodland of the TSC Act, and White Box - Yellow Box - Blakelys Red Gum Grassy Woodland and Derived Native Grasslands of the EPBC Act. Upper Hunter White Box – Ironbark Woodland is the only vegetation community that Peake (2006) mapped and described that is consistent with the EECs.

The analysis showed that the Central Hunter Box – Ironbark Woodland present in the Survey Area has no strong similarity to either of the listed white box EECs. The results indicate that neither of the white box EECs are present in the Survey Area.

3.5.2 Hunter Lowland Redgum Forest

The most floristically similar community in the Survey Area is the Hunter Floodplain Red Gum Woodland Complex. It does not conform to the description of the Hunter Lowland Redgum Forest EEC (NSW Scientific Committee 2004). The nearest mapped occurrence of Hunter Lowland Redgum Forest to the Survey Area is off Pamger Drive, just west of the Thomas Mitchell Drive intersection with the New England Highway (Peake 2006).

3.5.3 Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion

The presence of weeping myall (*Acacia pendula*) within the Survey Area (refer to **Figures 3.1** and **3.2**) dictates the presence of the EEC Hunter Valley Weeping Myall Woodland, as listed under the TSC Act. The records of weeping myall thus conform to both the Endangered Population and the EEC concerning this species.

A small example of this EEC is present within the southern parts of the Survey Area (refer to **Figures 3.1** and **3.2**).

3.5.4 Weeping Myall – Coobah - Scrub Wilga Shrubland of the Hunter Valley

The Weeping Myall – Coobah - Scrub Wilga Shrubland of the Hunter Valley is known from one location in a small (approximately two hectares) stand at Jerry's Plains, which includes the local cemetery. It is possible that other structurally and floristically complex stands of weeping myall (*Acacia pendula*) in the Hunter Valley could consist to the CEEC, however recent studies suggest that floristically simplistic stands such as the ones present in the Survey Area do not conform to the CEEC. The Hunter Valley Weeping Myall Woodland recorded within the Survey Area does not conform to the above description of Weeping Myall – Coobah – Scrub Wilga Scrubland, as it comprised a monospecific stand of weeping myall, with no other native species recorded. As a result, the Weeping Myall – Coobah – Scrub Wilga Scrubland community was not recorded in the Survey Area and is not expected to occur there.

4.0 Fauna Survey Results

4.1 Fauna Habitat of the Survey Area

The assessment of terrestrial fauna habitat identified a range of habitat characteristics which contribute to the distribution, abundance and diversity of terrestrial fauna within the Survey Area.

Several general fauna habitat types are located within the Survey Area. Each of these broad habitat types has a range of characteristics which influence the habitat value, and the range of fauna species which are likely to be identified within each type. The broad habitat types recorded within the Survey Area consisted of woodland, grassland, riparian and aquatic habitats.

4.1.1 Woodland Habitat

Woodland is scattered across the Survey Area with mature, middle-aged and regenerating trees occurring at different densities. The eucalypt species present within this habitat type provide seasonal foraging resources for a number of nectarivorous bird species and mammals, as well as insectivorous birds. The eucalypt species present within this habitat type also provide a nesting resource for small birds (such as the grey fantail, *Rhipidura fuliginosa*) and larger birds of prey (such as the black-shouldered kite *Elanus notatus*). Mistletoe is present throughout the woodland habitat type, providing a foraging and nesting resource for small birds. A moderate number of hollow-bearing trees were present throughout this habitat type, with hollows ranging in size from small (26 to 50 mm) to large (100 to 300 mm). These hollows may provide nesting habitat for a number of bird species, arboreal mammals and micro-bats. The shrub layer within this habitat type ranges from scarce to medium density, providing shelter for a number of small woodland birds. Scattered logs and rocks within the woodland habitat type provide refuge and foraging habitat for reptiles and amphibians. The grassy understorey provides foraging habitat for macropods and for omnivorous birds such as the Australian magpie (*Gymnorhina tibicen*).

4.1.2 Grassland Habitat

The grassland habitat type occurs widely across the Survey Area, providing habitat for a variety of native fauna species. This habitat type is the most extensive in the Survey Area, comprising approximately 87 per cent of the Survey Area. The large areas of open grassland provide a foraging resource for macropods and a hunting resource for owls and micro-bats. Small mammals such as antechinus (*Antechinus* spp.) have foraging habitat as well as refuge habitat within the dense grass layers. This habitat type also provides foraging and refuge habitat for a number of reptile species and amphibians.

4.1.3 Riparian Habitat

The riparian habitat recorded within the Survey Area is located along Saddlers Creek. There was no specific riparian habitat recorded along Quarry Creek. The mature eucalypts within this habitat type provide a seasonal foraging resource for arboreal mammals and nectarivorous birds. These large eucalypts also provide a foraging habitat for insectivorous birds, and foraging and roosting resources for micro-bats. The numerous hollow-bearing trees within this habitat type provide a nesting resource for a number of bird species as well as arboreal mammals and micro-bats. The shrub layer, although scarce in density, provides a foraging and refuge resource for small birds. The grassy understorey provides a foraging and refuge resource for reptiles and amphibians. Some water was present within the riparian habitat type, providing a drinking resource for native fauna as well as a foraging and refuge resource for amphibians.

4.1.4 Aquatic Habitat

The aquatic habitat type is provided in the form of farm dams. There are a number of dams located within the Survey Area, and these provide a water source for native fauna. The dams also provide a foraging and refuge resource for a number of amphibian species, particularly in those dams where fringing vegetation is present.

4.2 Fauna Survey Results

A total of 97 fauna species were recorded during the fauna surveys across the Survey Area, including eight species listed as threatened on the TSC Act, and two migratory species listed under the EPBC Act. A further 23 species listed under the Schedules of the Japan Australia Migratory Bird Agreement (JAMBA), China Australia Migratory Bird Agreement (CAMBA) and Bonn agreements (under the EPBC Act) as marine or migratory species were recorded within the Survey Area. Details of the results of the fauna survey are provided below, and **Appendix 2** lists all fauna species recorded in the Survey Area.

4.2.1 Birds

A total of 58 bird species were recorded in the Survey Area during the fauna survey undertaken for the Underground Project. The location of bird searches undertaken within the Survey Area are shown on **Figure 2.2**.

Ten bird species were recorded at the northern site during the survey. The most common bird species recorded at this site included the noisy friarbird (*Philemon corniculatus*), pied butcherbird (*Cracticus nigrogularis*), grey fantail (*Rhipidura fuliginosa*) and pied currawong (*Strepera graculina*). No threatened bird species were recorded at this site during the survey. No listed EPBC species were recorded at this site during the survey.

A total of 19 bird species were recorded at the middle site during the survey. The most common bird species recorded at this site included the noisy miner (*Manorina melanocephala*), pied currawong, striated pardalote (*Pardalotus striatus*) and the superb fairy-wren (*Malurus cyaneus*). No threatened species listed under the TSC Act were recorded at the middle site during the survey. Three listed EPBC species, fan-tailed cuckoo (*Cacomantis flabelliformis*), wedge-tailed eagle (*Aquila audax*) and white-throated needletail (*Hirundapus caudacutus*), were recorded at the middle site.

A total of 25 bird species were recorded at the southern site during the survey. The most common bird species recorded at this site included the weebill (*Smicrornis brevirostris*), yellow-rumped thornbill (*Acanthiza chrysorrhoa*), rufous whistler (*Pachycephala rufiventris*) and mistletoe bird (*Dicaeum hirundinaceum*). One threatened species listed under the TSC Act was recorded at this site, being the speckled warbler (*Pyrrholaemus sagittata*). Four listed EPBC species were recorded at this site, comprising the white-throated needletail (*Hirundapus caudacutus*), rainbow bee-eater (*Merops oranatus*), magpie-lark (*Grallina cyanoleuca*) and the black-faced cuckoo-shrike (*Coracina novaehollandiae*).

Twenty-one bird species were recorded at the McDonalds Road site during the survey. The most common bird species recorded at this site included the eastern rosella (*Platycercus eximius*), laughing kookaburra (*Dacelo novaeguineae*), brown gerygone (*Gerygone mouki*) and the rufous whistler (*Pachycephala rufiventris*). One threatened species under the TSC Act was recorded at this site, being the speckled warbler (*Pyrrholaemus sagittata*). Three EPBC Act listed species were also recorded here, being the magpie-lark (*Grallina cyanoleuca*), black-faced cuckoo shrike (*Coracina novaehollandiae*) and shining bronze-cuckoo (*Chrysococcyx lucidus*).

A total of 14 bird species were recorded at the Saddlers Creek site during the survey. The most common bird species recorded at this site included the crested pigeon (*Ocyphotes lophotes*), sulphur crested cockatoo (*Cacatua galerita*), eastern rosella (*Platycercus eximius*) and Australia raven (*Corvus coronoides*). One threatened species under the TSC Act was recorded at this site, being the grey-crowned babbler (*Pomatostomus temporalis temporalis*). Two listed EPBC species, magpie-lark (*Grallina cyanoleuca*) and black faced cuckoo-shrike (*Coracina novaehollandiae*) were recorded at this site during the survey.

Six bird species were recorded at the north-western Drainage Line site during the survey. The most common bird species recorded at this site included the galah (*Cacatua roseicapilla*), superb fairy-wren (*Malurus cyaneus*), eastern rosella (*Platycercus eximius*) and noisy miner (*Manorina melanocephala*). No threatened species or listed EPBC species were recorded at this site during the survey.

Seven bird species were recorded at Mt Ogilvie site during the survey. The most common bird species recorded at this site included the eastern rosella (*Platycercus eximius*), noisy miner (*Manorina melanocephala*), Australian magpie (*Gymnorhina tibicen*) and the pied currawong (*Strepera graculina*). No threatened species were recorded at the time of the survey. One listed EPBC species, Richard's pipit (*Anthus novaeseelandiae*) was recorded at this site during the survey.

A total of 11 bird species were recorded at the Edderton Road site during the survey. The most common bird species recorded at this site included the eastern rosella (*Platycercus eximius*), galah (*Cacatua roseicapilla*), yellow thornbill (*Acanthiza nana*) and willie wagtail (*Rhipidura leucophrys*). No threatened species were recorded at this site during the survey. One listed EPBC species, the magpie-lark (*Grallina cyanoleuca*), was recorded.

A total of 19 bird species were recorded at the South Pit site during the survey. The most common bird species recorded at this site included the galah (*Cacatua roseicapilla*), sulphur-crested cockatoo (*Cacatua galerita*), eastern rosella (*Platycercus eximius*) and the striated pardalote (*Pardalotus striatus*). No threatened species were recorded at this site during the survey. Four EPBC species, being the wedge-tailed eagle (*Aquila audax*), black-shouldered kite (*Elanus notatus*), masked lapwing (*Vanellus miles*) and the magpie-lark (*Grallina cyanoleuca*), were recorded within the South Pit site during the survey.

An additional 16 bird species that had not been previously recorded within the survey sites were recorded opportunistically during other survey activities within the Survey Area. These species included the zebra finch (*Taeniopygia guttata*), masked lapwing (*Vanellus miles*), black-shouldered kite (*Elanus notatus*) and black swan (*Cygnus atratus*). No threatened species were identified opportunistically. Seven of these opportunistic species are EPBC listed species including the stubble quail (*Coturnix pectoralis*), Australian wood duck (*Chenonetta jubata*), Australasian shoveler (*Anas rhynchotis*) and grey teal (*Anas gracillis*).

4.2.2 Reptiles

Eight reptile species were identified during the survey. The snake-necked turtle (*Chelodina longicollis*) and eastern bearded dragon (*Pogona barbata*) were recorded at the Northern site. The eastern bearded dragon (*Pogona barbata*) and the southern rainbow skink (*Carlia tetradactyla*) were recorded at the middle site. The tree skink (*Egernia striolata*) and the red-naped snake (*Furina diadema*) were recorded at the McDonalds Road site. The copper-tailed skink (*Ctenotus taeniolatus*) was recorded at the Saddlers Creek Site. The red-bellied black snake (*Pseudechis porphyriacus*) was recorded at the Edderton Road site. The eastern bearded dragon (*Pogona barbata*), southern rainbow skink (*Carlia tetradactyla*) and the tree skink (*Egernia striolata*) were recorded at the South Pit site.

No threatened or EPBC listed reptile species were recorded, and no additional reptile species were recorded as opportunistic sightings.

4.2.3 Amphibians

Four amphibian species were identified across the Survey Area during the survey. The brown froglet (*Crinia signifera*) was recorded at the Saddlers Creek site. The spotted marsh frog (*Limnodynastes tasmaniensis*) was recorded at the Middle, Southern, South Pit and Edderton Road sites. The smooth toadlet (*Uperoleia laevis*) was recorded at the southern and Edderton Road sites, while the broad-palmed frog (*Litoria latopalmata*) was the only amphibian recorded at the McDonalds Road site.

No threatened or EPBC listed amphibian species were recorded during the survey, and no additional amphibian species were recorded as opportunistic sightings.

4.2.4 Mammals

A total of 27 mammal species were recorded in the Survey Area during the survey period, including six species listed under the TSC Act.

No mammals were recorded at the northern site during the survey.

Four mammal species (including one threatened species) were recorded at the middle site during the survey. The red-necked wallaby (*Macropus rufogriseus*) was recorded grazing in the grassy understorey at the middle site. The threatened squirrel glider (*Petaurus norfolcensis*) was the only arboreal mammal recorded at this site. Two micro-bat species Gould's wattled bat (*Chalinolobus gouldii*) and little forest bat (*Vespadelus vulturnus*) were recorded during the Anabat survey.

Ten mammal species (including four threatened species) were recorded at the southern site during the survey. The common brushtail possum (*Trichosurus vulpecula*), eastern grey kangaroo (*Macropus giganteus*), chocolate wattled bat (*Chalinolobus morio*) and lesser long-eared bat (*Nyctophilus geoffroyi*) were recorded during the surveys at the southern site. Four threatened species, the squirrel glider (*Petaurus norfolcensis*), eastern freetail-bat (*Mormopterus norfolkensis*), large-footed myotis (*Myotis adversus*) and eastern cave bat (*Vespadelus troughtoni*) were recorded at the southern site during the survey.

Seven mammal species (including two threatened species) were recorded at the McDonalds Road site during the survey. The eastern grey kangaroo (*Macropus giganteus*) was recorded grazing on the grassy understorey, while the southern forest bat (*Vespadelus regulus*) and little forest bat (*Vespadelus vulturnus*) were recorded during the Anabat survey at the McDonalds Road site. The threatened micro-bats large-footed myotis (*Myotis adversus*) and the eastern cave bat (*Vespadelus troughtoni*) were also recorded during the Anabat survey.

Ten mammal species (including three threatened species) were recorded at the Saddlers Creek site during the survey. Nine of the ten mammal species recorded at this site were micro-bats, while one introduced species (the brown rat, *Rattus norvegicus*) was recorded. The southern freetail-bat (*Mormopterus planiceps*), Gould's wattled bat (*Chalinolobus gouldii*), chocolate wattled bat (*Chalinolobus morio*) and the inland broad-nosed bat (*Scotorepens balstonii*) were all recorded during the Anabat survey. The threatened eastern freetail-bat (*Mormopterus norfolkensis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and the large-footed myotis (*Myotis adversus*) were also recorded during the Anabat survey.

Two mammal species were recorded within the north-western drainage line site during the survey. The southern forest bat (*Vespadelus regulus*) and the southern freetail bat (*Mormopterus planiceps*) were recorded during the Anabat survey. No threatened mammal species were recorded at this site during the survey.

Three mammal species were recorded within the Mt Ogilvie site during the survey. The dog (*Canis familiaris*) was recorded during the spotlight survey and southern forest bat (*Vespadelus regulus*) was recorded during the Anabat survey. One threatened species, the greater broad-nosed bat (*Scoteanax rueppellii*) was recorded during the Anabat survey.

Twelve mammal species were recorded within the Edderton Road site during the survey. The common ringtail possum (*Pseudocheirus peregrinus*), common brushtail possum (*Trichosurus vulpecula*) and eastern grey kangaroo (*Macropus giganteus*) were recorded during the spotlight survey. The southern freetail-bat (*Vespadelus regulus*) was recorded during the Anabat survey. No threatened mammal species were recorded at this site during the survey.

Sixteen mammal species (including four threatened species) were recorded within the South Pit site during the survey. The common brushtail possum (*Trichosurus vulpecula*) was recorded during the spotlight survey. The chocolate wattled bat (*Chalinolobus morio*), Gould's wattled bat (*Chalinolobus gouldii*) and the eastern forest bat (*Vespadelus pumilus*) were recorded during the Anabat survey. Four threatened species, the squirrel glider (*Petaurus norfolcensis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large-footed myotis (*Myotis adversus*) and the eastern cave bat (*Vespadelus troughtoni*) were recorded during the survey.

No additional mammal species were recorded as opportunistic sightings.

4.2.4.1 Trapping Capture Rates

The capture rates for terrestrial Elliot trapping (refer to **Table 4.1**) undertaken at five of the nine sites ranged from 0.8 per cent at the Saddlers Creek site to 11.0 per cent at the McDonalds Road site. Arboreal Elliot trapping success, undertaken at four of the nine sites, ranged from 0 to 60 per cent at the Saddlers Creek Site and South Pit sites respectively. No fauna species were caught in the cage traps. Hair tube success ranged from 0 to 65 per cent across the nine sites.

Table 4.1 - Trapping Success (percentage) across the Nine Survey Sites

	Site								
	Southern Site	Middle Site	Saddlers Creek	Northern Site	McDonalds Road	NW Drainage Line	Mt Ogilvie	Edderton Road	South Pit Site
Terrestrial Elliot	5.6	2.5	0.8	-	11	-	-	-	6.6
Arboreal Elliot	25	6.6	0	-	-	-	-	-	60
Cage Traps	0	0	0	-	0	-	-	-	0
Hair Funnels and Tubes	0	17.5	0	45	25	0	60	65	5

Note: Both mammal and reptile captures were included in calculations

4.3 Significant Fauna Species and Populations

4.3.1 Threatened Species

Eight threatened fauna species were recorded during surveys conducted for the Underground Project. These species comprise:

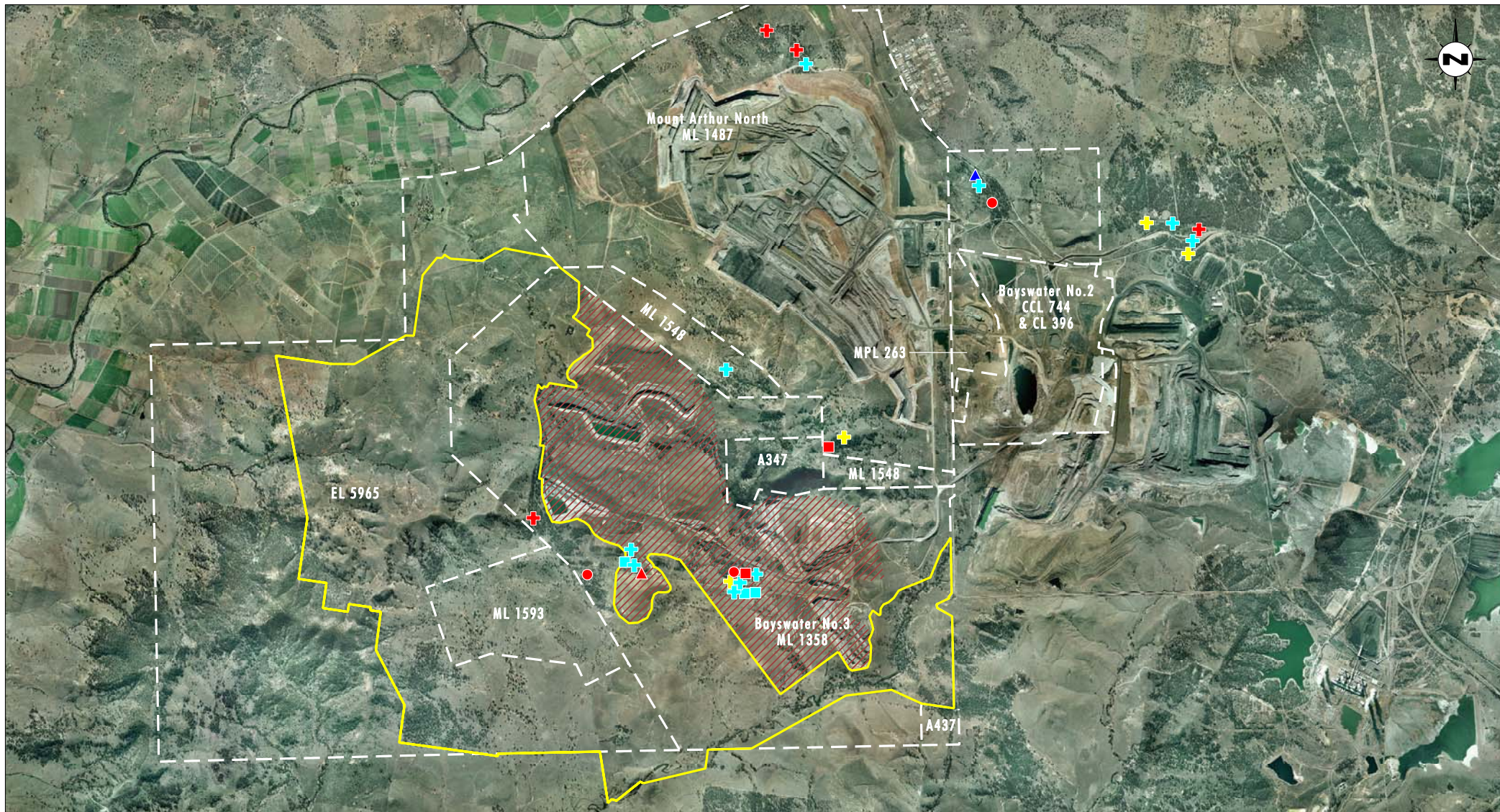
- speckled warbler (*Pyrrholaemus saggitata*);
- grey-crowned babbler (*Pomatostomus temporalis temporalis*);
- squirrel glider (*Petaurus norfolcensis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- large-footed myotis (*Myotis adversus*);
- greater broad-nosed bat (*Scoteanax rueppellii*);
- eastern freetail-bat (*Mormopterus nfolkensis*); and
- eastern cave bat (*Vespadelus troughtoni*).

Threatened fauna species were generally restricted to areas of remnant vegetation within the Survey Area, with no records obtained from the grassland habitats. The locations of threatened fauna species recorded within the Survey Area during surveys conducted for the Underground Project are shown on **Figure 3.2**.

An additional five threatened species have been previously recorded within the Mt Arthur Coal operations area. These species include threatened woodland birds, micro-bats and two mammal species. Two species, the hooded robin (*Melanodryas cucullata cucullata*) and diamond firetail (*Stagonopleura guttata*) were recorded as part of the MAN EIS and were not listed as threatened at the time of the assessment. The location of threatened species previously recorded within the Mt Arthur Coal operations area is shown on **Figure 4.1**, where sufficient information was provided to allow accurate mapping. The locations of threatened species recorded during the MAN EIS (URS 2000) and Bayswater No. 3 EIS (Resource Planning 2003) are indicative only, as precise locations of these records were not provided.

In addition to these, the parma wallaby (*Macropus parma*) and turquoise parrot (*Neophema pulchella*) were previously tentatively recorded at Mt Arthur Coal. The parma wallaby was tentatively recorded on Mt Arthur via predatory scat analysis as part of survey work for the MAN EIS (URS, 2000). The turquoise parrot was tentatively recorded during surveys conducted for the Bayswater No. 3 EIS (Resource Planning 1993). The locations of threatened species recorded during the MAN EIS and Bayswater No. 3 EIS are not shown as precise locations are not known.

Searches of the DEC Atlas of NSW Wildlife (2006a) have identified a total of thirty species listed as threatened under the TSC Act that have been recorded within a 20 kilometre radius of the Survey Area. This includes fifteen birds, fourteen mammals, and one amphibian. Of these previously recorded species, eight were recorded in the Survey Area from current surveys (as shown on **Figure 3.2**). Table 2 in **Appendix 3** lists all species from the DEC Atlas of NSW Wildlife searches, and assesses the likelihood of their occurrence within the Survey Area. Of the 30 potential species, 27 species are considered to have potential habitat within the Survey Area. A number of these species are also listed under the EPBC Act, and were identified from searches of the DEH Protected Matters



Base Source: Mt Arthur Coal, 2006

0 1 2 4 km
1:85 000

Legend

- | | | |
|---------------------------------------|--------------------------------|---------------------|
| Mining and Exploration Lease Boundary | yellow-bellied sheath-tail-bat | large-footed myotis |
| Survey Area | speckled warbler | |
| Bayswater No.3 Mining Area | squirrel glider | |
| grey-crowned babbler | eastern bentwing-bat | |
| grey-crowned babbler nest | eastern freetail-bat | |

File Name (A4): R17_V1/2051_139.dgn

FIGURE 4.1

Previously Recorded Threatened
Species Locations

Database (2006). These species are also listed in **Appendix 3** and are assessed in **Appendix 4**.

4.3.2 Endangered Fauna Populations

There are no Endangered Fauna Populations that are listed for the region, and none occur or are expected to occur within the Survey Area.

4.4 Critical Habitat

There are currently six listings on the Critical Habitat Register, these being:

- Eastern Suburbs Banksia Scrub EEC – critical habitat recommendation;
- Bomaderry zieria within the Bomaderry bushland - critical habitat recommendation;
- *Wollemia nobilis* (the Wollemi pine) - critical habitat recommendation;
- Little penguin population in Sydney's North Harbour - critical habitat declaration;
- Gould's Petrel – critical habitat declaration; and
- Mitchells Rainforest Snail in Stotts Island Nature Reserve - critical habitat declaration.

The Underground Project will not impact on any areas of declared critical habitat.

5.0 Impact Assessment

5.1 Predicted Impacts from Underground Project

The majority of impacts of the Underground Project will arise from potential subsidence cracking, subsidence remediation works to repair areas of cracking, the construction of surface infrastructure and from stream remediation works completed to rectify changes to drainage lines due to subsidence. The potential impacts from each of these issues are discussed in the following sections.

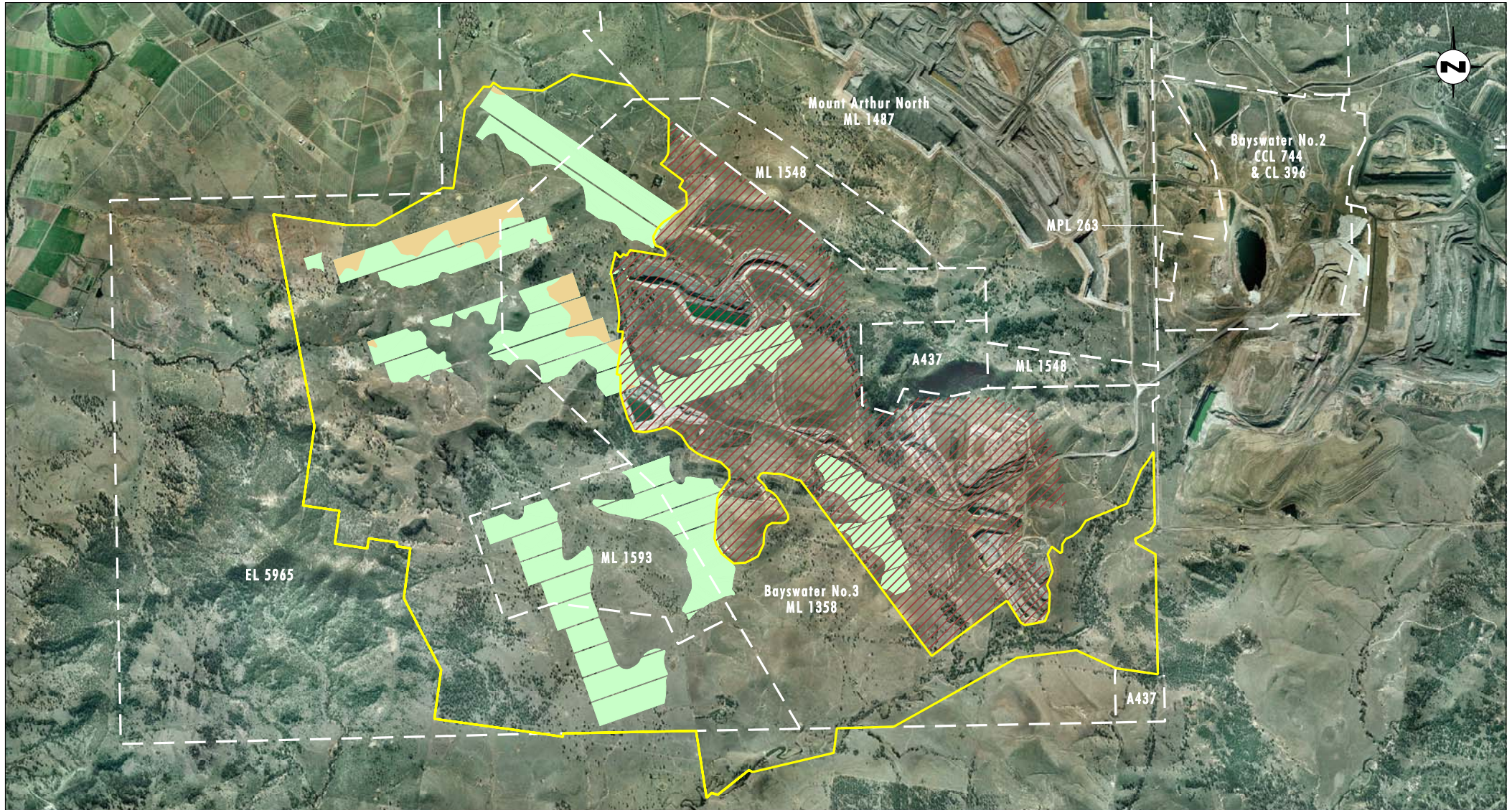
5.1.1 Potential Subsidence and Subsidence Cracking

The proposed underground mining operations will result in subsidence above the extracted longwall panels. Subsidence itself does not typically adversely impact on ecological values, however subsidence can lead to surface cracking and changes to surface drainage that may impact on ecological values. The subsidence impacts associated with this project are not expected to result in tree failure or death. Subsidence related cracking is predicted to occur along the tensile zones (occurring at the edge of the longwall panels) plus in areas where there is less than 100 metres depth of cover. These areas are shown on **Figure 5.1**. In these areas, subsidence remediation works consisting of either cultivation works (such as tilling and deep ripping) or earthworks (more extensive works using heavy machinery such as graders) will be required to repair areas of cracking. In some of the areas mapped as potentially requiring cultivation, cracking may be repaired by infilling of cracks negating the need for any ground disturbing works. Subsidence remediation work does not result in total clearing of vegetation, with only the areas affected by cracking requiring disturbance. Within the areas identified as requiring remediation works may be required in drainage lines to repair cracking, with a small number of areas of stream remediation works also potentially required (refer to **Section 5.1.4**). Some crack infilling or repair (by cultivation) may be required in the tensile zones (refer to **Figure 5.1**) along the edges of some longwall panels with shallow depths of cover. Tensile zone cracking is typically limited to a small area near the longwall panel edge.

For the purpose of this impact assessment, the predicted maximum subsidence remediation impact zone has been used to define the extent of potential impact due to subsidence from the Underground Project. Within this impact zone, areas expected to require cultivation versus earthworks to repair areas of cracking have been identified. It is considered that this approach provides a conservative impact assessment as there will not be total disturbance of ecological values within the impact zone. Outside of this zone, no impact is predicted to occur to ecological values except as related to the establishment of surface infrastructure, cracking in tensile zones and due to stream remediation works (refer to **Sections 5.1.3 and 5.1.4**).

Figure 5.1 identifies the predicted subsidence impact zone, that is, those areas that are expected to be subject to cracking and remediation works. The figure also identifies the expected scale of remediation works required, be it cultivation or earthworks. Above the remainder of the proposed mining area, the depth of cover is greater and the risk of subsidence-related cracking and subsequent requirement for remediation works is low.

Figure 5.2 identifies the predicted impact of the subsidence impact zone on the vegetation communities identified within the Survey Area. **Table 5.1** identifies the amount of each vegetation community that falls within the expected subsidence impact zone, noting, as discussed above that the project will not result in the total loss of ecological values from within the subsidence impact zone.



Base Source: Mt Arthur Coal, 2006

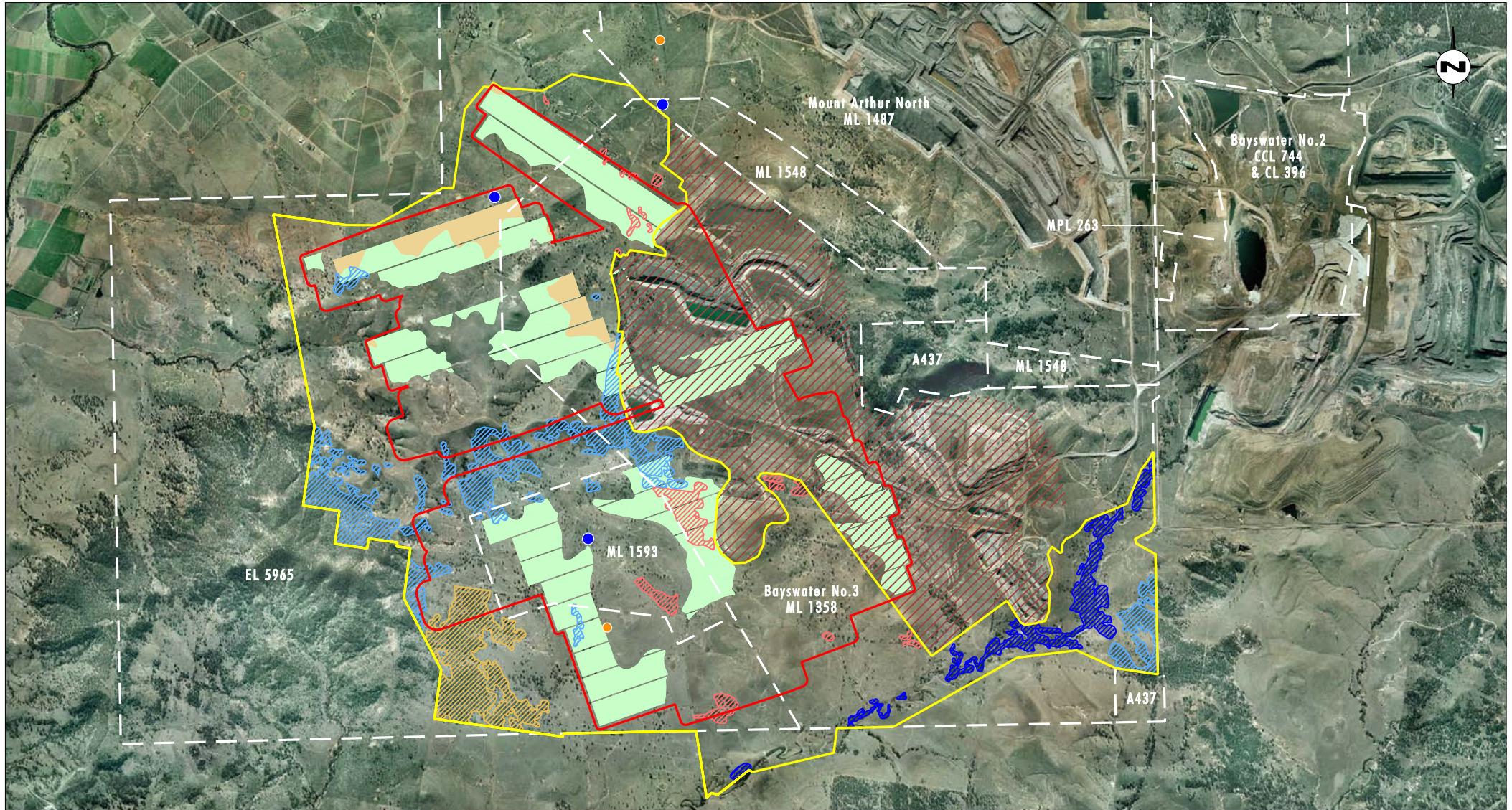
0 1 2 3 km
1:65 000

Legend

- Mining and Exploration Lease Boundary
- Survey Area
- Bayswater No.3 Mining Area
- Potential Subsidence Remediation Area - Cultivation
- Potential Subsidence Remediation Area - Earthworks

FIGURE 5.1

Potential Areas of Subsidence
Remediation Works



Base Source: Mt Arthur Coal, 2006

0 1 2 3km
1:65 000

Legend

- | | | |
|---|--|--|
| --- Mining and Exploration Lease Boundary | ■ Potential Subsidence Remediation Area - Earthworks | ● Location of Hunter Valley Weeping Myall Woodland |
| — Survey Area | ▨ Central Hunter Box-Ironbark Woodland | ● <i>Bothriochloa biloba</i> |
| — Subsidence Affection Area | ▨ Central Hunter Bullock Regeneration | |
| ▨ Bayswater No.3 Mining Area | ▨ Hunter Floodplain Redgum Woodland | |
| ■ Potential Subsidence Remediation Area - Cultivation | ▨ Narrabeen Footslopes Slaty Box Woodland | |

Note: Areas within the survey area not otherwise delineated constitute derived grassland (or aquatic vegetation if fringing dams)

File Name (A4): R17_V1/2051_190.dgn

FIGURE 5.2

**Subsidence Remediation
Impact on Vegetation**

Table 5.1 - Approximate Area of Vegetation Communities Occurring within Predicted Subsidence Impact Zone

Vegetation Community	Amount of Community within Predicted Subsidence Remediation Impact Zone – Cultivation (ha)	Amount of Community within Predicted Subsidence Remediation Impact Zone – Earthworks (ha)	Amount of Vegetation within Survey Area (ha)	% of Vegetation Community Impacted by Underground Project
Hunter Valley Weeping Myall Woodland	0	0	<1	0
Central Hunter Bulloak Forest Regeneration	24	0	55	44
Central Hunter Box – Ironbark Woodland	23	1	245	10
Hunter Floodplain Red Gum Woodland Complex	0	0	75	0
Narrabeen Foothills Slaty Box Woodland	0	0	115	0
Derived Grassland	559	71	3275	19
Aquatic Vegetation	0	0	<1	0
Total	606	72	3765	

From **Table 5.1** it can be seen that 93 per cent of the predicted surface subsidence impact is expected to occur within the Derived Grassland vegetation community. The highly modified state of this vegetation community, and its limited fauna habitat value, means that the predicted subsidence in this area is not likely to cause a negative impact on biodiversity values in the Survey Area.

Table 5.1 identifies that approximately 7 per cent of the predicted surface subsidence impact will occur within woodland vegetation communities. This consists of approximately 24 hectares of Central Hunter Bulloak Forest Regeneration and approximately 24 hectares of Central Hunter Box – Ironbark Woodland. The predicted impact represents 44 per cent and 10 per cent of the extent of these vegetation communities within the Survey Area, respectively. The predicted extent of subsidence in these woodland communities/forest is not expected to cause tree failure or tree death. The main impact in these woodland areas will come from the required subsidence remediation works (either cultivation or earthworks) which can be managed to require only minimal clearing. This impact is described in **Section 5.1.2**. The potential impacts from altered drainage in these vegetation communities are detailed in **Section 5.1.4**.

5.1.2 Subsidence Remediation Works

Subsidence remediation works will be required where subsidence-related cracking occurs. Such works generally include either cultivation works (such as tilling or deep ripping) or earthworks (more extensive works using heavy machinery such as graders and excavators) within cracked areas. These remediation methods restructure the soil profile, allowing the subsidence cracks to be repaired. Where such methods are required to remediate subsidence cracking, groundcover vegetation will be disturbed and vegetation may need to be cleared to allow access for machinery, or to allow the cracks to be adequately repaired. Where remediation works are required within woodland areas, the requirement to clear vegetation can be minimised by using small machinery which requires less room to

manoeuvre. In particularly sensitive areas of vegetation, hand methods can be used to repair any cracking and restore the soil profile.

Approximately 24 hectares of Central Hunter Box – Ironbark Woodland and 24 hectares of Central Hunter Bulloak Forest Regeneration are likely to be subject to subsidence remediation works (refer to **Figure 5.2**). The majority of this disturbance will be as a result of cultivation remediation works, however, one hectare of Central Hunter Box – Ironbark Woodland Forest is predicted to require earthworks to remediate subsidence impacts. Appropriate impact amelioration measures that aim to minimise the impact to native vegetation communities are provided in **Section 6** of this report. It is expected that subsidence remediation works in these areas can be managed to require minimal clearing.

5.1.3 Surface Infrastructure

The Underground Project will require the construction of a number of areas of surface infrastructure, including:

- ventilation fan facilities and downcast ventilation shafts;
- borehole facilities including dewatering boreholes, materials and service boreholes and gas drainage boreholes and other similar facilities required above the long wall panels as mining progresses, along with their associated access tracks, power lines, gas pipelines and other services and infrastructure;
- the overland conveyor (within a 15 metre wide easement) from the North Saddlers ROM Facility to the existing CHPP, including a crossing of Saddlers Creek (refer to **Figure 1.3**);
- the Underground Project access road and associated services easement (corridor approximately 25 metres wide) (refer to **Figure 1.3**);
- site services including power lines, potable water pipelines, mine water and ground water pipelines, minor access roads and other minor infrastructure; and
- drainage works around infrastructure areas and within the underground mining area.

The majority of this surface infrastructure will be located within areas that have been disturbed by past mining operations or that have been subject to past ecological survey and assessment. This includes the main surface facilities for each target coal seam and the North Saddlers ROM facility.

The construction of the overland conveyor and associated services corridor will require the crossing of Saddlers Creek, as well as a minor upper tributary of Saddlers Creek in the east of the Survey Area (refer to **Figures 1.3** and **1.4**). The crossing of Saddlers Creek will pass through approximately 1586 m² of the Hunter Floodplain Red Gum Woodland Complex. This will require the removal of approximately 0.16 hectares of this vegetation community, representing approximately 0.2 per cent of the extent of this community within the Survey Area.

The construction of the access road and associated services corridor will cross a minor upper tributary of Saddlers Creek, in the east of the Survey Area (refer to **Figures 1.3** and **1.4**), however it will not cross Saddlers Creek itself. The access road is likely to cross through approximately 5004m² of Hunter Floodplain Red Gum Woodland Complex. This will require the removal of approximately 0.5 hectares of this vegetation community, representing approximately 0.7 per cent of the extent of this community within the Survey Area.

Due to the recorded presence of threatened species (particularly the squirrel glider) in this vegetation community, pre-clearance surveys (according to the Mt Arthur Clearing Procedure detailed in **Section 6.5**) will be required. These pre-clearance surveys will be completed by a person with appropriate qualifications and experience to be competent to undertake the work, and will target the identification of hollow-bearing trees in this area.

The precise location of infrastructure such as ventilation fans, borehole facilities and associated access tracks and power lines will not be known until mining in each area has commenced (indicative locations for some facilities are shown on **Figures 1.3** and **1.4**). The facilities will be located as part of the detailed mine planning process for each set of panels and will consider ecological factors such as the presence of remnant native vegetation and significant ecological features such as threatened species or hollow-bearing trees. Where possible, these facilities will be located to avoid clearing of woodland/forest vegetation, with the area required for each facility typically small (i.e. <1 hectare). Further details regarding the management process for placement of surface facilities are included in **Section 6.3**.

The construction of surface infrastructure will occur in areas of Derived Grassland wherever possible, however where this is not possible (and disturbance to native vegetation cannot be avoided), the following due diligence processes will be implemented:

- disturbance to native vegetation communities will be limited to the minimum area required;
- areas of known ecological significance (refer to **Figures 3.2** and **4.1**) will be avoided (i.e. areas containing known records of threatened species, Endangered Populations or EECs);
- appropriate disturbance setbacks to the abovementioned known significant ecological features; and
- pre-clearing surveys will be completed by a suitably qualified and experienced person to identify any significant ecological features of the chosen site and any required management measures.

Due to the extensive ecological survey conducted within the Survey Area, it is considered that these surface infrastructure requirements can be constructed without significant impact on vegetation communities and fauna habitats, in accordance with the due diligence process outlined above. Further detailed assessment is not required prior to the construction of these facilities, however sites containing *Acacia pendula* (as shown on **Figure 3.2**), will be avoided (with appropriate disturbance setbacks implemented) to minimise impact on this listed Endangered Population and EEC.

5.1.4 Drainage

A small number of highly ephemeral drainage lines occur within the predicted subsidence impact zone. As with the majority of drainage lines within the Survey Area, the vegetation and habitat of these drainage lines are significantly altered as a result of a long history of grazing and clearing. None of the drainage lines within the predicted subsidence impact zone contain specific riparian vegetation, or important areas of aquatic habitat.

Within the predicted subsidence impact zone, it is expected that some cracking may occur within the drainage lines. Where these cracks do not repair themselves, some works may be required within the bases of the drainage lines to repair cracking. Works may also be required to rectify any areas of the stream ponding that occurs due to subsidence. Due to the highly ephemeral nature of these drainage lines, and their existing high levels of disturbance, it is not expected that repair works will significantly impact on drainage line

habitat within the Survey Area. These drainage lines contain very little native riparian or aquatic vegetation, so the potential works will not significantly reduce the occurrence of riparian or aquatic vegetation within the project area.

Stream remediation works may also be required in a small number of areas to rectify subsidence related drainage impacts. These works will be relatively small-scale in nature and the potential works will not significantly reduce the occurrence of riparian or aquatic vegetation within the Survey Area.

A number of small farm dams occur within the predicted subsidence impact zone. There is some potential that subsidence-related cracking may impact on dam walls, thus requiring rectification works, however, these repair works are not expected to significantly impact on aquatic habitat or vegetation within the project area.

5.2 Impact on Flora Species and Vegetation Communities

In terms of general diversity of flora species, the Survey Area appears to be representative of surrounding areas in the locality. Overall, plant species diversity within the Survey Area is considered to be moderate, with a total of 220 species being recorded. Of these, 57 species (30 per cent) were not native to the Survey Area.

Although the natural vegetation within the Survey Area is of some ecological significance due to the high levels of historical clearing in the region, the impact of predicted subsidence remediation works within a small area of this vegetation will not be extensive. Subsidence remediation works are predicted to be necessary within approximately 19 per cent of the extent of Derived Grassland within the Survey Area, approximately 10 per cent of the Central Hunter Box - Ironbark Woodland, and approximately 44 per cent of the Central Hunter Bulloak Forest Regeneration within the Survey Area (refer to **Table 5.1**). As disturbance will only occur where it is necessary to repair areas of cracking, clearing of canopy vegetation is unlikely to be required and the majority of vegetation will remain largely undisturbed. This predicted impact is not expected to result in a significant loss of floristic diversity in the Survey Area, Mt Arthur Coal operations area or the region.

The construction of the conveyor across Saddlers Creek will require the removal of Hunter Floodplain Red Gum Woodland Complex (see **Section 5.1.3**), resulting in the loss of 0.16 hectare of this vegetation community (<1 per cent of occurrence within the Survey Area).

The construction of boreholes is not expected to require the clearing of woody vegetation, as these will be located in previously disturbed or grassland areas, wherever possible.

Floristic diversity in the Survey Area is considered to be representative of surrounding areas, including in conserved habitats of the MAN mining area at Mt Arthur and MacLeans Hill and within unaffected parts of the Survey Area. The Underground Project will not result in a significant loss of regionally significant species, as these species occur widely across the Mt Arthur Coal operations area (Umwelt 2001; Umwelt 2003; Umwelt 2005; Umwelt 2006a, 2006b; URS 2000).

Any potential changes to floristic diversity or community composition as a result of the Underground Project are not expected to be significant, due to the amount of unaffected vegetation within the Survey Area and the floristic similarity of the vegetation of the Survey Area to the wider region.

It is not expected that subsidence alone will cause tree failure or tree death, with the main likely subsidence-related impact associated with subsidence remediation works. In addition,

there may also be the requirement to complete stream remediation works to rectify subsidence-related drainage impacts in small areas of the subsidence impact area.

5.3 Impact on Fauna Species and Habitats

It is unlikely that the Underground Project will result in a significant loss or deterioration of fauna habitat within the Survey Area. The existing fauna habitat within the Survey Area broadly consists of remnant woodland vegetation (approximately 13 per cent of the Survey Area), extensive grasslands (87 per cent of the Survey Area), as well as limited areas of riparian and aquatic habitat (<1 per cent of Survey Area).

There is potential that subsidence remediation works may be required within the bases of minor drainage lines within the predicted subsidence impact area. These works may be required to repair potential cracking, where it does not repair itself over time. As these drainage lines are highly ephemeral, significantly altered and lacking substantial areas of aquatic or riparian habitat, potential works within these areas are not likely to impact on the availability or functioning of aquatic or riparian habitats.

A portion of the woodland and grassland habitats will, however, be subject to surface cracking and associated remediation works. The woodland habitat within the Survey Area offers a variety of habitat types for native fauna species. The various vegetation layers in this woodland provide a variety of foraging resources for native fauna species, as well as protective cover and breeding habitat. The provision of hollows of a variety of sizes within this vegetation habitat is particularly important in such a fragmented landscape. It is expected that remediation of surface cracking within approximately 48 hectares (7 per cent of the total occurrence within Survey Area) of the woodland habitat will not cause an overall loss of fauna habitat within the Survey Area. Surface cracking in these areas will be repaired with the use of small machinery, in order to minimise the need to clear or modify large areas of existing vegetation. The rehabilitation of disturbed areas and ongoing monitoring will ensure minimal impact on this habitat formation within the project area.

The grassland habitat within the Survey Area offers mainly foraging habitat for native fauna, although the dense ground layers offer protection for some smaller species. This vegetation formation is not likely to form core habitat for any threatened species recorded (or with potential habitat) within the project area. The limited habitat diversity and overall value of the grassland formation means that the impact of remediation works within 630 hectares of this formation within the Survey Area will be minimal. It is unlikely that the disturbance of approximately 19 per cent of this vegetation formation within the Survey Area will significantly impact on the provision of habitat to fauna species, such that the biodiversity of the project area will be impacted.

The impact on fauna habitat from the construction of the conveyor across Saddlers Creek is expected to be minor. This will result in the loss of <1 hectare of the Hunter Floodplain Red Gum Woodland Complex, representing <1 per cent of this vegetation community recorded within the Survey Area.

The completion of pre-clearing surveys for arboreal fauna in this vegetation will ensure a minor impact on fauna species (particularly threatened species) within this area.

The construction of boreholes within previously disturbed and grassland areas, where possible, will minimise the potential for impacts of borehole construction on the availability of fauna habitat within the project area.

5.4 Impact on Threatened Species, Endangered Populations and EECS

5.4.1 State Legislation

5.4.1.1 Environmental Planning and Assessment Act 1979

Two Endangered flora Populations and one EEC were recorded in the Survey Area. These consisted of components of the Endangered Populations of *Acacia pendula* and *Cymbidium canaliculatum* (refer to **Figure 3.2**), and the EEC Hunter Valley Weeping Myall Woodland (refer to **Figure 3.1**). No state listed threatened flora species were recorded within the Survey Area.

A number of threatened fauna species listed under the TSC Act are considered to have potential habitat in the Survey Area, with the following eight species being recorded during surveys (refer to **Figure 3.2**):

- grey-crowned babbler (*Pomatostomus temporalis temporalis*);
- speckled warbler (*Pyrrholaemus sagittata*);
- squirrel glider (*Petaurus norfolcensis*);
- eastern freetail-bat (*Mormopterus norfolkensis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- greater broad-nosed bat (*Scoteanax rueppellii*);
- large-footed myotis (*Myotis adversus*); and
- eastern cave bat (*Vespadelus troughtoni*).

Threatened species, Endangered Populations and EECs recorded during previous surveys of the project area or Mt Arthur Coal locality (refer to **Figure 4.1**) were also considered when undertaking the impact assessment.

An assessment of significance has been used to determine the potential impact of the Underground Project on threatened species, Endangered Populations and EECs recorded, or considered likely to occur in the project area. The assessment of significance, provided in **Appendix 3**, concludes that the Underground Project will not have a significant impact on threatened species, Endangered Populations, EECs or their habitats recorded within the project area. The assessment of significance also concludes that the Underground Project would not pose a significant impact on threatened species, Endangered Populations or EECs that have the potential to occur within the Project area.

The potential modification of some areas of grassland and woodland habitat as a result of the Underground Project will not result in a significant impact on any potentially occurring threatened species due to the presence of extensive habitat areas within the Mt Arthur Coal operations area and the small area of potential habitat affected. It is unlikely that the Underground Project will disrupt the lifecycle of any of the identified potentially occurring threatened species such that a viable population will be placed at risk of extinction.

5.4.1.2 SEPP 44 Assessment

The Underground Project is subject to assessment under State Environmental Planning Policy (SEPP) No. 44 (Koala Habitat Protection) as it lies in a local government area (LGA) listed in Schedule 1 of the policy. SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas (*Phascolarctos cinereus*), to ensure permanent free-living populations over their present range and to reverse the current trend of population decline. Any development application in an identified LGA, affecting land one hectare or greater, including adjoining lands on the same holding, must be assessed under the policy.

Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 constitutes 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 identified in **Table 5.2**.

Table 5.2 – Species Listed in Schedule 2 of SEPP 44

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

The vegetation communities of the Survey Area were assessed according to this Schedule, and it was found that *Eucalyptus albens*—*moluccana* was recorded within the Survey Area. Although *Eucalyptus moluccana* is not listed under Schedule 2, *Eucalyptus albens* is, and the intergrade present in the Survey Area is likely to comprise enough genetic material of *Eucalyptus albens* to assume that *Eucalyptus albens* is present. This species is likely to comprise 15 per cent of overstorey species within the Survey Area, which indicates that the Survey Area contains potential koala habitat.

Given that potential koala habitat occurs in the Survey Area, the policy requires that it must be determined whether the area forms core koala habitat under the definition of SEPP 44. Core koala habitat is defined under this legislation as; “an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population”. Targeted searches and area searches for scats failed to identify the koala, or evidence of the species and there is no historical record of the species within the Survey Area.

It is likely that a resident population of koalas does not occur within the Survey Area, as no evidence of koala use was observed during field surveys. There are also no historical or anecdotal records of koalas occurring in the Survey Area, although there are previous records from the local area and region. The area is not considered to be core koala habitat

as defined under SEPP 44, hence the preparation of a Koala Plan of Management is not required. SEPP 44 does not place any constraints on the Underground Project.

5.4.1.3 Fisheries Management Act 1994

The threatened species Schedules of the *Fisheries Management Act 1994* comprise lists of Endangered species, populations and ecological communities and species presumed extinct, Vulnerable species, and key threatening processes. These Schedules indicate that the Hunter River drainage basin is outside the known distribution of species, populations and ecological communities listed under this legislation. Therefore, none of the listed species, populations and ecological communities are expected to occur in the project area, and none would be impacted by the Underground Project.

5.4.2 Commonwealth Legislation

5.4.2.1 Environment Protection and Biodiversity Conservation (EPBC) Act 1999

Under the Commonwealth EPBC Act, the approval of 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 communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- World Heritage properties;
- National Heritage places; and
- nuclear actions.

A search of the DEH Protected Matters Search Tool (DEH 2006) identified (discounting fishes and marine species) two threatened ecological communities, 23 threatened species and seven migratory species considered likely to occur, on the basis of habitat modelling, within a 20 kilometre radius of the Survey Area. Those species and ecological communities with potential habitat in the Survey Area are shown in **Table 1** of **Appendix 3**.

The EPBC Act 1999 lists criteria which are used to determine whether an action is likely to have a significant impact on matters of NES. These criteria are addressed in the Assessment of Significance provided in **Appendix 4**.

One EPBC Act threatened flora species, *Bothriochloa biloba*, was recorded during vegetation surveys within the Survey Area (refer to **Figure 5.2**). One additional species, *Diuris tricolor*, is also considered to potentially occur in the Survey Area due to the presence of suitable habitat, and a historical record from near to the Survey Area. This species was not recorded despite targeted surveys for the Underground Project.

Two EPBC database listed migratory species, the white throated needletail (*Hirundapus caudacutus*) and the rainbow bee-eater (*Merops ornatus*) were recorded within the Survey Area during surveys. A further 23 species listed under the Schedules of the JAMBA/CAMBA

and Bonn agreements as marine or migratory species were recorded within the Survey Area. These were also considered in the assessment of significance provided in **Appendix 4**.

From the assessment of significance, it is concluded that the Underground Project will not pose a significant impact on listed threatened species and communities or migratory species as listed under the Schedules of the EPBC Act.

6.0 Ecological Management and Monitoring

6.1 Existing Mt Arthur Coal Ecological Monitoring and Management Strategies

A range of management strategies will be used by Mt Arthur Coal to limit impacts on native flora and fauna in the project area. The strategies will include:

- management of noise and dust to minimise impacts to adjoining vegetation communities and fauna (as addressed in the Main Text of the EA);
- feral animal and noxious weed control consistent with existing practice at Mt Arthur Coal;
- rehabilitation of disturbed areas with a mix that includes native and non-native (including improved pasture species for area with a grazing final land use) species found in the local area (as addressed in **Section 6.4**);
- the linkage and integration of rehabilitation areas with existing vegetated areas to improve ecological function and provide habitat (as addressed in **Section 6.4**);
- management of erosion and sedimentation to ensure that adjoining vegetation communities and aquatic systems are not disturbed (as addressed in the Main Text of the EA);
- management of surface water to ensure that adjoining vegetation communities, aquatic systems and associated fauna are not disturbed (as addressed in the Main Text of the EA);
- adaptive management, as required, if a previously unrecorded or assessed threatened species is identified in the project area during operations;
- ongoing monitoring and maintenance of all revegetation works and habitat enhancement activities;
- pre-clearance inspections and tree felling procedures;
- ongoing monitoring of native flora and fauna across the Mt Arthur Coal site (as discussed in **Section 6.6**); and
- creation of habitat corridors linking isolated remnant vegetation stands (refer to **Section 6.4**).

6.2 Management of Subsidence Remediation Works

It is predicted that approximately 678 hectares of vegetation (630 hectares of grassland and 48 hectares of woodland habitat) will potentially require subsidence remediation works. These works, where required, could include infilling of cracks, cultivation works (such as tilling or deep ripping) or earthworks (using heavy machinery such as graders). The majority of potential disturbance to vegetation communities will be as a result of cultivation remediation works, however, one hectare of Central Hunter Box – Ironbark Woodland Forest will require earthworks to remediate subsidence impacts. Management recommendations to reduce the impact of these works on ecological values within the project area are outlined below.

6.2.1 Woodland Forest Communities

Typically, it is necessary to remove elements of the canopy, shrub and ground layers to allow for access for earthmoving machinery. The remediation of surface cracking within woodland vegetation communities will be managed, however, to reduce the amount of vegetation that will be disturbed or removed as a result of earthworks. In order to achieve this, small earthmoving machinery will be used in these areas as much as possible. The use of small rather than large machinery will reduce the potential to require the clearing of small tree, shrub and other vegetation layers. It is considered unlikely that mature trees will need to be cleared to complete the required subsidence remediation, however, in the unlikely circumstances where it is required, clearing will be undertaken in accordance with the procedure described in **Section 6.5**.

In woodland areas, shrub and ground layers will be the strata that are most significantly impacted by remediation activities. Regular monitoring of remediated woodland areas will be required to ensure that the shrub and ground layers regenerate from the soil seed bank following subsidence remediation works. In the event that natural regeneration does not occur to a satisfactory level, Mt Arthur Coal will facilitate the revegetation of these sites through the planting of native shrub and ground cover species. Species selection will be undertaken to ensure the long term viability of the revegetation works and the preservation of the floristic diversity within this vegetation formation.

6.2.2 Weeping Myall (*Acacia pendula*)

Figure 5.2 identifies that the location of weeping myall within the southern part of the Survey Area lies close to (although not within) the predicted subsidence remediation works impact zone. While it is not predicted that this area will be impacted by subsidence remediation works, its proximity to predicted works areas warrants caution. Due to the ecological significance of this area, regular monitoring will be necessary to gauge the impact of the predicted nearby subsidence cracking on this Endangered Population and EEC.

Should subsidence remediation works be required in (or near to) this area, all works will be done by hand to minimise any potential impact on this species. An appropriately qualified and experienced ecologist will be consulted prior to works being completed to assist in determining the most appropriate management measures, as well as to monitor the ongoing health of the species.

6.2.3 Grassland Communities

Derived Grassland is the most widespread vegetation community within the project area, and approximately 19 per cent of this community within the Survey Area is expected to be impacted by surface cracking. Remediation works within this community are likely to consist of deep-ripping and cultivation with earthworks machinery. Revegetation will be undertaken as required to ensure target species are established. These practices are expected to have minimal impact on the floristic diversity of this community, and the remediation works are not likely to result in the net loss of grassland within the Survey Area, therefore no specific management measures are required.

6.3 Management of Minor Surface Infrastructure

As discussed in **Section 5.1.3**, the Underground Project will require the construction of various minor surface infrastructure such as borehole facilities and associated services for which the exact locations cannot be known at this stage of the project. While these facilities

will be located within previously disturbed areas, or areas of Derived Grassland wherever possible, it may be necessary to disturb some areas of native vegetation. Where this is unavoidable, all effort will be made to avoid areas containing significant ecological features such as known threatened species habitat, or hollow-bearing trees. Where it will be necessary to disturb areas of native vegetation for these types of infrastructure, the following due diligence processes will be implemented:

- disturbance to native vegetation communities will be limited to the minimum area required;
- areas of known ecological significance (refer to **Figures 3.2** and **4.1**) will be avoided where possible (that is, areas containing known records of threatened flora species, Endangered Populations and EECs. Hollow-bearing trees should be retained, where possible);
- appropriate disturbance setbacks to the abovementioned known significant ecological features will be established where possible; and
- pre-clearing surveys will be completed by a suitably qualified and experienced person to identify any significant ecological features of the chosen site and required management and mitigation measures.

Further detailed assessment is not required for the construction of these facilities, however sites containing weeping myall (*Acacia pendula*) (as shown on **Figure 3.2**), will be avoided to minimise impact on this listed Endangered Population and EEC.

6.4 Enhancement and Protection of Threatened Species Habitat

6.4.1 Saddlers Creek

Saddlers Creek has been identified as a significant regional corridor providing habitat for a range of threatened species and significant vegetation communities. While Saddlers Creek will not be impacted by the Underground Project (with the exception of the service corridor containing the conveyor), opportunity exists to further enhance and protect the riparian corridor for the long term protection of threatened species at Mt Arthur Coal.

Saddlers Creek riparian vegetation provides known habitat for the threatened squirrel glider (*Petaurus norfolcensis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), eastern cave bat (*Vespadelus troughtoni*), large-footed myotis (*Myotis adversus*), grey-crowned babbler (*Pomatostomus temporalis temporalis*) and *Cymbidium canaliculatum* (listed as an Endangered Population in the Hunter catchment). In addition, the Hunter Floodplain Red Gum Woodland Complex is considered to be regionally significant, potentially qualifying for listing on the EPBC and TSC Acts (refer to **Section 3.3.3**).

The squirrel glider was identified in the south of the Survey Area in habitats associated with Saddlers Creek. The species has been widely recorded in the Mt Arthur Coal operations area. It is likely that the squirrel glider utilises the woodland habitats along Saddlers Creek, a small portion of which may be impacted by the Underground Project. Threatened micro-bats, including the eastern bentwing-bat, eastern cave bat and the large-footed myotis were also recorded along Saddlers Creek. These species are also likely to utilise the woodland habitats in the Survey Area for foraging. To assist in further offsetting the impacts of the project on the threatened species recorded in the Survey Area, the following habitat enhancement and protection recommendations will be implemented along Saddlers Creek:

- Saddlers Creek will be fenced to protect the riparian corridor and encourage natural regeneration in previously disturbed areas. Natural regeneration will be supplemented (where necessary) with plantings of native species to assist in the regeneration of native vegetation communities (excluding the area established as a cultural heritage conservation area so as to minimise disturbance to known or potential artefacts). This will provide future foraging and nesting habitat for the squirrel glider and enhanced foraging resources for the threatened micro-bats recorded; and
- cattle grazing will cease along Saddlers Creek, with watering points established outside of the riparian zone. The removal of grazing will promote natural regeneration and improve habitat quality for a range of threatened species.

Much of Saddlers Creek in the project area will be conserved as a cultural heritage conservation area, with this area also assisting to conserve ecological values.

6.4.2 Woodland Habitats

The monitoring of nest boxes established for squirrel gliders will be included in the three-yearly monitoring of nest boxes (refer to **Section 6.6.5** below) and the habitats of Saddlers Creek will continue to be monitored to determine any deterioration in habitat quality and threatened species utilisation of the area. The monitoring of the occupancy and condition of nest boxes is proposed on a three-yearly basis (refer to **Section 6.6.5**).

6.5 Protection and Management of Arboreal Habitat

Mt Arthur Coal has a detailed pre-clearance survey and clearing procedure in place for the existing MAN operations. This procedure will be implemented for any vegetation clearing required as part of the Underground Project.

Trees will be cleared in accordance with the procedure described below. Where possible, salvaged micro-habitats (tree hollows, logs etc.) will be relocated to areas lacking in tree hollows or retained for use in rehabilitation once re-established vegetation is suitably mature. The identification of tree hollows is to be undertaken by a person with appropriate qualifications and experience to be competent to undertake the work, during pre-clearance inspections.

The following pre-clearance survey and clearing procedure has been prepared by Mt Arthur Coal to minimise the potential for impact on native fauna species (including threatened species), as a result of the clearing of hollow-bearing trees. The clearing procedure will be used in combination with pre-clearance inspections, which will determine if any hollow bearing trees or significant habitat resources are to be affected.

- Within the area of clearing, hollow-bearing trees and other habitat structures such as stags, logs and stumps will be clearly marked by a person with appropriate qualifications and experience to be competent to undertake the work, to prevent accidental clearing.
- Vegetation surrounding the marked habitat structures will be cleared and the marked structures left undisturbed for a period of 24 hours.
- Marked hollow-bearing trees will be shaken prior to felling using a bulldozer and then left for a short period to allow any fauna using the hollows to be observed.
- Hollow-bearing trees will be slowly pushed over using a bulldozer, with care taken to avoid damage to hollows.

- Following tree felling each of the identified hollows will be examined for fauna by a suitably qualified and experienced person.
- Where practical, felled trees will be left for a 24-hour period prior to removal in order to allow species to move in to adjoining vegetation of their own volition.
- Nocturnal species which do not immediately move into adjoining vegetation will be captured and kept in a warm, dark and quiet place prior to release within the same vegetation community from which it was captured at night.
- Captured nocturnal animals will be released on the evening of capture and will not be held for extended periods of time.
- Suitable hollows and other habitat structures (including logs, stumps and stags) suitable for relocation to areas not intended for future development or for use in rehabilitation, will be selected by the appropriately qualified and experienced person.
- Hollows intended for re-erection will be removed and then capped with marine plywood or other suitable material.
- Logs, stumps, stags and hollows intended for ground habitat will be cut into sections, as required and relocated to suitable habitat areas.
- In the event that injured fauna are identified, species will be immediately taken to the nearest veterinarian or certified wildlife carer for treatment.

6.5.1 Timing of Clearing

The timing of clearing operations will be designed to reduce the potential impact on breeding species, particularly the squirrel glider and threatened micro-bats. Clearing will (where possible) avoid the winter months when micro-bats are hibernating and the squirrel glider begins breeding.

6.5.2 Replacement of Arboreal Habitat

In the event that hollow-bearing trees are removed as part of subsidence remediation works or the construction of surface infrastructure, the enhancement of arboreal habitat will be achieved through the relocation of salvaged tree hollows and (where required) the establishment of nest boxes in adjacent vegetation communities. Tree hollows lost during clearing activities will be replaced at a ratio of 1:1 using salvaged tree hollows and nest boxes.

Nest boxes have been shown to be effective at providing arboreal habitat at Mt Arthur Coal (Umwelt 2003 and 2005) with a range of species including the common brushtail possum (*Trichosurus vulpecula*), sugar glider (*Petaurus breviceps*) and Australian Owlet nightjar (*Aegotheles cristatus*) recorded in nest boxes across the Mt Arthur Coal site.

6.6 Offset Strategy

As part of the Aboriginal Archaeological Assessment for the Underground Project (Umwelt 2007), Mt Arthur Coal has made a commitment to establish the Saddlers Creek Conservation Area, and to conserve it in perpetuity. This area has been established primarily to offset the impacts of the proposed Underground Project on Aboriginal cultural heritage, however it also

provides the opportunity to conserve significant ecological features, and to offset the impacts of the Underground Project on ecological values.

The likely impacts of the Underground Project on the ecological values of the project area involve the removal of approximately 0.66 hectares Hunter Floodplain Forest Red Gum Woodland Complex for the construction of the access road and overland conveyor (including associated service easements), and the potential impact from subsidence remediation works within approximately 24 hectares of Central Hunter Box – Ironbark Woodland and 24 hectares of Central Hunter Bullock Forest Regeneration (refer to **Figure 5.2**). **Section 6.2.1** identifies management actions to be implemented in order to reduce the potential impact of subsidence remediation works on woodland vegetation, however, there is the potential that some woodland vegetation (most likely to be the ground and shrub layers) will be impacted.

The proposed Saddlers Creek Conservation Area is approximately 295 hectares in size and runs along the southern and south-eastern boundaries of the project area. Most of the length of the creek shows evidence of severe bank and gully erosion, as well as, in parts, impacts from cattle grazing. The tree canopy is dense in places along the creek bank with a very sparse shrub layer. The ground layer is dense and includes many introduced species.

The vegetation of the proposed Saddlers Creek Conservation Area is dominated by Derived Grassland (approximately 212 hectares), Hunter Floodplain Red Gum Woodland Complex (approximately 53 hectares) and Central Hunter box Ironbark Woodland (approximately 29 hectares) (**Figure 3.1**). There are small areas of Aquatic Vegetation located along Saddlers Creek, however these areas are too small to be accurately mapped.

6.6.1 Ecological Significance of Proposed Saddlers Creek Conservation Area

The proposed Saddlers Creek Conservation Area is of ecological significance for a number of reasons, namely:

- **Known threatened species records:** A number of threatened species have been recorded from Saddlers Creek. The eastern cave bat and grey-crowned babbler have been recorded within the proposed Conservation Area, and records from the north-eastern parts of Saddlers Creek (within the Survey Area, however outside of the proposed Conservation Area) include the squirrel glider, eastern freetail-bat, large-footed myotis, and eastern bentwing-bat, all of which are likely to occur in the proposed Conservation Area.
- **Known regionally significant species:** The regionally significant southern forest bat (*Vespadelus regulus*) and inland forest bat (*Scotorepens rueppellii*) have been recorded from this area.
- **Presence of Tree Hollows:** The vegetation along Saddlers Creek provides particular habitat for hollow-dependent species, with a number of hollow-bearing trees being identified during surveys. This is of particular importance as threatened species habitat, as the riparian habitat was recorded as containing more hollow-bearing trees than the remaining habitat types in the Survey Area.
- **Known examples of tiger orchid (*Cymbidium canaliculatum*) Endangered Population:** At least one example of this Endangered Population was recorded from within the proposed Conservation Area. This is currently the only known record of this Endangered Population from the Survey Area, however there is potential that other examples are present.

- **Riparian Corridor:** the proposed Saddlers Creek Conservation Area serves to protect part of an important riparian corridor that contributes greatly to the biodiversity values of the immediate area, as well as the greater Mt Arthur Coal holdings. This corridor allows movement through the project area, and provides connectivity through the landscape in a north-east – south-west direction.
- **Regionally significant vegetation community:** the Hunter Floodplain Red Gum Woodland Complex vegetation community is regionally significant, and has been nominated for listing as an EEC.

The combined value of the significant ecological features of the proposed Saddlers Creek Conservation Area identifies it as an ideal area for the offsetting of the ecological impacts of the Underground Project. The proposed Conservation Area contains approximately 53 hectares, or 70 per cent of the Hunter Floodplain Red Gum Woodland Complex within the Survey Area, easily offsetting the loss of 0.66 hectares of this vegetation community for the construction of the access road and the overland conveyor.

The conservation of the high biodiversity values of the Hunter Floodplain Red Gum Woodland Complex are likely to adequately offset any loss of biodiversity resulting from the potential impact from subsidence remediation works within 35 hectares of woodland vegetation.

6.6.2 Ecological Management of Proposed Saddlers Creek Conservation Area

The following recommendations apply to the ecological management of the proposed Saddlers Creek Conservation Area. Many of these recommended controls overlap with proposed cultural management requirements:

- the proposed Saddlers Creek Conservation Area will be managed and conserved in perpetuity by Mt Arthur Coal;
- ground surface disturbance will not be allowed without approval by the Management Committee established to assist in conservation of archaeological values and Mt Arthur Coal;
- the proposed Saddlers Creek Conservation Area will be fenced and sign-posted to avoid any inadvertent damage from mining activities. The design of new or replacement fencing and materials used will consider potential impacts on native fauna and movement opportunities. Barbed wire will not be used in this new or replacement fencing;
- all stock will be removed from the proposed Saddlers Creek Conservation Area to allow for natural regeneration;
- weed management and feral fauna management will occur within the proposed Saddlers Creek Conservation Area, as required. Any works with the potential to disturb the ground surface will require consultation with the Management Committee; and
- ecological monitoring will occur in the area, as required.

6.7 Monitoring and Maintenance

Mt Arthur Coal currently has an existing ecological monitoring program which is implemented at the site, with the results reported externally in the Annual Environmental Management Report. This program includes monitoring of fauna, remnant vegetation, rehabilitated areas

and the use of nest boxes. The program includes monitoring of remnant vegetation in the vicinity of the project area, as well as two remnant vegetation monitoring sites, within the subsidence impact zone near to Edderton Road.

Proposed additions to the existing monitoring program at Mt Arthur Coal are discussed in the following sections.

6.7.1 Revegetated Areas

Monitoring of any revegetated areas will include annual checks by a suitably qualified and experienced person of the following aspects:

- revegetation germination rates;
- plant health;
- feral animals and the need for their control;
- weed infestation and the need for their control;
- requirements for additional planting to be undertaken;
- need for further fertilisation;
- requirement for application of lime or gypsum to control pH and improve soil structure;
- erosion and the need for repair of eroded areas;
- fire management;
- quality and effectiveness of fencing;
- signs of disturbance, either by animals or humans; and
- success of any management programs implemented following previous monitoring inspections.

In the event that the monitoring reveals unsatisfactory progress in any of these features, recommendations will be provided to rectify the situation.

6.7.2 Monitoring of Vegetation in Subsidence Areas

Monitoring of the condition of vegetation within subsidence affected areas will be undertaken every three years during mining operations in that area to identify any differences in habitat quality in these areas. This monitoring will be undertaken by a suitably qualified and experienced person. The monitoring is to assess the following vegetation characteristics:

- general health of vegetation;
- evidence of natural regeneration;
- occurrence and abundance of weed species;
- signs of disturbance by stock or humans;

- evidence of feral animals; and
- any other observable impacts from the Underground Project.

Two vegetation monitoring sites are proposed within woodland areas subject to subsidence remediation works. Woodland monitoring sites will be selected prior to mining and baseline surveys will be completed for comparison with post-mining monitoring. Particular attention will be paid to identifying any potential impacts from subsidence and subsidence remediation works within this vegetation.

6.7.3 Monitoring of Weeping Myall (*Acacia pendula*)

Due to the ecological significance of the stand of weeping myall (*Acacia pendula*) located within the Survey Area, it will be necessary to monitor the ongoing health and condition of this EEC and Endangered Population on an annual basis, following mining. A baseline survey from which to compare potential impacts will be completed prior to undermining near to this area. This monitoring will be completed by a suitably qualified and experienced person and will focus on the ongoing viability of the stand, particularly documenting:

- general health of stand;
- evidence of natural regeneration;
- occurrence and abundance of weed species;
- signs of disturbance by stock or humans;
- evidence of feral animals; and
- any other observable impacts from the Underground Project.

6.7.4 Fauna Monitoring

Fauna monitoring will be undertaken in selected areas as mining progresses to ensure that subsidence predictions and remediation works do not adversely affected fauna populations and threatened species. Fauna monitoring is currently undertaken at Mt Arthur Coal, in accordance with the recommendations of the MAN Flora and Fauna Management Plan (Umwelt 2001) and the Bayswater Rail Facility Flora and Fauna Management Plan (Umwelt 2002).

One new monitoring site is proposed within an area subject to subsidence remediation works to build on the existing monitoring sites covering the MAN and Bayswater No. 3 mining area, including another site to be impacted by subsidence. At this proposed monitoring site, a range of fauna survey techniques will be employed to determine ongoing use of habitat within the Survey Area, particularly focussing on the ongoing presence of threatened fauna species. It is proposed that fauna monitoring be undertaken once every three years, consistent with remnant vegetation monitoring (refer to **Section 6.6.2**). The types of surveys that will be required to undertake appropriate fauna monitoring may include spotlighting, call playback, herpetological surveys, diurnal bird surveys, Anabat echolocation call detection, and the use of hair funnels to detect terrestrial and arboreal mammals. As the rehabilitated communities mature, the range of fauna monitoring techniques will increase, as microhabitats and niches for a wide range of species become established. Fauna surveys will specifically target threatened species previously recorded, or with potential to occur within the area.

The results of the monitoring will be analysed and compared to previous survey results to determine general population trends. In the event that negative trends are identified indicating the decline of particular threatened species, appropriate amelioration measures will be developed.

In the event that further threatened species are identified within the Survey Area the monitoring program will incorporate surveys to adequately assess and monitor these species.

6.7.5 Nest Box Monitoring

In the event that nest boxes are required as part of the project due to a loss of arboreal habitat through the construction of surface facilities, monitoring of the occupancy of the nest boxes will be undertaken every three years to record the effectiveness of artificial habitat structures. This occupancy monitoring will report on the degree of use of nest boxes, as well as which species are making use of the boxes. As part of this monitoring, the condition of the nest boxes will be inspected to ensure they remain in place within the trees, and are in an appropriate structural condition. This condition monitoring will make recommendations for any maintenance or replacement works that are required.

Occupancy monitoring should be undertaken during spring, where possible, when the use of boxes by nesting bird species can be detected. While mammal species will den in the nest boxes all year, bird species such as parrots using the boxes solely for breeding will only be present for 8 to 12 weeks during early to late spring. All nest box occupancy monitoring should be undertaken by a person with appropriate qualifications and experience to be competent to undertake the work. The condition monitoring of the nest boxes can be undertaken by an appropriately trained mine Environmental Officer. Nest box condition monitoring will be undertaken for the life of the project to prevent loss of boxes through deterioration over time.

The results of nest box occupancy and condition monitoring are to be documented in the Underground Project's annual environmental management report.

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APPENDIX 1

Flora Species List

Appendix 1 – Flora Species List

The following list was developed from surveys of the Survey Area detailed in **Section 2.2** of the main report. It includes all species of vascular plants observed in the Survey Area during fieldwork. The list will not be comprehensive, because not all species are readily detected at any one time of the year. 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; and
- 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 Survey Area;
- subsp. subspecies;
- var. variety;
- f. forma; and
- X hybrid.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000a & 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 2006), the on-line plant name database maintained by the National Herbarium of New South Wales. Names revised since Harden (1992, 1993, 2000 & 2002) are listed in **Section 2.2.1** of the main report.

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.

Family/Subfamily	Scientific Name	Common Name
Filicopsida (Ferns)		
Adiantaceae	<i>Adiantum aethiopicum</i>	common maidenhair
Adiantaceae	<i>Cheilanthes distans</i>	bristly cloak fern
Adiantaceae	<i>Cheilanthes sieberi</i>	poison rock fern
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	poison rock fern

Family/Subfamily	Scientific Name	Common Name
Magnoliopsida (Flowering Plants) – Liliidae (Monocots)		
Anthericaceae	<i>Arthropodium</i> sp.	
Commelinaceae	<i>Commelina ensifolia</i>	scurvy grass
Cyperaceae	<i>Carex inversa</i>	knob sedge
Cyperaceae	<i>Cyperus fulvus</i>	
Cyperaceae	<i>Cyperus gracilis</i>	
Cyperaceae	<i>Cyperus</i> sp.	
Cyperaceae	<i>Fimbristylis dichotoma</i>	common fridge-sedge
Juncaceae	* <i>Juncus acutus</i> subsp. <i>acutus</i>	sharp rush
Juncaceae	<i>Juncus</i> poss. <i>subglaucus</i>	
Juncaceae	<i>Juncus</i> sp.	
Juncaceae	<i>Juncus usitatus</i>	
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	many-flowered mat-rush
Luzuriagaceae	<i>Eustrephus latifolius</i>	wombat berry
Luzuriagaceae	<i>Geitonoplesium cymosum</i>	scrambling lily
Phormiaceae	<i>Dianella caerulea</i>	blue flax-lily
Phormiaceae	<i>Dianella</i> sp.	
Poaceae	<i>Aristida jerichoensis</i>	Jericho wiregrass
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 racemosa</i> var. <i>racemosa</i>	
Poaceae	<i>Austrodanthonia</i> sp.	
Poaceae	<i>Austrostipa scabra</i>	speargrass
Poaceae	<i>Austrostipa</i> sp.	
Poaceae	<i>Austrostipa verticillata</i>	slender bamboo grass
Poaceae	<i>Bothriochloa biloba</i>	
Poaceae	<i>Bothriochloa macra</i>	red grass
Poaceae	<i>Bothriochloa</i> sp.	
Poaceae	* <i>Bromus hordeaceus</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>Eleusine tristachya</i>	goose grass
Poaceae	<i>Elymus scaber</i> var. <i>scaber</i>	common wheatgrass

Family/Subfamily	Scientific Name	Common Name
Magnoliopsida (Flowering Plants) – Liliidae (Monocots)		
Poaceae	<i>*Eragrostis curvula</i>	African lovegrass
Poaceae	<i>Eragrostis leptostachya</i>	paddock lovegrass
Poaceae	<i>Eulalia aurea</i>	silky browntop
Poaceae	<i>Panicum effusum</i>	hairy panic
Poaceae	<i>Panicum queenslandicum</i>	Yadbila grass
Poaceae	<i>Panicum</i> sp.	
Poaceae	<i>*Paspalum dilatatum</i>	paspalum
Poaceae	<i>Paspalum</i> sp.	
Poaceae	<i>Poa labillardieri</i>	tussock
Poaceae	<i>*Setaria gracilis</i>	slender pigeon grass
Poaceae	<i>*Sorghum halepense</i>	Johnson grass
Poaceae	<i>Sporobolus creber</i>	slender rats tail grass
Poaceae	<i>*Stenotaphrum secundatum</i>	buffalo grass
Typhaceae	<i>Typha orientalis</i>	broad-leaved cumbungi
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
Acanthaceae	<i>Rostellularia adscendens</i>	
Aizoaceae	<i>*Galenia pubescens</i>	galenia
Amaranthaceae	<i>*Alternanthera pungens</i>	khaki weed
Amaranthaceae	<i>*Gomphrena celosioides</i>	gomphrena weed
Amaranthaceae	<i>Ptilotus semilanatus</i>	
Apiaceae	<i>*Cyclospermum leptophyllum</i>	slender celery
Apiaceae	<i>Daucus glochidiatus</i>	native carrot
Apiaceae	<i>Hydrocotyle laxiflora</i>	stinking pennywort
Asclepiadaceae	<i>*Gomphocarpus fruticosus</i>	narrow-leaved cotton bush
Asclepiadaceae	<i>*Gomphocarpus</i> sp.	
Asteraceae	<i>*Bidens pilosa</i>	cobblers pegs
Asteraceae	<i>Calotis lappulacea</i>	yellow burr-daisy
Asteraceae	<i>Calotis</i> sp.	
Asteraceae	<i>*Carthamus lanatus</i>	saffron thistle
Asteraceae	<i>Cassinia quinquefaria</i>	
Asteraceae	<i>Cassinia</i> sp.	
Asteraceae	<i>*Chondrilla juncea</i>	skeleton weed
Asteraceae	<i>Chrysocephalum apiculatum</i>	common Everlasting
Asteraceae	<i>*Conyza sumatrensis</i>	tall fleabane
Asteraceae	<i>*Coreopsis lanceolata</i>	coreopsis
Asteraceae	<i>Euchiton ?gymnocephalus</i>	
Asteraceae	<i>Euchiton</i> sp.	
Asteraceae	<i>*Hypochaeris radicata</i>	catsear

Family/Subfamily	Scientific Name	Common Name
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
Asteraceae	<i>Olearia elliptica</i>	sticky daisy bush
Asteraceae	* <i>Onopordum acanthium</i> subsp. <i>acanthium</i>	scotch thistle
Asteraceae	<i>Senecio hispidulus</i> var. <i>hispidulus</i>	
Asteraceae	* <i>Senecio madagascariensis</i>	fireweed
Asteraceae	<i>Sigesbeckia</i> sp.	
Asteraceae	* <i>Sonchus oleraceus</i>	common sowthistle
Asteraceae	* <i>Tagetes minuta</i>	stinking Roger
Asteraceae	* <i>Taraxacum officinale</i>	dandelion
Asteraceae	* <i>Tragopogon porrifolius</i>	salsify
Asteraceae	<i>Vernonia cinerea</i>	
Asteraceae	<i>Vernonia cinerea</i> var. <i>cinerea</i>	
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i> forma <i>cuneata</i>	
Asteraceae	<i>Vittadinia muelleri</i>	
Asteraceae	<i>Vittadinia</i> sp.	
Asteraceae	* <i>Xanthium spinosum</i>	Bathurst burr
Brassicaceae	* <i>Lepidium africanum</i>	
Brassicaceae	<i>Lepidium pseudohyssopifolium</i>	peppercress
Brassicaceae	<i>Lepidium</i> sp.	
Brassicaceae	* <i>Rapistrum rugosum</i>	turnip weed
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</i> sp.	
Caryophyllaceae	* <i>Paronychia brasiliana</i>	Chilean whitlow wort
Caryophyllaceae	* <i>Petrorhagia</i> sp.	
Caryophyllaceae	* <i>Polycarpon tetraphyllum</i>	four-leaved allseed
Caryophyllaceae	<i>Spergularia</i> sp. 3 (syn. <i>S. rubra</i>)	
Casuarinaceae	<i>Allocasuarina luehmannii</i>	bulloak
Casuarinaceae	<i>Casuarina glauca</i>	swamp oak
Chenopodiaceae	<i>Atriplex</i> sp.	
Chenopodiaceae	<i>Einadia hastata</i>	berry saltbush
Chenopodiaceae	<i>Einadia nutans</i>	climbing saltbush
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>linifolia</i>	
Chenopodiaceae	<i>Einadia trigonos</i>	fishweed
Chenopodiaceae	<i>Maireana microphylla</i>	eastern cottonbush
Chloanthaceae	<i>Spartothamnella juncea</i>	
Clusiaceae	<i>Hypericum gramineum</i>	small St Johns wort

Family/Subfamily	Scientific Name	Common Name
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
Convolvulaceae	<i>Convolvulus erubescens</i>	
Convolvulaceae	<i>Dichondra repens</i>	kidney weed
Convolvulaceae	<i>Evolvulus alsinoides</i>	
Crassulaceae	<i>*Bryophyllum delagoense</i>	mother of millions
Dilleniaceae	<i>Hibbertia</i> sp.	
Euphorbiaceae	<i>Breynia oblongifolia</i>	coffee bush
Euphorbiaceae	<i>Chamaesyce ?drummondii</i>	caustic weed
Euphorbiaceae	<i>Phyllanthus</i> sp.	
Euphorbiaceae	<i>Phyllanthus virgatus</i>	
Fabaceae (Faboideae)	<i>Bossiaea rhombifolia</i> subsp. <i>rhombifolia</i>	
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	broom bitter pea
Fabaceae (Faboideae)	<i>Desmodium</i> sp.	
Fabaceae (Faboideae)	<i>Desmodium varians</i>	slender tick-trefoil
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	false sarsaparilla
Fabaceae (Faboideae)	<i>Indigofera australis</i>	Australian indigo
Fabaceae (Faboideae)	<i>Jacksonia scoparia</i>	dogwood
Fabaceae (Faboideae)	<i>*Medicago ?polymorpha</i>	burr medic
Fabaceae (Faboideae)	<i>*Medicago</i> sp.	
Fabaceae (Faboideae)	<i>*Trifolium arvense</i>	haresfoot clover
Fabaceae (Faboideae)	<i>*Trifolium campestre</i>	hop clover
Fabaceae (Faboideae)	<i>*Trifolium repens</i>	white clover
Fabaceae (Faboideae)	<i>*Trifolium</i> sp.	
Fabaceae (Faboideae)	<i>*Vicia</i> sp.	
Fabaceae (Mimosoideae)	<i>Acacia ?parvipinnula</i>	silver-stemmed wattle
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	fan wattle
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	western golden wattle
Fabaceae (Mimosoideae)	<i>Acacia gunnii</i>	ploughshare wattle

Family/Subfamily	Scientific Name	Common Name
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	hickory wattle
Fabaceae (Mimosoideae)	<i>Acacia paradoxa</i>	kangaroo thorn
Fabaceae (Mimosoideae)	<i>Acacia pendula</i>	boree
Fabaceae (Mimosoideae)	<i>Acacia salicina</i>	cooba
Gentianaceae	<i>Centaurium spicatum</i>	spike centaury
Geraniaceae	<i>Erodium</i> sp.	
Geraniaceae	* <i>Geranium dissectum</i>	
Geraniaceae	<i>Geranium</i> sp.	
Goodeniaceae	<i>Goodenia pinnatifida</i>	
Goodeniaceae	<i>Goodenia</i> sp.	
Goodeniaceae	<i>Scaevola humilis</i>	
Lamiaceae	<i>Ajuga australis</i>	austral bugle
Lamiaceae	* <i>Marrubium vulgare</i>	horehound
Lamiaceae	<i>Mentha satureioides</i>	native pennyroyal
Lamiaceae	<i>Salvia</i> sp.	
Linaceae	<i>Linum marginale</i>	native flax
Linaceae	* <i>Linum trigynum</i>	French flax
Lobeliaceae	<i>Pratia purpurascens</i>	whiteroot
Loranthaceae	<i>Amyema</i> sp.	
Malvaceae	<i>Abutilon oxycarpum</i>	flannel weed
Malvaceae	<i>Abutilon</i> sp.	
Malvaceae	<i>Hibiscus sturtii</i>	hill hibiscus
Malvaceae	<i>Hibiscus sturtii</i> var. <i>sturtii</i>	hill hibiscus
Malvaceae	<i>Sida corrugata</i>	corrugated sida
Malvaceae	* <i>Sida rhombifolia</i>	Paddy's lucerne
Malvaceae	<i>Sida</i> sp.	
Myoporaceae	<i>Eremophila debilis</i>	amulla
Myoporaceae	<i>Myoporum montanum</i>	western boobialla
Myrtaceae	<i>Angophora floribunda</i>	rough-barked apple
Myrtaceae	<i>Eucalyptus albens</i> x <i>moluccana</i>	
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 melliodora</i>	yellow box
Myrtaceae	<i>Eucalyptus moluccana</i>	grey box

Family/Subfamily	Scientific Name	Common Name
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
Oleaceae	<i>Notelaea microcarpa</i>	native olive
Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	native olive
Oxalidaceae	<i>Oxalis exilis</i>	
Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	
Plantaginaceae	<i>Plantago debilis</i>	
Plantaginaceae	* <i>Plantago lanceolata</i>	lambs tongues
Polygonaceae	* <i>Polygonum arenastrum</i>	wireweed
Polygonaceae	<i>Rumex brownii</i>	swamp dock
Primulaceae	* <i>Anagallis arvensis</i>	scarlet/blue pimpernel
Ranunculaceae	<i>Clematis glycinoides</i>	headache vine
Ranunculaceae	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	headache vine
Rosaceae	* <i>Rubus fruticosus</i> sp. agg.	blackberry complex
Rosaceae	<i>Rubus parvifolius</i>	native raspberry
Rubiaceae	<i>Canthium buxifolium</i>	stiff canthium
Rubiaceae	<i>Canthium odoratum</i>	shiny-leaved canthium
Rubiaceae	<i>Galium</i> sp.	
Rubiaceae	<i>Opercularia</i> sp.	
Rubiaceae	<i>Richardia</i> sp.	
Rubiaceae	* <i>Richardia stellaris</i>	
Scrophulariaceae	* <i>Linaria pelisseriana</i>	Pelissers toadflax
Scrophulariaceae	<i>Veronica calycina</i>	hairy speedwell
Scrophulariaceae	<i>Veronica</i> sp.	
Solanaceae	* <i>Lycium ferocissimum</i>	African boxthorn
Solanaceae	<i>Solanum brownii</i>	violet nightshade
Solanaceae	<i>Solanum opacum</i>	green-berry nightshade
Solanaceae	<i>Solanum</i> sp.	
Sterculiaceae	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	kurrajong
Thymelaeaceae	<i>Pimelea curviflora</i> var. <i>divergens</i>	
Thymelaeaceae	<i>Pimelea linifolia</i>	
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	
Thymelaeaceae	<i>Pimelea</i> sp.	
Verbenaceae	* <i>Verbena aristigera</i>	
Verbenaceae	* <i>Verbena bonariensis</i>	purpletop
Verbenaceae	<i>Verbena gaudichaudii</i>	
Verbenaceae	* <i>Verbena litoralis</i>	
Verbenaceae	<i>Verbena</i> sp.	
Violaceae	<i>Hymenanthera dentata</i>	tree violet
Vitaceae	<i>Cayratia clematidea</i>	slender grape

APPENDIX 2

Fauna Species List

Appendix 2 - Fauna Species List

The following list was developed from surveys of the Survey Area detailed in **Section 2.3** of the main report. It includes all species of vertebrate fauna observed on the Survey Area during fieldwork.

The following abbreviation or symbols are used to identify the method of detection in the appendix table:

✓	Identified from visual sighting or characteristic call;
S	Identified from scat sample(s) in field;
D	“Definite” identification from scat or hair sample by Barbara Triggs;
C	“Confident” identification by Fly by Night Bat Surveys Pty Ltd;
P	“Probable” identification by Fly by Night Bat Surveys Pty Ltd; and
Po	“Possible” identification by Fly by Night Bat Surveys Pty Ltd.

Any species that could not be identified to the species 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; and
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 Project Area;
subsp.	subspecies;
MAR	Listed marine species under the <i>Environment Protection and Biodiversity Act</i> 1999 (EPBC Act);
MIG	Listed migratory species under the EPBC Act;
V	Vulnerable under Schedule 2 of the <i>Threatened Species Conservation Act</i> 1995 (TSC Act); and
E	Endangered under Schedule 2 of the TSC Act.

Birds recorded were identified using descriptions in Slater et al. (2003) and the scientific and common name nomenclature of Birds Australia. Reptiles recorded were identified using keys and descriptions in Cogger (1994), Swan et al. (2004), Weigel (1990) and Wilson & Swan (2003) and the scientific and common name nomenclature of Cogger (1994).

Amphibians recorded were identified using keys and descriptions in Cogger (1994), Robinson (1998), Anstis (2002) and Barker et al. (1995) and the scientific and common name nomenclature of Cogger (1994). Mammals recorded were identified using keys and descriptions in Strahan (1995), Churchill (1998) and Menkhorst & Knight (2004) and the scientific and common name nomenclature of Strahan (1995) for non-bat species and Churchill (1998) for bats.

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
BIRDS													
Phasianidae													
<i>Coturnix pectoralis</i>	stubble quail		MAR										194
Anatidae													
<i>Cygnus atratus</i>	black swan		MIG										172
<i>Chenonetta jubata</i>	Australian wood duck		MIG										172
<i>Anas superciliosa</i>	Pacific black duck		MIG										172
<i>Anas rhynchotis</i>	Australasian shoveler		MIG										172
<i>Anas gracilis</i>	grey teal		MIG										172
<i>Aythya australis</i>	hardhead		MIG										172
Podicipedidae													
<i>Tachybaptus novaehollandiae</i>	Australasian grebe												194, 172
Accipitridae													
<i>Elanus notatus</i>	black-shouldered kite		MIG									✓	194
<i>Circus assimilis</i>	spotted harrier		MIG	✓									
<i>Aquila audax</i>	wedge-tailed eagle		MIG		✓							✓	40, 172, 193, 188

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
Falconidae													
<i>Falco berigora</i>	brown falcon		MIG										201, 194, 197
<i>Falco longipennis</i>	Australian hobby		MIG										180
<i>Falco cenchroides</i>	nankeen kestrel		MAR & MIG	✓									199, 152, 189, 194, 172, 185
Rallidae													
<i>Gallinula tenebrosa</i>	dusky moorhen												172
<i>Fulica atra</i>	Eurasian coot												172
Charadriidae													
<i>Euseyonis melanops</i>	black-fronted dotterel		MIG										172
<i>Vanellus miles</i>	masked lapwing		MIG									✓	188, 186
Columbidae													
<i>Ocyphaps lophotes</i>	crested pigeon							✓					172
Cacatuidae													
<i>Cacatua roseicapilla</i>	galah				✓				✓		✓	✓	194, 181, 167
<i>Cacatua galerita</i>	sulphur-crested cockatoo							✓				✓	62, 181
Psittacidae													
<i>Glossopsitta pusilla</i>	little lorikeet					✓							
<i>Alisterus scapularis</i>	Australian king-parrot							✓					
<i>Platycercus eximius</i>	eastern rosella				✓	✓	✓	✓	✓	✓	✓	✓	157, 194, 181, 152, 193, 195, 152, 185

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
Cuculidae													
<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo		MAR		✓								
<i>Chrysococcyx lucidus</i>	shining bronze-cuckoo		MAR				✓						
Podargidae													
<i>Podargus strigoides</i>	tawny frogmouth							✓		✓		✓	
Aegothelidae													
<i>Aegotheles cristatus</i>	Australian owlet-nightjar				✓	✓		✓			✓		
Apodidae													
<i>Hirundapus caudacutus</i>	white-throated needletail		MAR & MIG		✓	✓							
Halcyonidae													
<i>Dacelo novaeguineae</i>	laughing kookaburra					✓	✓				✓	✓	
Meropidae													
<i>Merops ornatus</i>	rainbow bee-eater		MAR & MIG			✓							
Maluridae													
<i>Malurus cyaneus</i>	superb fairy-wren			✓	✓		✓		✓			✓	
Pardalotidae													
<i>Pardalotus striatus</i>	striated pardalote				✓	✓	✓	✓				✓	155, 185
<i>Pyrrholaemus sagittata</i>	speckled warbler	V				✓	✓						
<i>Smicrornis</i>	weebill				✓	✓	✓					✓	172

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
<i>brevirostris</i>													
<i>Gerygone mouki</i>	brown gerygone				✓	✓	✓						
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill			✓	✓	✓	✓						172
<i>Acanthiza nana</i>	yellow thornbill					✓	✓				✓		
Meliphagidae													
<i>Philemon corniculatus</i>	noisy friarbird			✓	✓	✓			✓				
<i>Manorina melanocephala</i>	noisy miner				✓	✓	✓	✓	✓	✓	✓	✓	152, 181, 167, 202, 194, 197
<i>Lichenostomus penicillatus</i>	white-plumed honeyeater					✓							
Pomatostomidae													
<i>Pomatostomus temporalis temporalis</i>	grey-crowned babbler (eastern subspecies)	V						✓					
Pachycephalidae													
<i>Pachycephala rufiventris</i>	rufous whistler				✓	✓	✓						
Dicruridae													
<i>Grallina cyanoleuca</i>	magpie-lark		MAR	✓		✓	✓	✓			✓	✓	160, 185, 184
<i>Rhipidura fuliginosa</i>	grey fantail			✓			✓						
<i>Rhipidura leucophrys</i>	willie wagtail					✓	✓		✓		✓		40, 172
Campephagidae													
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike		MAR			✓	✓	✓					151, 152

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
Artamidae													
<i>Cracticus torquatus</i>	grey butcherbird				✓			✓				✓	
<i>Cracticus nigrogularis</i>	pied butcherbird			✓	✓	✓	✓	✓				✓	181, 160, 201, 157, 197
<i>Gymnorhina tibicen</i>	Australian magpie				✓	✓	✓	✓		✓	✓	✓	194, 181, 193, 195, 160, 182, 186, 187, 188, 195, 167, 152, 185, 228, 197
<i>Strepera graculina</i>	pied currawong			✓	✓	✓				✓	✓	✓	193, 181
Corvidae													
<i>Corvus coronoides</i>	Australian raven			✓		✓	✓			✓	✓	✓	40, 160, 182, 152, 186
Corcoracidae													
<i>Corcorax melanorhamphos</i>	white-winged chough												62
Motacilidae													
<i>Anthus novaeseelandiae</i>	Richard's pipit		MAR							✓			194, 186, 188
Passeridae													
<i>Taeniopygia guttata</i>	zebra finch												40
<i>Taeniopygia bichenovii</i>	double-barred finch					✓	✓						172
Dicaeidae													
<i>Dicaeum hirundinaceum</i>	mistletoebird				✓	✓	✓					✓	
Sturnidae													
<i>*Sturnus vulgaris</i>	common starling												160, 186

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
REPTILES													
Cheloniidae													
Chelodina longicollis	snake-necked turtle		MIG	✓									

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
Varanidae													
<i>Varanus varius</i>	lace monitor											✓	
Agamidae													
<i>scincidae</i>	eastern bearded dragon				✓							✓	197
Scincidae													
<i>Carlia tetradactyla</i>	southern rainbow skink				✓							✓	
<i>Ctenotus taeniolatus</i>	copper-tailed skink							✓					
<i>Egernia striolata</i>	tree skink						✓					✓	
Elapidae													
<i>Furina diadema</i>	red-naped snake						✓						
<i>Pseudechis porphyriacus</i>	red-bellied black snake										✓		
AMPHIBIANS													
Myobatrachidae													
<i>Crinia signifera</i>	brown froglet							✓					
<i>Limnodynastes tasmaniensis</i>	spotted marsh frog				✓	✓					✓	✓	193, 195
<i>Uperoleia laevisgata</i>	smooth toadlet					✓					✓		193

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
Hylidae													
<i>Litoria latopalmata</i>	broad-palmed frog						✓						
MAMMALS													
Petauridae													
<i>Petaurus norfolcensis</i>	squirrel glider	V			✓	✓						✓	
Pseudocheiridae													
<i>Pseudocheirus peregrinus</i>	common ringtail possum										✓		
Phalangeridae													
<i>Trichosurus</i> sp.											D	D	
<i>Trichosurus vulpecula</i>	common brushtail possum					✓					✓	✓	
Macropodidae													
<i>Macropus giganteus</i>	eastern grey kangaroo					✓	✓				✓	✓	212, 193, 194, 195, 152, 168, 181, 183, 185, 187, 188, 189, 228
<i>Macropus rufogriseus</i>	red-necked wallaby				✓								

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
Molossidae													
<i>Mormopterus norfolkensis</i>	eastern freetail-bat	V				C		Po					
<i>Mormopterus planiceps</i>	southern freetail-bat							P	P		C		
<i>Mormopterus</i> sp. 2						P					P		
<i>Nyctinomus australis</i>	white-striped freetail-bat										✓		
Vespertilionidae													
<i>Miniopterus schreibersii oceanensis</i>	eastern bentwing-bat	V						C				C	
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat					✓							
<i>Chalinolobus gouldii</i>	Gould's wattled bat				P			P				C	
<i>Chalinolobus morio</i>	chocolate wattled bat					Po		P				C	
<i>Myotis adversus</i>	large-footed myotis	V				P	P	Po				P	
<i>Scoteanax rueppellii</i>	greater broad-nosed bat	V								Po			
<i>Scotorepens balstoni</i>	inland broad-nosed bat							P			C	Po	

Common Name	Scientific Name	Conservation Status		Sites									
		TSC Act	EPBC Act	1 Northern Site	2 Middle Site	3 Southern Site	4 McDonalds Road	5 Saddlers Creek	6 North-western Drainage Line	7 Mt Ogilvie	8 Edderton Road	9 South Pit	Opportunistic Sightings (Map Grid Number)
<i>Vespadelus pumilus</i>	eastern forest bat											✓	
<i>Vespadelus regulus</i>	southern forest bat					Po	Po	C	P	P	P	P	
<i>Vespadelus troughtoni</i>	eastern cave bat	V				P	P					Po	
<i>Vespadelus vulturnus</i>	little forest bat				P		C	C			P	C	
Muridae													
* <i>Mus musculus</i>	house mouse											✓	
* <i>Rattus norvegicus</i>	brown rat							✓			✓		
Canidae													
* <i>Canis familiaris</i>	dog						✓			✓			
* <i>Vulpes vulpes</i>	fox										✓		40, 215
Leporidae													
* <i>Oryctolagus cuniculus</i>	rabbit											✓	193, 215
* <i>Lepus capensis</i>	brown hare						✓					✓	

APPENDIX 3

Threatened Species Impact Assessment – EP&A Act

Appendix 3 - Assessment of Significance under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act)

Significant ecological survey has been completed in the wider Mt Arthur Coal operations area over the past 10-15 years for numerous environmental assessments and ecological monitoring projects (Resource Planning 1993; URS 2000; Umwelt 2006a, 2006b; Umwelt 2005). The information gathered from these surveys has been used in the compilation of potential threatened species lists, survey design, habitat assessments and impact assessment.

Threatened species, endangered populations, or endangered ecological communities (EECs) recorded during the previous surveys and during surveys undertaken within the current Survey Area are listed in **Tables 1** and **2** below, as are the results of the searches of the DEC Atlas of NSW Wildlife and DEH Protected Matters Database. These database searches provided lists of species, populations or EECs previously recorded within a 20 kilometre radius of the Survey Area, or with potential habitat within that radius.

Tables 1 and **2** provides basic information on each potentially occurring threatened species (including specific habitat, distribution, reservation) and provides a basic assessment of a potential impact from the Underground Project. Those species considered to have the potential for a significant impact are addressed in more detail in the 'Assessment of Significance' below. An assessment of significance for species listed under the Commonwealth EPBC Act is provided in **Appendix 4**.

Table 1 - Threatened Flora Assessment

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Ozothamnus tessellatus</i>	V (TSC) V (EPBC)	Dry sclerophyll forest and woodlands.	Restricted to a few locations north of Rylstone. The Survey Area is outside of the known distribution for this species.	Goulburn River NP – 7 records.	This species was not recorded within the Survey Area and is not expected to occur due to its restricted distribution. There is no potential for a significant impact on this species.	No
tricolour diuris <i>Diuris tricolor</i>	V (TSC) PD EP (TSC) V (EPBC)	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 is not known from any conservation reserves in the region.	This species was not recorded during extensive flora surveys undertaken in potential habitat for the species. Despite this, an historical record in the Mt Arthur Coal operations area identifies the likelihood of potential habitat within the Survey Area.	Yes
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 Survey Area is outside of the known distribution for this species.	This species is not known from any conservation reserves in the region.	This species was not recorded within the Survey Area and is not expected to occur due to its restricted distribution. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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 Survey Area is within the known distribution of this species.	Belford NP – 2 records.	The Survey Area is unlikely to provide potential habitat for this species and the species was not recorded during flora surveys. There is no potential for a significant impact on this species.	No
narrow goodenia <i>Goodenia macbarronii</i>	V (TSC) V (EPBC – nominated to de-list)	This species usually occurs in shaded, seasonally damp sites in clay-loam, sandy-loam and sandy soils. Habitats in NSW include a recently graded roadside drain adjacent to <i>Eucalyptus crebra</i> and <i>Callitris glaucophylla</i> woodland, dry eucalypt forest with low shrubby undergrowth in sandy soil, damp sandy patches in bushland areas, along roadsides, near water in a shallow	This species grows on the western slopes of the Great Dividing Range in NSW, south from the Guyra and Inverell districts. It is widely distributed throughout the tablelands, western slopes and western plains. The species also occurs in north-eastern Victoria and the Darling Downs in Queensland. In the	This species is not known from any conservation reserves in the region.	This species was not recorded during extensive flora surveys undertaken in potential habitat for the species. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. While potential habitat is present, it is unlikely this species occurs within the Survey Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
		excavation which has exposed the clay subsoil, on the banks of a sandy creek and in <i>Eucalyptus blakelyi</i> and <i>Angophora floribunda</i> woodland.	Hunter Valley it is known to occur around the Wybong district. The Survey Area is within the known distribution of this species.			
<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 – Gungal area within Merriwa and Muswellbrook LGAs. Three sites are recorded within Goulburn River NP. The Survey Area is within the known distribution of this species.	Goulburn River NP – 3 records.	The Survey Area is unlikely to provide potential habitat for this species and the species was not recorded during flora surveys. There is no potential for a significant impact on this species.	No
<i>Philotheca ericifolia</i>	V (TSC) 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	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	This species is not known from any conservation reserves in the region.	The Survey Area is unlikely to provide potential habitat for this species and the species was not recorded during flora surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
		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>Philotheca australis</i> , <i>Leucopogon muticus</i> and <i>Calytrix tetragona</i> . This species flowers in the spring and produces fruit from November to December.	upper Hunter it grows on exposed rocky outcrops around Scone. The Survey Area is at the margin of the known distribution of this species.			
<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. The Survey Area is within the known distribution of this species.	This species is not known from any conservation reserves in the region.	The Survey Area is unlikely to provide potential habitat for this species and it was not recorded during flora surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	This species is not known from any conservation reserves in the region.	This species was not recorded during extensive flora surveys undertaken in potential habitat for the species. Approximately 45% of potential habitat for this species may be impacted due to the Underground Project, however 55% of potential habitat will remain unaffected within the Survey Area. While potential habitat is present, it is unlikely this species will occur within the Survey Area. There is no potential for a significant impact on this species.	No
<i>Pomaderris reperta</i>	E (TSC) Nominated as E (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. The Survey Area is outside of but close to the limit of this species known distribution.	This species is not known from any conservation reserves in the region.	The Survey Area is unlikely to provide potential habitat for this species and the species was not recorded during flora surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
<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 Survey Area is within the known distribution of this species.	Wollemi NP – 1 record.	The Survey Area is unlikely to provide potential habitat for this species and the species was not recorded during flora surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Isotropsis foliosa</i>	PD V (TSC)	This species often grows in sclerophyll forests on skeletal sites and in the Hunter Valley the species has been recorded on sandy and alluvial soils on ridgelines and hillslopes.	<i>Isotropis foliosa</i> occurs in NSW and Queensland. In NSW, it occurs north of Denman to the Queensland border. It mainly occurs in the NSW bioregions of Nandewar and Sydney Basin, with other records from New England Tableland, NSW North Coast and the Brigalow Belt South bioregions. The Survey Area is within the known distribution of this species.	A very small population of this species is known to occur in Towarri NP near Scone.	The Survey Area is unlikely to provide potential habitat for this species and the species was not recorded during flora surveys. There is no potential for a significant impact on this species.	No
<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 is not known from any conservation reserves in the region.	Recorded in two locations in the Survey Area and is also known from a site adjacent to Edderton Road and the Mt Arthur North access road. The location of <i>Bothriochloa biloba</i> is shown on Figure 3.2 .	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Weeping Myall Woodland	EEC (TSC)	A dense to open tree canopy up to 15 m tall, depending on disturbance and regrowth history. The most common tree is weeping myall (<i>Acacia pendula</i>), which may occur with narrow-leaved ironbark (<i>Eucalyptus crebra</i>), cooba (<i>Acacia salicina</i>) and/or trees within the <i>Acacia homalophylla</i> – <i>Acacia melvillei</i> complex. Understorey shrubs may include stiff canthium (<i>Canthium buxifolium</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>). The shrub stratum is absent from some stands. The groundcover varies from dense to sparse, and is comprised of grasses such as a wallaby grass (<i>Austrodanthonia fulva</i>) and kangaroo grass	Currently known from parts of the Muswellbrook and Singleton LGAs, but may occur elsewhere, including the Upper Hunter LGA.	No known natural remnants/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).	The location of Hunter Valley Weeping Myall Woodland is provided within the vegetation mapping (Figure 3.1), as well as on Figure 3.2 as records for <i>Acacia pendula</i> .	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
		(<i>Themeda australis</i>), and low shrubs and herbs such as common everlasting (<i>Chrysocephalum apiculatum</i>), climbing saltbush (<i>Einadia nutans</i> subsp. <i>nutans</i>), ruby saltbush (<i>Enchylaena tomentosa</i>), eastern cotton bush (<i>Maireana microphylla</i>) and <i>Ptilotus semilanatus</i> .				
Hunter Lowland Redgum Forest	EEC (TSC)	This EEC occurs on the Permian sediments of the Hunter Valley floor. Much of the remaining community is disturbed and fragmented. The floristic composition and structure of the community is influenced by both the size and disturbance history of the remaining fragments. Consequently at heavily disturbed sites only some of the species which characterise the community may be present.	This EEC occurs from Muswellbrook to the Lower Hunter in the Sydney Basin and North Coast bioregions. It has been recorded from the Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton local government areas, but may occur elsewhere in these bioregions. The Survey Area is at the western edge of the known distribution of this EEC.	The nearest mapped occurrence of this community to the Survey Area is off Pamger Drive, just west of the Thomas Mitchell Drive turn off the New England Highway.	This EEC was not recorded within the Survey Area and there is no potential for a significant impact on this EEC.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area 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 Blakely's 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. polyanthemos</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	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 Survey Area is at the eastern edge of the known distribution of this EEC.	There are no known occurrences of this EEC within the conservation reserves of the region.	A detailed agglomerative cluster analysis showed that this EEC is not present within the Survey Area and there is no potential for a significant impact on this EEC.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
		(<i>Austrodanthonia</i> spp.) and spear-grasses (<i>Austrostipa</i> spp.). Shrubs are generally sparse or absent, though they may be locally common.				
White Box - Yellow Box - Blakelys Red Gum Grassy Woodland and Derived Native Grasslands	CEEC (EPBC)	This EEC can occur as either a 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 Blakely's 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 Blakely's 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	The Survey Area is at the eastern edge of the known distribution of this EEC.	Very little of the community is reserved, and these examples tend to be shrubbier and occur on less arable soils. While the community does occur in a number of reserves, most are only small occurrences, and have are often highly modified.	A detailed agglomerative cluster analysis showed that this EEC is not present within the Survey Area and there is no potential for a significant impact on this EEC.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
		also be dominant or co-dominant in the community.				
Weeping Myall – Coobah – Scrub Wilga Shrubland	CEEC (EPBC)	This EEC 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>Canthium buxifolium</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 EEC occurs in a small stand on heavy, brown clay soil at Jerry's Plains in the Hunter Valley, in the South Hunter Province of the Sydney Basin Bioregion. The Survey Area is outside of the known distribution of this EEC.	No known natural remnants/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 EEC was not recorded within the Survey Area and there is no potential for a significant impact on this EEC.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
weeping myall <i>Acacia pendula</i>	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 as far west as Kerrabee, west of Sandy Hollow. <i>Acacia pendula</i> is not known to occur naturally further north than the Muswellbrook-Wybong area. Eight planted <i>A. pendula</i> populations (not naturally occurring) have been recorded in the Hunter, and it is likely that numerous more planted populations occur. The Survey Area is within the range of the population.	No known natural remnants/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).	Weeping myall (<i>Acacia pendula</i>) was recorded at one location within the Survey Area and an additional population was recorded immediately north of the Survey Area along Edderton Road. The location of both of these weeping myall populations are shown on Figure 3.2 .	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
tiger orchid <i>Cymbidium canaliculatum</i>	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. The Survey Area is within the range of the population.	This species is known to occur within Wollemi and Goulburn River National Parks.	A single example of the tiger orchid (<i>Cymbidium canaliculatum</i>) was recorded along Saddlers Creek in the south eastern portion of the Survey Area (Figure 3.2).	Yes
river red gum <i>Eucalyptus camaldulensis</i>	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 Survey Area is within the known distribution of this endangered population.	This species is not known from any conservation reserves in the region.	This endangered population was not recorded within the Survey Area and there is no potential for a significant impact on this endangered population.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
<i>Leionema lamprophyllum</i> subsp. <i>obovatum</i>	PD 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.	There are no records of <i>L. lamprophyllum</i> subsp. <i>obovatum</i> from a conservation reserve in the Hunter Catchment.	This endangered population was not recorded within the Survey Area and there is no potential for a significant impact on this endangered population.	No

Key: TSC = *Threatened Species Conservation Act* 1995;
 EPBC Act = *Environment Protection and Biodiversity Conservation Act* 1999;
 E = Endangered;
 V = Vulnerable;
 PD = Preliminary Determination;
 EEC = Endangered Ecological Community;
 CEEC = Critically Endangered Ecological Community; and
 EP = Endangered Population

Table 2 - Threatened Fauna Assessment

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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 Survey Area is close to 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 Survey Area however potential habitat exists within the farm dams as well as along sections of Saddlers Creek. The Underground Project may impact on small numbers of farm dams within the predicted subsidence impact zone, however any repair work required will not impact on habitat for this species. A large number of farm dams within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No
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	This species is not known from any conservation reserves in the region.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 30% of potential habitat for this species may be impacted due to the Underground Project, however 70% of potential habitat will remain unaffected within the Survey Area. While potential habitat is present, it is very unlikely this species would occur	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
			rare or extinct throughout its former range. The Survey Area is within the known distribution of this species.		within the Survey Area. There is no potential for a significant impact on this species.	
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.	This species is not known from any conservation reserves in the region.	This species was not recorded within the Survey Area during surveys. The Survey Area does not contain preferred habitat features for this species (i.e. dense fringing vegetation surrounding dams). There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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 Survey Area is close to the limit of this species' known distribution.	Barrington Tops NP – 1 record. Goulburn River NP – 2 records. Wollemi NP – 190 records. Yengo NP – 62 records.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. While potential habitat is present, it is unlikely this species will occur within the Survey Area. There is no potential for a significant impact on this species.	No
glossy black-cockatoo <i>Calyptrorhynchus lathamii</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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 19 records. Wollemi NP – 134 records. Yengo NP – 41 records. Barrington Tops NP – 9 records. Mount Royal NP – 8 records.	This species was not recorded within the Survey Area, however potential habitat exists in the form of the secondary feed tree, bullock (Allocasuarina luehmannii). Approximately 10% of potential habitat for this species may be impacted due to the Underground Project. However, a further 90% of potential habitat will remain unaffected for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
grey-crowned babbler <i>Pomatostomus temporalis</i> <i>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.	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 Survey Area is not at the limit of this species' known distribution.	Belford NP – 1 record. Goulburn River NP – 2 records. Wollemi NP – 4 records. Yengo NP – 3 records. It is also known to occur in Belford NP.	This species was recorded within the Survey Area. The Underground Project may impact on approximately 30% of potential woodland habitat for this species. 70% of this habitat within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
brown treecreeper (eastern subsp.) <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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 26 records. Wollemi NP – 39 records. Yengo NP – 3 records.	This species was not recorded within the Survey Area, however potential habitat exists within the woodlands across the Survey Area. Approximately 30% of potential woodland habitat for this species may be impacted due to the Underground Project. 70% of this habitat within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 15 records. Wollemi NP – 83 records. Yengo NP – 17 records.	This species was recorded previously within the Mount Arthur Coal holdings during surveys conducted for the Bayswater No 3 EIS. Potential habitat for this species exists within woodland habitat of the Survey Area. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project. 80% of this habitat within the Survey Area will remain unaffected. There is no potential for a significant impact on this species.	No
swift parrot <i>Lathamus discolor</i>	E (TSC) E (EPBC)	This species often visits box-ironbark forests, feeding on nectar and lerps. In NSW, typical tree species in which it forages include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box.	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 Survey Area is within the known distribution of this species.	Wollemi NP – 2 records.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. While potential habitat is present, it is unlikely this species will occur within the Survey Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
regent honeyeater <i>Xanthomyza phrygia</i>	E (TSC) E (EPBC)	This species 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. An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills.	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 Survey Area is within the known distribution of this species.	Goulburn River NP – 10 records. Wollemi NP – 38 records. Yengo NP – 3 records.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. While potential habitat is present, it is unlikely this species will occur within the Survey Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
hooded robin <i>Melanodryas cucullata cucullata</i>	V (TSC)	This species occupies a range of eucalypt woodlands, acacia shrublands and open forests. In temperate woodlands it favours open areas adjoining large woodland blocks, with areas of dead timber and sparse shrub cover. In semi-arid western NSW, the hooded Robin favours open woodlands of belah, rosewood, mulga and cypress.	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> . The Survey Area is within the known distribution of this species.	Goulburn River NP – 1 record. Wollemi NP – 2 records.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No
speckled warbler <i>Pyrholaemus saggitata</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. The Survey Area is not at the limit of this species' known distribution.	Goulburn River NP – 9 records. Wollemi NP – 40 records. Yengo NP – 11 records.	Three individuals of this species were recorded within the Survey Area. The Underground Project may impact on approximately 20% of potential habitat for this species. 80% of this habitat within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 3 records Wollemi NP – 20 records	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area 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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 2 records. Wollemi NP – 3 records. Yengo NP – 2 records. Barrington Tops NP – 8 records. Mount Royal NP – 4 records.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area 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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 2 records. Wollemi NP – 6 records. Yengo NP – 3 records. Barrington Tops NP – 1 record.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 9 records. Wollemi NP – 32 records. Yengo NP – 9 records. Barrington Tops NP – 8 records. Mount Royal NP – 6 records.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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 Survey Area is within the known distribution of this species.	Wollemi NP – 5 records. Yengo NP – 1 record. Barrington Tops NP – 33 records. Mount Royal NP – 11 records.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 30% of potential habitat for this species may be impacted due to the Underground Project, however 70% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for 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> ,	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	Goulburn River NP – 1 record Wollemi NP – 30 records Yengo NP – 45 records Barrington Tops NP – 21 records	This species was not recorded within the Survey Area, however a known feed tree (<i>Eucalyptus albens/moluccana</i> intergrade) was recorded within the Survey Area. The Survey Area contains potential koala habitat. No evidence of a resident population of koalas was recorded within the Survey Area, and no evidence of koala use was observed. There are no historical or anecdotal records of koalas occurring in the Survey Area, although	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
		<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.	Range. The Survey Area is within the known distribution of this species.	Mount Royal NP – 6 records.	significant numbers have been recorded in the local area and region. There is no potential for a significant impact on this species.	
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 Survey Area is close to the western extent of the known distribution of this species.	Yengo NP – 2 records. Barrington Tops NP – 2 records. Mount Royal NP – 2 records.	The parma wallaby was tentatively recorded on Mt Arthur via predatory scat analysis (URS 2000). Further detail on this record (such as species confirmation and location) was not provided by URS (2000). This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. While potential habitat is present, it is unlikely this species will occur within the Survey Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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.	The brush-tailed rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia. Its distribution roughly followed the Great Dividing Range for 2500km 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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 4 records. Wollemi NP – 73 records. Yengo NP – 19 records. Barrington Tops NP – 1 record.	The Survey Area does not contain suitable habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	Wollemi NP – 14 records. Yengo NP – 4 records. Mount Royal NP – 1 record.	The squirrel glider was identified in the south of the Survey Area in habitats associated with Saddlers Creek (Figure 3.2).	Yes
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. The Survey Area is within the known distribution of this species.	Wollemi NP – 30 records. Yengo NP – 8 records. Barrington Tops NP – 1 record.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 20% of potential habitat for this species may be impacted due to the Underground Project, however 80% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	Wollemi NP – 16 records. Yengo NP – 1 record. Barrington Tops NP – 1 record.	This species was recorded within the Survey Area at three separate locations. Approximately 30% of woodland habitat may be impacted due to the Underground Project. 70% of this habitat within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No
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 bent-wing bats occur along the east and north-west coasts of Australia. The Survey Area is within the known distribution of this species.	Goulburn River NP – 1 record. Wollemi NP – 36 records. Yengo NP – 5 records. Barrington Tops NP – 4 records. Mount Royal NP – 1 record.	This species was recorded within the Survey Area at one location as well as adjacent to the Survey Area. Approximately 30% of woodland habitat may be impacted due to the Underground Project. 70% of this habitat within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 1 record. Wollemi NP – 26 records. Yengo NP – 1 record. Barrington Tops NP – 1 record.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 30% of potential habitat for this species may be impacted due to the Underground Project, however 70% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No
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.	Wollemi NP – 10 records. Yengo NP – 1 record. Barrington Tops NP – 1 record.	This species was recorded within the Survey Area at one location. Approximately 30% of woodland habitat may be impacted due to the Underground Project. 70% of this habitat within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
			The Survey Area is within the known distribution of this species.			
yellow-bellied sheath-tail 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 sheath-tail 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. The Survey Area is within the known distribution of this species.	Wollemi NP – 2 records	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 30% of potential habitat for this species may be impacted due to the Underground Project, however 70% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	Wollemi NP – 2 records.	This species was recorded within the Survey Area on four separate locations. Approximately 30% of woodland habitat may be impacted due to the Underground Project. 70% of this habitat within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area 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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 10 records. Wollemi NP – 1 record.	This species was recorded within the Survey Area on four separate locations. No caves were recorded within the Survey Area therefore there is no roosting habitat, only foraging habitat available for this species. Approximately 30% of woodland habitat may be impacted due to the Underground Project. 70% of this habitat within the Survey Area will remain unaffected by the Underground Project. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region	Occurrence in Survey Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
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. The Survey Area is within the known distribution of this species.	Goulburn River NP – 9 records. Wollemi NP – 79 records. Yengo NP – 21 records.	This species was not recorded during extensive surveys undertaken in potential habitat. Approximately 30% of potential habitat for this species may be impacted due to the Underground Project, however 70% of potential habitat will remain unaffected within the Survey Area. Due to the small amount of potential habitat to be potentially impacted by the Underground Project, there is no potential for a significant impact on this species.	No

Key: TSC = *Threatened Species Conservation Act 1995*;
EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*;
E = Endangered; and
V = Vulnerable.

Part 3A of the EP&A Act requires an assessment of significance relating to the potential impacts of proposed development on listed threatened species, endangered populations or EECs. As a formal assessment method format is yet to be established by the relevant government authorities, an assessment that applies the key principles of the Section 5A assessment has been used to assess the potential for the Underground Project to impact on threatened species, endangered populations or EECs within the Survey Area.

An assessment of significance is provided below for those identified threatened species, endangered populations or EECs considered (within **Tables 1** and **2**) to have the potential to be impacted by the Underground Project. The following species, populations and EEC are assessed:

- tricolour diuris (*Diuris tricolor*);
- squirrel glider (*Petaurus norfolcensis*);
- weeping myall (*Acacia pendula*) Endangered Population;
- tiger orchid (*Cymbidium canaliculatum*) Endangered Population;
- tricolour diuris (*Diuris tricolor*) Preliminary Endangered Population; and
- Hunter Valley Weeping Myall Woodland EEC.

1. Tricolor diuris (*Diuris tricolor*)

Tricolor diuris was not recorded within the Survey Area, however potential habitat for this species exists. This species has previously recorded near to the Survey Area.

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 is sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the far north of NSW. This species grows in sclerophyll forest among grass, often with native cypress pine (*Callitris* spp.). It is found in sandy soils, either on flats or small rises. It has also been recorded from a red earth soil in a bumble box community in western NSW.

Tricolour diuris was not recorded within the Survey Area, however potential habitat exists within the woodland communities across the Survey Area. The majority of general environmental impacts of the Underground Project will arise from the need to remediate subsidence-related surface cracking and the construction and operation of surface infrastructure. The Underground Project may result in disturbance to up to 20% of potential habitat for this species within the Survey Area. Where subsidence remediation is required within woodland areas, actions will be taken to minimise disturbance to these habitats. Surface infrastructure will be located outside of woodland areas, wherever possible. Where disturbance to woodland areas cannot be avoided, due diligence inspections will be conducted to minimise potential impact on significant ecological features. The remaining 80% of potential habitat for this species within the Survey Area will remain unaffected by the Underground Project. It is unlikely that the Underground Project will impact on the lifecycle of this species such that a viable population is placed at risk of extinction.

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- 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 potential subsidence (and associated remediation works) may impact on up to 20% (10 hectares) of Central Hunter Box – Ironbark Woodland within the Survey Area. Peake (2006) identified that there are approximately 14,800 hectares of this vegetation community remaining in the region. It is not expected that the impacts from the Underground Project will significantly alter the quality or extent of woodland habitat within the Survey Area. No significant area of known habitat will be modified or removed, or isolated from currently interconnecting or proximate areas.

Conclusion

The Underground Project is not expected to result in a significant impact on this species. The potential impact from the Underground Project will occur within a small proportion of the potential habitat for this species within the Survey Area, and the impact itself is unlikely to result in the extinction of a local population of the species.

2. Squirrel glider (*Petaurus norfolcensis*)

The squirrel glider was recorded through arboreal mammal trapping within the Survey Area. Eleven individuals were recorded across the fauna survey sites within the Survey Area.

- 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.***

The squirrel glider 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 squirrel glider prefers mixed species stands with a shrub or acacia midstorey, as well as an abundance of tree hollows for refuge and nest sites.

The majority of general environmental impacts of the Underground Project will arise from the need to remediate subsidence-related surface cracking and the construction and operation of surface infrastructure. The Underground Project may result in disturbance to up to 20% of potential habitat for this species within the Survey Area. Where subsidence remediation is required within woodland areas, actions will be taken to minimise disturbance to these habitats. Surface infrastructure will be located outside of woodland areas, wherever possible. Where disturbance to woodland areas cannot be avoided, due diligence inspections will be conducted to minimise potential impact on significant ecological features. The remaining 80% of potential habitat for this species within the Survey Area will remain unaffected by the Underground Project. The mobile nature of the squirrel glider will allow it to access large areas of connected habitat within the Survey Area as well as the wider Mt Arthur Coal operations area. It is unlikely that the Underground Project will impact on the lifecycle of the squirrel glider such that a viable population is 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 potential subsidence (and associated remediation works) may impact on up to 20% (10 hectares) of Central Hunter Box – Ironbark Woodland within the Survey Area. Peake (2006)

identified that there are approximately 14,800 hectares of this vegetation community remaining in the region. It is not expected that the impacts from the Underground Project will significantly alter the quality or extent of woodland habitat within the Survey Area. No significant area of known habitat will be modified or removed, or isolated from currently interconnecting or proximate areas.

Conclusion

The Underground Project is not expected to result in a significant impact on this species. The potential impact from the Underground Project will occur within a small proportion of the potential habitat for this species within the Survey Area, and the impact itself is unlikely to result in the extinction of a local population of the species.

3. Weeping Myall (*Acacia pendula*) Endangered Population

The weeping myall population identified within the south western corner of the Survey Area covers an area of approximately 0.1 ha, and contains between 20 and 50 individuals.

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

The weeping myall endangered population occurs as a disjunct population of fewer than 1000 individuals in the Hunter Valley. This Hunter population is known to occur as far east as Warkworth, and extends north-west to Muswellbrook and to the west of Muswellbrook at Wybong. Weeping myall occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations.

The majority of general environmental impacts of the Underground Project will arise from the need to remediate subsidence-related surface cracking and the construction and operation of surface infrastructure. The weeping myall population within the Survey Area occurs outside of (although close to) the predicted subsidence impact area. The low level of predicted subsidence is not expected to cause tree death. Provisions have been made to protect this population and to ensure that any subsidence remediation works required in the vicinity of the population will be completed by hand, rather than by machinery. The Underground Project will not significantly impact the lifecycle of the species (*Acacia pendula*) that constitutes the endangered population such that the viability of the population is likely to be significantly compromised.

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.*

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.

The endangered population of this species already exists within a highly fragmented landscape. While the Underground Project may require works within up to 20% of Central Hunter Box – Ironbark Woodland, 25% of Derived Grassland and 10% of Central Hunter Bulloak Forest Regeneration within the Survey Area for surface infrastructure and remediation works, this will not impact on the weeping myall population, nor increase its existing fragmentation or isolation.

Conclusion

The Underground Project is not expected to result in a significant impact on this Endangered Population. The potential impact from the Underground Project will occur near to the known occurrence of this Endangered Population, however is not expected to result in an impact on this population.

4. Tiger orchid (*Cymbidium canaliculatum*) Endangered Population

The tiger orchid (*Cymbidium canaliculatum*) was recorded as a single specimen located along Saddlers Creek in the south-eastern corner of the Survey Area.

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

Tiger orchid has a scattered distribution in northern and eastern Australia from northeast NSW, through Queensland and the Northern Territory to Western Australia. In NSW it occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees. Within the Hunter Catchment the tiger orchid is most commonly found in *Eucalyptus albens* (white box)-dominated woodlands, usually occurring singly or as a single clump, typically between two and six metres above the ground. It has been found, less commonly, to grow on slaty box (*Eucalyptus dawsonii*), narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*Eucalyptus moluccana*), rough-barked apple (*Angophora floribunda*), cooba (*Acacia salicina*) and on some other tree species.

The majority of general environmental impacts of the Underground Project will arise from the need to remediate subsidence-related surface cracking and the construction and operation of surface infrastructure. The tiger orchid population within the Survey Area occurs outside of the predicted subsidence impact area. The Underground Project will not significantly impact the lifecycle of the species that constitutes the endangered population such that the viability of the population is likely to be significantly compromised.

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.*

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

The endangered population of this species already exists within a highly fragmented landscape. While the Underground Project may require the removal of up to 20% of Central Hunter Box – Ironbark Woodland, 25% of Derived Grassland and 10% of Central Hunter Bulloak Forest Regeneration within the Survey Area for surface infrastructure and remediation works, this will not increase the existing fragmentation or isolation of this endangered population.

Conclusion

The Underground Project is not expected to result in a significant impact on this Endangered Population. The potential impact from the Underground Project is not expected to occur near to the single occurrence of this Endangered Population within the Survey Area.

5. Tricolour diuris (*Diuris tricolor*) Endangered Population

This species has not been recorded in any of the ecological surveys completed within, or near to, the Survey Area by Umwelt, however it is known to occur close to the MAN access road (DEC Atlas of NSW Wildlife 2006a). This previous record would represent part of the preliminarily-listed endangered population within the Muswellbrook LGA.

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

Tricolor diuris is sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the far north of NSW. This species grows in sclerophyll forest among grass, often with native cypress pine (*Callitris* spp.). It is found in sandy soils, either on flats or small rises. This species also has been recorded from a red earth soil in a bumble box community in western NSW.

The population of *Diuris tricolor* in the Muswellbrook local government area (LGA) comprises a number of occurrences, ranging from a few scattered individuals to a few thousand individuals (NSW Scientific Committee 2006b). The area of occupancy of the population is c. 200 km² in the Muswellbrook LGA. Therefore, the geographic distribution of the population is estimated to be highly restricted.

The DEC Atlas of NSW Wildlife (DEC 2006a) has identified a record of tricolour diuris within the Mt Arthur Coal operations area, in A171, close to the MAN access road. It has not, however, been recorded in any of the ecological surveys completed within, or near to the Survey Area by Umwelt. Despite this, the known record of this species (DEC 2006a) would form part of the proposed endangered population of this species within the Muswellbrook LGA.

The majority of general environmental impacts of the Underground Project will arise from the need to remediate subsidence-related surface cracking and the construction and operation of surface infrastructure. The known tricolour diuris record falls outside of the predicted subsidence impact area. The Underground Project will not significantly impact the lifecycle of the species that constitutes the endangered population such that the viability of the population is likely to be significantly compromised.

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 population of *Diuris tricolor* in the Muswellbrook LGA comprises a number of occurrences, ranging from a few scattered individuals to a few thousand individuals. The area of occupancy of the population is c. 200 km² in the Muswellbrook LGA (NSW Scientific Committee 2006b). Therefore, the geographic distribution of the population is estimated to be highly restricted.

The endangered population of this species already exists within a highly fragmented landscape. While the Underground Project may require the removal of up to 20% of Central Hunter Box – Ironbark Woodland, 25% of Derived Grassland and 10% of Central Hunter Bullock Forest Regeneration within the Survey Area for surface infrastructure and remediation works, this will not increase the existing fragmentation or isolation of this endangered population.

Conclusion

The Underground Project is not expected to result in a significant impact on this species. The potential impact from the Underground Project will occur within a small proportion of the potential habitat for this species within the Survey Area, and the impact itself is unlikely to result in the extinction of a local population of the species.

6. Hunter Valley Weeping Myall Woodland Endangered Ecological Community

The Hunter Valley Weeping Myall Woodland EEC identified within the south western corner of the Survey Area covers an area of approximately 0.1 ha, and contains between 20 and 50 individuals.

- 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.***

The Hunter Valley weeping Myall woodland of the Sydney Basin bioregion is currently known from parts of the Muswellbrook and Singleton LGAs. The most common tree is weeping myall (*Acacia pendula*), which may occur with narrow-leaved ironbark (*Eucalyptus crebra*) and cooba (*Acacia salicina*).

The majority of general environmental impacts of the Underground Project will arise from the need to remediate subsidence-related surface cracking and the construction and operation of surface infrastructure. The weeping myall woodland within the Survey Area falls outside of (although close to) the predicted subsidence impact area. The degree of predicted subsidence is not expected to cause tree death. Provisions have been made to protect this population and to ensure that any subsidence remediation works required in the vicinity of the population will be completed by hand, rather than by machinery. This EEC already exists within a highly fragmented landscape and it is considered that the Underground Project will not modify, remove or isolate an area of known habitat for this EEC from currently interconnecting or proximate areas.

Conclusion

The Underground Project is not expected to result in a significant impact on this EEC. The occurrence of this EEC within the subsidence affectation area is outside the predicted subsidence remediation impact zone and is not predicted to be significantly adversely impacts. The Underground Project is therefore unlikely to result in the extinction of a local population of this EEC.

Key Threatening Processes

- a) *Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.***

There are currently 31 key threatening processes (KTPs) (including those pending finalisation) listed under the TSC Act. Of these, a number have been discounted from this assessment, due to their irrelevance to the Survey Area. The remaining KTPs are listed below, with a discussion on their relevance to the Underground Project, and the likelihood of the project causing an increase in the incidence of these processes within the Survey Area.

Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands: This is recognised as a major factor contributing to loss of biological diversity and ecological function in aquatic ecosystems, including floodplains.

The minor drainage lines located within the predicted subsidence impact zone may require works to repair potential cracking in the beds of the drainage lines. The drainage lines within this zone are highly ephemeral, and were not observed to contain ponded water or specific riparian vegetation.

Bushrock removal: Bushrock removal is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation. Bushrock removal destroys and/or disturbs habitat of native species, which may find shelter in or under rocks, may use rocks for basking, or which grow in rocky areas.

The Underground Project is not expected to cause disturbance to surface areas, except where subsidence-related cracking requires remediation. The majority of these works are expected to occur in the grassland habitats, with any works required within woodland areas being completed by small machinery (or by hand) to reduce disturbance. These works may require the removal or relocation of bushrock from specific areas, however this is not expected to be a common requirement. It is unlikely that activities associated with the Underground Project will cause an increase in the incidence of this KTP within the Survey Area, or locality in general.

Clearing of native vegetation: Parts of the Survey Area have already been impacted by historic clearing for agricultural purposes, selective logging, tracks/roads and mining exploration. Clearing of native vegetation is recognised as a major factor contributing to loss of biological diversity.

Clearing within the Survey Area will only be necessary for subsidence-remediation works, or the construction of surface infrastructure. The majority of subsidence remediation works are expected to occur within the grassland habitats. Where remediation works are required within the woodland habitats, small machinery and hand tools will be used to minimise disturbance to vegetation. The placement of surface infrastructure will occur in grassland areas wherever possible, and it is not expected that significant areas of vegetation will be removed for surface infrastructure. It is expected that no removal of mature trees will be required for such works. The Underground Project is likely to require the removal of small amounts of native vegetation, equating to a small increase in the incidence of this KTP. This is, however, is not likely to result in the loss of biodiversity in the Survey Area.

Invasion of native plant communities by exotic perennial grasses: A number of exotic perennial grasses invade and may dominate native plant communities. The resulting changed structure and fire regimes of the habitat are likely to adversely impact on both native vertebrate and invertebrate fauna. This may result in local and regional declines of many native species and communities, possibly to the extent that they become endangered. Many of the perennial exotic grasses establish following disturbances such as overgrazing, road works and management of roadside areas. Spread of these grasses is often aided by slashing, weed control, forestry and mining operations, movement or addition of fertilisers and nutrients, changes to drainage and fire regimes.

The Survey Area already contains exotic perennial grasses that range in density from sparse, to dense in some areas. Thus, this KTP is already operating within the Survey Area. It is expected that rehabilitation of disturbed areas within the Survey Area may require a mix that includes native and (where necessary) non-native species found in the local area. This may include the use of exotic perennials and/or improved pasture species. This may result in an increase the prevalence of these species within the Survey Area. It is likely that ecological

monitoring of rehabilitated areas, as well as remnant vegetation, and management actions such as weeding and revegetation will control and manage the incidence of this KTP in the Survey Area.

Removal of dead wood and dead trees: The accelerated and ongoing removal of standing dead trees and woody debris on the ground caused by human activity has been recognised as a factor contributing to loss of biological diversity. The removal of dead wood, either standing or fallen, can cause the broad-scale change of woodlands into paddocks with isolated standing trees, with little natural understorey and no woody debris on the ground. Removal of dead wood and dead trees may seriously affect the long term availability and viability of habitat.

The Underground Project may require the limited removal or relocation of fallen dead wood from within areas requiring subsidence remediation, or for the construction of surface infrastructure. If necessary, the removal of dead trees will occur as required by the Mt Arthur Coal pre-clearance survey and clearing procedure. This will limit the potential impact on native fauna, including threatened species.

Loss of hollow-bearing trees: this KTP has recently been preliminarily listed. The Underground Project may result in the loss of hollow-bearing trees from the construction of the conveyor, or potentially (albeit unlikely) as a result of subsidence remediation works. This will result in a small increase in the incidence of this KTP within the Survey Area. This impact will be addressed by the implementation of the MAN pre-clearing survey and clearing procedure, and the installation of an equivalent number of nest boxes to hollows lost within nearby secure vegetation. The maintenance and monitoring of these nest boxes will be in accordance with the ecological monitoring program.

APPENDIX 4

Threatened Species Impact Assessment – EPBC Act

Appendix 4 – Assessment of Significance under *Environment Protection and Biodiversity Conservation Act 1999*

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), approval from the Commonwealth Minister for Environment and Heritage 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; and
- Nuclear actions.

A search of the DEH Protected Matters Search Tool (DEH 2006) identified (discounting fishes and marine species) two threatened ecological communities, 23 threatened species and seven migratory species considered likely to occur, on the basis of habitat modelling, within a 20 kilometre radius of the Survey Area. Those species and ecological communities with potential habitat on the Survey Area are shown in **Table 1** below, accompanied with an assessment of the potential for these species to occur within the Survey Area. No invertebrate species were listed on the DEH Protected Matters database within a 20 kilometre radius.

Table 1 - Species Listed Under the EPBC Act Potentially Occurring within 20 Kilometres of Survey Area (DEH 2006)

Common Name	Scientific Name	Classification	Potential to Occur
green and golden bell frog	<i>Litoria aurea</i>	Threatened Species	No
Littlejohn's tree frog	<i>Litoria littlejohni</i>	Threatened Species	No
broad-headed snake	<i>Hoplocephalus bungaroides</i>	Threatened Species	No
Australian painted snipe	<i>Rostratula benghalensis australis</i>	Threatened Species	No
swift parrot	<i>Lathamus discolor</i>	Threatened Species Listed Marine Species	Yes
regent honeyeater	<i>Xanthomyza phrygia</i>	Threatened Species Migratory Terrestrial Species	Yes
spotted-tailed quoll (SE mainland)	<i>Dasyurus maculatus maculatus</i>	Threatened Species	Yes
brush-tailed rock-wallaby	<i>Petrogale penicillata</i>	Threatened Species	No
grey-headed flying-fox	<i>Pteropus poliocephalus</i>	Threatened Species	Yes
greater long-eared bat	<i>Nyctophilus timoriensis</i>	Threatened Species	Yes
large-eared pied bat	<i>Chalinolobus dwyeri</i>	Threatened Species	Yes

**Table 1 - Species Listed under the EPBC Act Potentially Occurring within
20 Kilometres of Survey Area (DEH 2006) (cont)**

Common Name	Scientific Name	Classification	Potential to Occur
rainbow bee-eater	<i>Merops ornatus</i>	Listed Marine Species	Recorded in Project Area
cattle egret	<i>Ardea ibis</i>	Listed Marine Species	Yes
great egret	<i>Ardea alba</i>	Listed Marine Species	Yes
white-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	Migratory Terrestrial Species Listed Marine Species	No
white-throated needletail	<i>Hirundapus caudacutus</i>	Migratory Terrestrial Species Listed Marine Species	Recorded in Project Area
black-faced monarch	<i>Monarcha melanopsis</i>	Migratory Terrestrial Species Listed Marine Species	Yes
satin flycatcher	<i>Myiagra cyanoleuca</i>	Migratory Terrestrial Species Listed Marine Species	Yes
Japanese snipe	<i>Gallinago hardwickii</i>	Migratory Wetland Species Listed Marine Species	No
painted snipe	<i>Rostratula benghalensis s. lat.</i>	Migratory Wetland Species Listed Marine Species	No
fork-tailed swift	<i>Apus pacificus</i>	Listed Marine Species	Yes
white-flowered wax plant	<i>Cynanchum elegans</i>	Threatened Species	No
finger panic grass	<i>Digitaria porrecta</i>	Threatened Species	No
tricolor diuris	<i>Diuris tricolor</i>	Threatened Species	Yes
slaty red gum	<i>Eucalyptus glaucina</i>	Threatened Species	No
	<i>Lasiopetalum longistamineum</i>	Threatened Species	No
	<i>Olearia cordata</i>	Threatened Species	No
	<i>Ozothamnus tessellatus</i>	Threatened Species	No
rufous pomaderris	<i>Pomaderris brunnea</i>	Threatened Species	No
	<i>Prostanthera cryptandroides</i>	Threatened Species	No
	<i>Rulingia procumbens</i>	Threatened Species	No
austral toadflax	<i>Thesium australe</i>	Threatened Species	Yes
Wollemi pine	<i>Wollemia nobilis</i>	Threatened Species	No
	Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley	Threatened Ecological Community	No
	White Box – Yellow Box – Blakelys Red Gum Grassy Woodlands and Derived Native Grasslands	Threatened Ecological Community	No

In addition to the above species, expert knowledge of the Survey Area and its surrounds, suggests the following species should also be considered:

- *Commersonia rosea*;
- *Goodenia macbarronii*; and
- *Pomaderris reperta*;

There is no potential habitat for these species within the habitats recorded in the Survey Area, and none of these species were recorded during surveys. These species will not be further addressed in this assessment.

Bothriochloa biloba did not appear on the search of the DEH Protected Matters Search Tool (DEH 2006), however is assessed below, due to its recorded presence within the Survey Area.

An assessment of significance has been completed below for those species recorded within the Survey Area, or considered to have potential to be significantly impacted by the Underground Project.

In addition to these listed migratory species, **Table 2** identifies those species listed under the Japan/Australia Migratory Bird Agreement (JAMBA) and China/Australia Migratory Bird Agreement (CAMBA) and Bonn Agreement lists that have been recorded within the Survey Area.

Table 2 - JAMBA/CAMBA and Bonn Agreement Species Recorded within Survey Area

Family/Common Name	Scientific Name
Phasianidae	
stubble quail	<i>Coturnix pectoralis</i>
Anatidae	
black swan	<i>Cygnus atratus</i>
Australian wood duck	<i>Chenonetta jubata</i>
Pacific black duck	<i>Anas superciliosa</i>
Australasian shoveler	<i>Anas rhynchotis</i>
grey teal	<i>Anas gracilis</i>
hardhead	<i>Aythya australis</i>
Accipitridae	
black-shouldered kite	<i>Elanus notatus</i>
spotted harrier	<i>Circus assimilis</i>
wedge-tailed eagle	<i>Aquila audax</i>
Falconidae	
brown falcon	<i>Falco berigora</i>
Australian hobby	<i>Falco longipennis</i>
nankeen kestrel	<i>Falco cenchroides</i>
Charadriidae	
black-fronted dotterel	<i>Elseyaornis melanops</i>
masked lapwing	<i>Vanellus miles</i>
Cuculidae	
fan-tailed cuckoo	<i>Cacomantis flabelliformis</i>

Table 2 - JAMBA/CAMBA and Bonn Agreement Species Recorded within Survey Area (cont)

shining bronze-cuckoo	<i>Chrysococcyx lucidus</i>
Apodidae	
white-throated needletail	<i>Hirundapus caudacutus</i>
Meropidae	
rainbow bee-eater	<i>Merops ornatus</i>
Dicruridae	
magpie-lark	<i>Grallina cyanoleuca</i>
Campephagidae	
black-faced cuckoo-shrike	<i>Coracina novaehollandiae</i>
Motacilidae	
Richard's pipit	<i>Anthus novaeseelandiae</i>
Cheloniidae	
snake-necked turtle	<i>Chelodina longicollis</i>

These are non-threatened species that are not listed on the DEH Protected Matters Database. They are, however, listed under the Schedules of the JAMBA/CAMBA and Bonn Agreements as marine or migratory species, and require consideration in the impact assessment. As such, a general assessment of the potential impact of the Project on these species has been provided below.

One threatened flora species, *Bothriochloa biloba*, was recorded during vegetation surveys within the Survey Area. One additional species, *Diuris tricolor*, is also considered to potentially occur in the Survey Area due to the presence of suitable habitat, and a historical record from near to the Survey Area. This species was not recorded despite targeted surveys for the Underground Project.

Two EPBC database listed migratory species, the white throated needletail (*Hirundapus caudacutus*) and the rainbow bee-eater (*Merops ornatus*), were recorded within the Survey Area and are assessed below. A further 20 non EPBC-listed migratory species were identified during field surveys. These 20 species are generally commonly occurring species and further assessment under the EPBC Act is not required.

An action requires approval from the Minister for the Environment & Heritage if the action has, will have, or is likely to have a significant impact on any matter of NES. An assessment of whether or not a significant impact occurs is undertaken using a test of significance.

The test of significance for Vulnerable, Migratory and JAMBA/CAMBA species is included below.

Vulnerable Species

Bothriochloa biloba was recorded within the Survey Area during the surveys. *Diuris tricolor* is considered to have potential habitat within the Survey Area. An assessment according to the DEH principal significant impact guidelines is provided below for these species.

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal; or
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

Neither of the recorded or potentially occurring threatened species are considered to comprise important populations, as defined above. Neither of the species were identified as key populations for breeding or dispersal or for maintaining genetic diversity. Only *Diuris tricolor*, which was not identified in the Survey Area, is considered to be at the eastern limit of its distribution in the local area.

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; or**

Bothriochloa biloba was recorded within the Survey Area and *Diuris tricolor* is known to occur within the Mt Arthur Coal operations area. Approximately 30% of the existing woodland vegetation and 25% of the existing grassland vegetation within the Survey Area may be subject to subsidence remediation works. As these works are not likely to remove or modify significant areas of habitat for these species, it is not likely that the Underground Project will result in a long term decrease in the size of an important population of a threatened species.

- **reduce the area of occupancy of an important population; or**

Approximately 30% of the existing woodland vegetation and 25% of the existing grassland vegetation within the Survey Area may be subject to subsidence remediation works. The Survey Area does not support an important population of *Bothriochloa biloba* or *Diuris tricolor*, and the Underground Project will not result in the significant reduction in the area of occupancy of these species.

- **fragment an existing important population into two or more populations; or**

The Underground Project will not lead to the fragmentation of an existing important population of *Bothriochloa biloba* or *Diuris tricolor* into two or more populations.

- **adversely affect habitat critical to the survival of a species; or**

The habitats occurring within the Survey Area are not considered to form critical habitat for the survival of *Bothriochloa biloba* or *Diuris tricolor*.

- **disrupt the breeding cycle of an important population; or**

The Underground Project is not expected to disrupt the breeding cycle of an important population of *Bothriochloa biloba* or *Diuris tricolor*.

- **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 Underground Project is unlikely to result in a significant reduction in the availability or quality of habitat for *Bothriochloa biloba* or *Diuris tricolor* such that the species are likely to decline. Significant areas of potentially suitable habitat are located widely across the Mt Arthur Coal operations area.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; or;**

The Underground Project is not expected to result in the introduction of any invasive species which may be detrimental to *Bothriochloa biloba* or *Diuris tricolor* or their habitat.

- **interferes substantially with the recovery of the species.**

The Underground Project will not result in the loss of important habitat for *Bothriochloa biloba* or *Diuris tricolor*, and is not expected to substantially interfere with the recovery of these species.

Migratory Species

The EPBC-listed migratory species white-throated needletail (*Hirundapus caudacutus*) and rainbow bee-eater (*Merops ornatus*) were recorded within the Survey Area. In addition to this, a number of JAMBA/CAMBA or Bonn Agreement species were recorded within the Survey Area (**Table 2**). An assessment according to the significant impact criteria is provided.

An area of important habitat is:

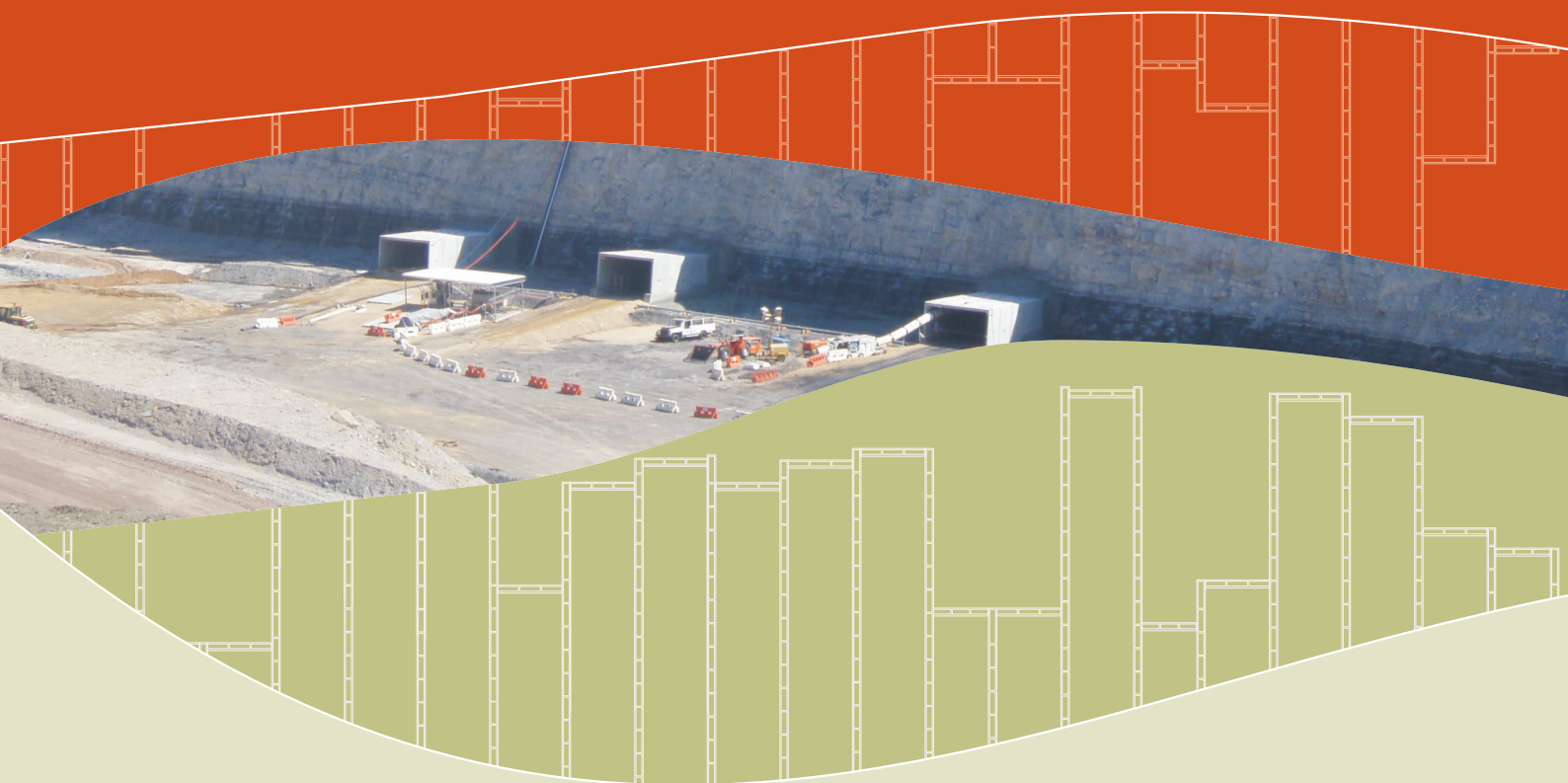
- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; or
- habitat that is of critical importance to the species at particular life-cycle stages; or
- habitat utilised by a migratory species which is at the limit of the species range; or
- habitat within an area where the species is declining.

The white-throated needletail (*Hirundapus caudacutus*) and rainbow bee-eater (*Merops ornatus*) were recorded within the Survey Area. In addition to this, a number of JAMBA/CAMBA or Bonn Agreement species were recorded within the Survey Area. Records of these species are distributed broadly across NSW, with no obvious concentrations of records in the local area to suggest the presence of an ecologically significant proportion of the entire population of these species. The Survey Area is not at the limit of the known distribution for these species, nor is there any evidence to suggest these species are declining in the local area. It is unlikely that the Survey Area forms an area of important habitat for the white-throated needletail (*Hirundapus caudacutus*) and rainbow bee-eater (*Merops ornatus*), nor the JAMBA/CAMBA or Bonn Agreement species that were recorded within the Survey Area.

Conclusion

From the assessment of significance, it is concluded that the Underground Project will not pose a significant impact on matters of NES as listed under the Schedules of the EPBC Act.

The Underground Project is not a controlled action, and will not require referral to the Minister for determination.



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