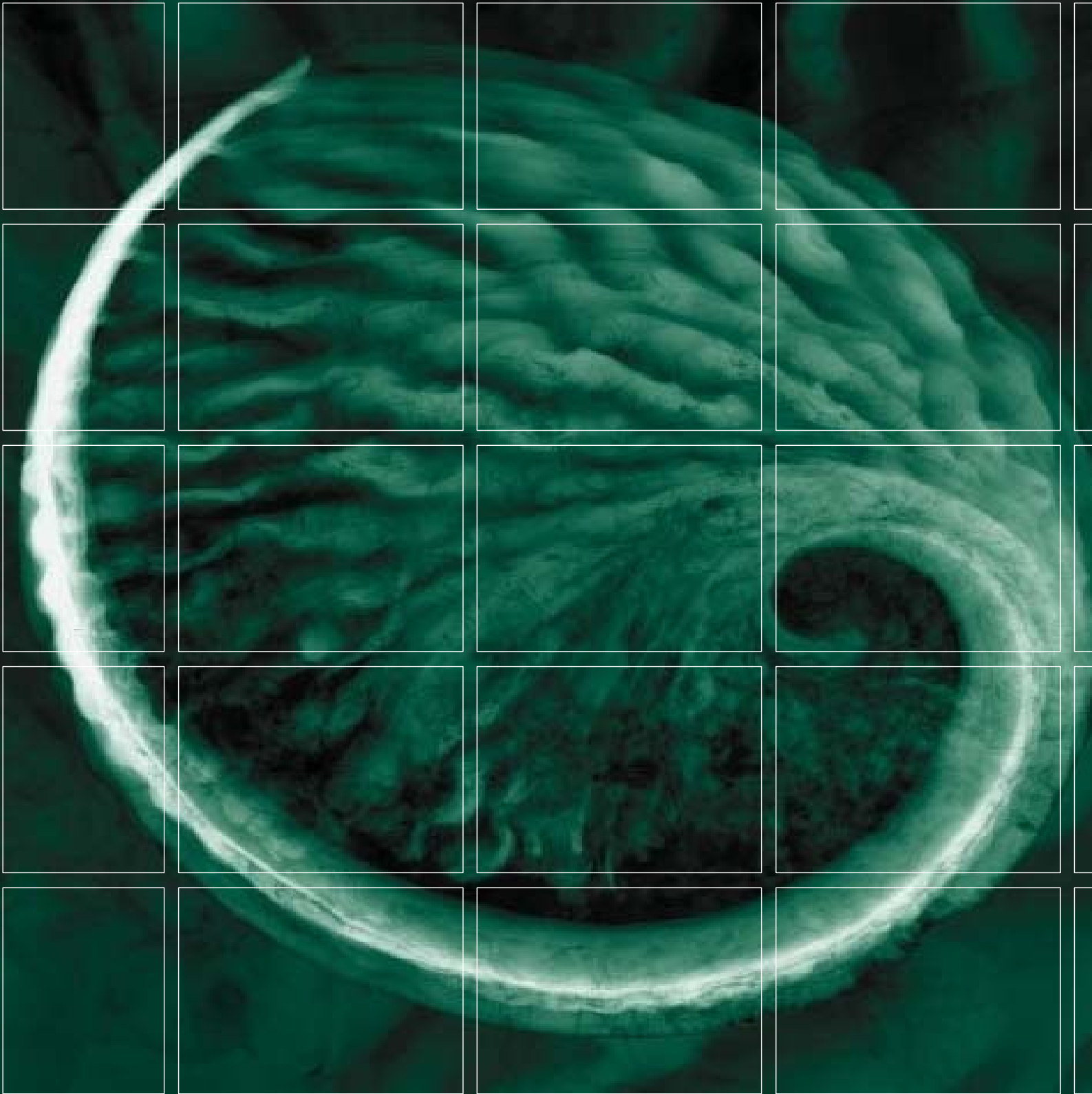




**Flora and Fauna Assessment
(ERM, 2006a)**



**Glennies Creek Mine
Longwalls 10 to 17**
Flora and Fauna Assessment

Integra Coal Operations Pty Ltd

April 2007

0047481 Final

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Approved by:	<u>Joanne Woodhouse</u>
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Date:	<u>18 April, 2007</u>

Environmental Resources Management Australia Pty Ltd Quality System

Glennies Creek Mine Longwalls 10 to 17 *Flora and Fauna Assessment*

Integra Coal Operations Pty Ltd

April 2007

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GLOSSARY OF TERMS

Angle of draw	The angle between the vertical and the line joining the edge of the mining void with the limit of vertical subsidence, usually taken as 20mm.
Application Area	The surface area that is likely to be affected by the proposed underground mining. As a minimum it is defined by the depth of cover, angle of draw of 26.5 and the limit of the proposed extraction area.
Depth of Cover	The depth of the roof of the coal seam from the ground measured in metres.
Goaf	The mined out area into which the immediate roof strata break.
Longwall Panel	
Subsidence	Mining induced movements and deformations at the ground surface where: - the vertical downward surface movements are greater than 20mm; or - the potential impacts on major surface infrastructure and/or natural features may be significant, notwithstanding that the vertical downward surface movements are less than 20mm.
Tilt	Change in slope of the surface landform as a result of underground mining.
Vertical Subsidence	Vertical downward movements of the ground surface caused by underground coal mining.
Critical habitat	Habitat declared to be critical under Part 3 of the TSC Act.
Arboreal	Adapted for living in and/or moving around in trees.
Threatened Species	A plant or animal identified in the TSC Act or EPBC Act as extinct, critically endangered, endangered, or vulnerable. This term may be extended to encompass threatened species, populations or ecological communities.
Endangered	A species, population or ecological community that is likely to become extinct or is in immediate danger of extinction.
Endangered species	Species identified in Part 1 of Schedule 1 of the TSC Act.
Vulnerable	A species or ecological community that is rare, not presently endangered but likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Vulnerable species	Species identified in Part 1 of Schedule 2 of the TSC Act.
Ecological community	An assemblage of native species that inhabits a particular area.
Exotic species	A non-indigenous species.
Habitat	An area or areas occupied or periodically occupied by a species, population or ecological community and includes any biotic or abiotic component.
Hollow-bearing tree	Tree where the base, trunk or limbs contain hollows, holes or cavities that have formed as a result of decay, injury or other damage.
threatening process	A process that threatens, or may threaten the survival, abundance or evolutionary development of species, populations or ecological communities.
Key threatening process	Threatening process identified as such in Schedule 3 of the TSC Act.
Community	The recognisable association of species that regularly occur together in similar environments.
Indigenous	Native to, or originating in, a particular region or country.
Understorey	Vegetation which grows below the canopy of a forest or woodland.
Groundcover	Structural layer closest to the ground containing grasses, forbs, ferns, sub-shrubs, and sedges.
Myrtaceous	Trees and shrubs of the Myrtaceae family. This includes eucalypts, paperbarks and bottlebrushes.
Riparian	Associated with drainage lines.
Littoral	Associated with the shoreline.
Site	Area directly affected by the project
Study area	The site and any additional areas that may be affected by the proposal either directly or indirectly.
Native or Indigenous	Species that existed in NSW before European settlement.
Clearing	Clearing of native vegetation is defined in the <i>Native Vegetation Act 2003</i> as any one or more of the following: <ul style="list-style-type: none"> • cutting down, felling, thinning, logging or removal; • killing, destroying, poisoning, ringbarking, uprooting or burning
Regrowth vegetation	Defined in the <i>Native Vegetation Act 2003</i> as any native vegetation that has regrown since 1 January 1990 (or 1

January 1983 Western Division). Excluding regrowth after illegal clearing or natural events such as bushfire, floods and drought.

Extinct

Critically endangered

BioMetric Microsoft Excel-based tool for assessing terrestrial biodiversity in particular threatened species, soils, water quality and salinity in preparation of Property Vegetation Plans under the *Native Vegetation Act 2003*.

Derived communities Vegetation type that are secondary to a community.

Native groundcover or understorey Is where at least 50% of the perennial vegetation cover in the groundcover strata or understorey is made up of native species and not less than 10% of the area is covered with vegetation (dead or alive).

Derived grassland Derived grasslands occur where the tree or shrub cover of the grassy woodland has been removed and the understorey is predominantly native species. Derived grassland qualifies as an ecological community when it is greater than 0.1 hectares and native species dominate the perennial vegetation with at least 12 native, non-grass understorey species (forbs, shrubs, ferns and sedges). At least one understorey species should be an important species (eg grazing-sensitive, regionally significant or uncommon).

Remnant vegetation Any native vegetation that is not regrowth.

Endangered ecological community Ecological community specified as endangered under Commonwealth or State legislation.

Vulnerable ecological community Ecological community specified as vulnerable under Part 2 of Schedule 2 of the TSC Act.

ABBREVIATIONS

°C	degrees Celsius
µm	micrometres (ie. 10 ⁻⁶)
ABS	Australian Bureau of Statistics
AEMR	Annual Environmental Management Report
AEP	Annual Exceedance Probability
AHC	Australian Heritage Commission
AHD	Australian Height Datum
Al ₂ O ₃	aluminium oxide
AMCI	AMCI Holdings Australia Pty Ltd
AMR	Annual Environmental Management Report
ASS	acid sulfate soils
Boral	Boral Resources (Country) Pty Limited
CAMBA	China - Australian Migratory Birds Agreement
CaO	calcium oxide
CHPP	Coal Handling and Preparation Plant
CKPoM	Comprehensive Koala Plan of Management
CL	Coal Lease
CMA	Catchment Management Authority
DA	Development Application
DEC	Department of Environment and Conservation (NSW)
DEC	Department of Environment and Conservation (NSW) including the Parks and Wildlife Division, Cultural Heritage Division and Environment Protection and Regulation Division.
DEH	Department of Environment and Heritage (Commonwealth)
DMR	Department of Mineral Resources
DNR	Department of Natural Resources (NSW)
DoP	Department of Planning (NSW)
DPI	Department of Primary Industries
ECRTN	Environmental Criteria for Road Traffic Noise
EIS	Environmental Impact Statement
EP&A Act	<i>Environmental Planning and Assessment Act, 1979</i>
EP&A Regulation	Environmental Planning and Assessment Regulation, 2000
EPA	Environment Protection Authority (NSW)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act, 1999</i>
ERM	Environmental Resources Management Australia Pty Ltd
ESD	Ecologically Sustainable Development
GCC	Glennies Creek Colliery

GCCM	Glennies Creek Coal Management
GPa	
ha	hectares
HREP	Hunter Regional Environmental Plan, 1989
HVCC	Hunter Valley Coal Corporation
HVRF	Hunter Valley Research Foundation
ISCM	
JAMBA	Japan - Australian Migratory Bird Agreement
km	kilometres
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
LHCCREMS	Lower Hunter and Central Coast Regional Environmental Management Strategy
m	metres
m/s	metres per second
MCMPR	Ministerial Council on Mineral and Petroleum Resources
MDL	Mineral Deposits Limited
ML	Mining Lease
mm	millimetres
mm/m	millimetres per metre
MMC	Maitland Main Collieries Pty Ltd
MOP	Mine Operations Plan
MPa	mega Pascals
MSB	Mine Subsidence Board
Mt	million tonnes
Mtpa	Million tonnes per annum
NATA	National Association of Testing Authorities Australia
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NV Act	<i>Native Vegetation Act, 2003</i>
OH&S	Occupational Health and Safety
PASS	potential acid sulfate soils
POEO Act	<i>Protection of the Environment Operations Act, 1997</i>
PSC	Port Stephens Council
R&FI Act	<i>Rivers and Foreshores Improvement Act, 1948</i>
ROM	Run of Mine (raw coal prior to crushing and washing.
ROTAP	Rare or Threatened Australian Plant

RTA	Roads and Traffic Authority
SEPP	State Environmental Planning Policy
SMP	Subsidence Management Plan
sp.	species
subsp.	sub-species
tpa	tonnes per annum
TSC Act	<i>Threatened Species Conservation Act, 1995</i>
WM Act	<i>Water Management Act, 2000</i>
RFS	Rural Fire Services (NSW)

1 INTRODUCTION

1.1 BACKGROUND

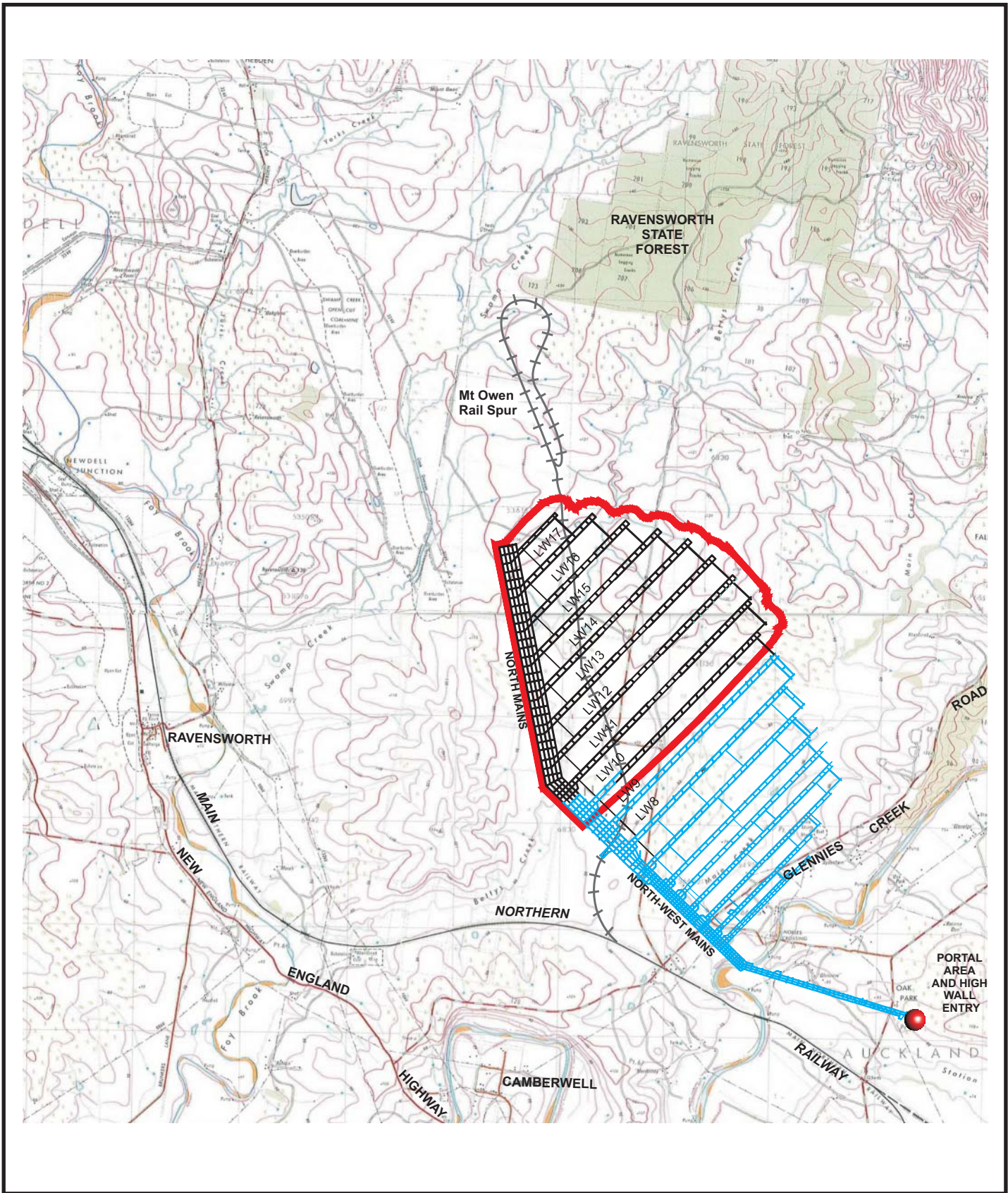
Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by Glennies Creek Coal Management (GCCM) to prepare an application under Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) to bring the extraction of Longwall Panels 10 to 17 of the Middle Liddell seam together with associated underground development and transportation activities at the Glennies Creek Colliery (GCC). This report provides an assessment of the potential impacts to flora and fauna and their habitats arising from the extraction of Longwall Panels 10 to 17 (refer to *Figure 1.1*). The assessment has been prepared based on the Guidelines for Threatened Species Assessment under Part 3A prepared by the Department of Environment and Conservation (DEC) and Department of Primary Industries (DPI).

The diversion of Bettys Creek over Longwall panels 14 to 17 and the development of the Eastern Rail Pit planned by the Mt Owen Mine have been taken into consideration in this assessment. These activities, which will extend into the Longwall 10 to 17 Application Area within the timeframe of the proposed longwall mining activities, have been shown in *Figure 1.2*. Given the timing of these activities, the assessment of Bettys Creek and associated habitats has assumed that the natural state of the creek will have been altered above Longwalls 14 to 17 prior to the commencement of the proposed underground mining activities.




1.2 OBJECTIVES OF THE REPORT

The objectives of the flora and fauna assessment are to provide information to the determining authority on how the development will:

- maintain or improve biodiversity values;
- conserve biological diversity and promote ecologically sustainable development;
- protect areas of high conservation value (if present);
- prevent the extinction of threatened species (if present);
- protect the long-term viability of local populations of a threatened species, population or ecological community (if present); and
- protect aspects of the environment that are matters of national environmental significance as defined by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (if present).



Legend

-  Study Area
-  Existing Mine Workings
-  Proposed Mine Workings (Mains and Gateroads)

Client:	Integra Coal Operations Pty Ltd
Project:	Env. Assessment Glennies Creek Part 3A
Drawing No:	0047481hv_eol_rev_01
Date:	17/04/07 Drawing size: A4
Drawn by:	JD Reviewed by: JW
Source:	1:25000 Topo Series, Camberwell Sheet
Scale:	Refer to Scale Bar

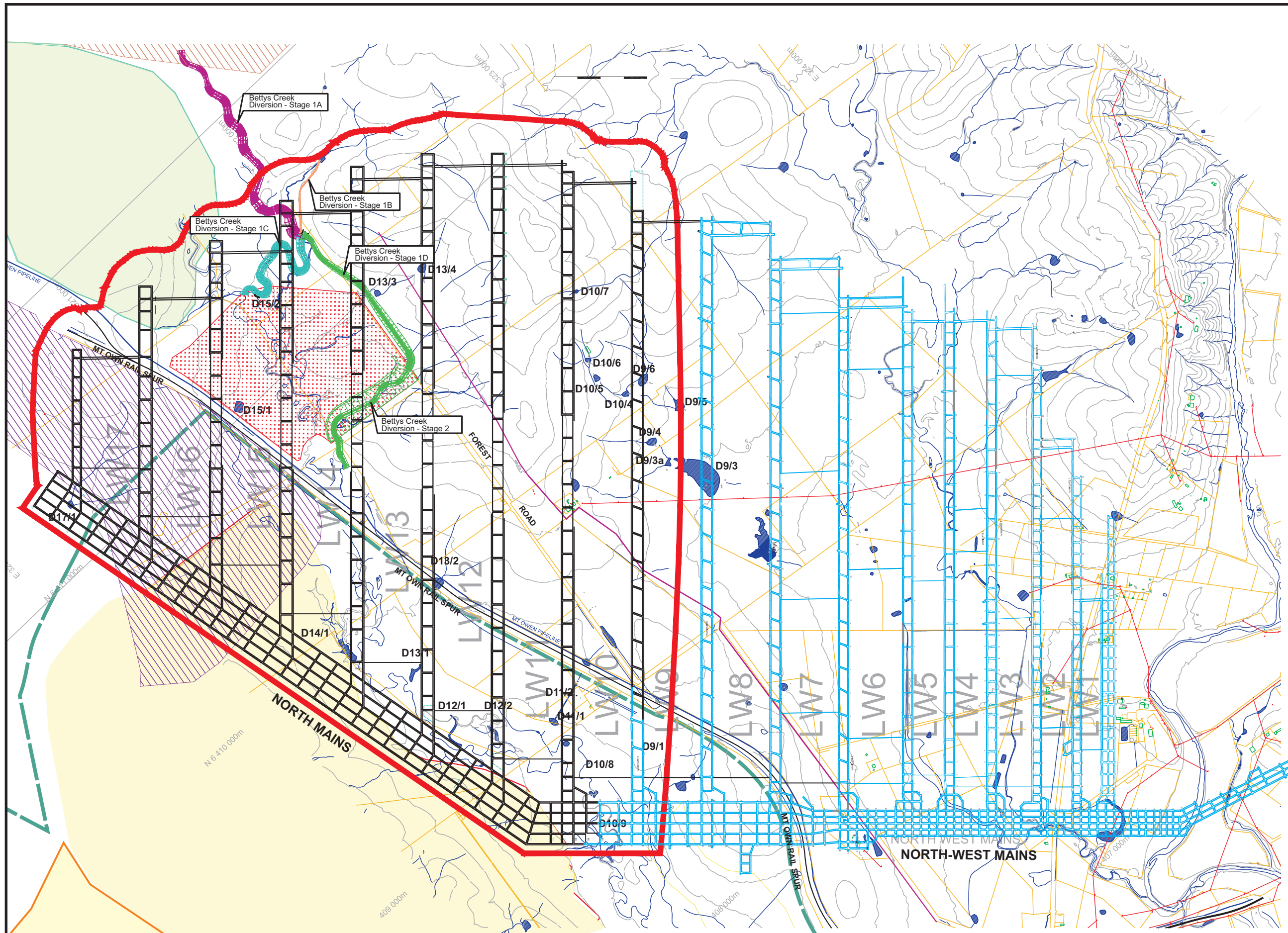


Figure 1.1

Locality Plan

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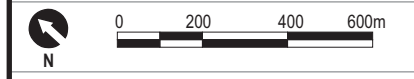




- Legend**
- Project Area
 - Existing Mine Workings
 - Proposed Mine Workings (Mains and Gateroads)
 - ~ Waterway
 - Surveyed Dam
 - Fences
 - Powerline
 - Telstra Cable
 - Fences
 - Mt. Owen Eastern Rail Pit
 - Ravensworth East Pit
 - West Dump
 - Mt. Owen Extension
 - Glendell Open Cut
 - Glendell Emplacement Area
 - Glendell DA Boundary
 - Existing Buildings

Figure 1.2
Existing and Proposed Mining Activities

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_Ecol_rev_02		
Date:	16/04/07	Drawing size:	A3
Drawn by:	SP	Reviewed by:	JW
Source:	Glennies Creek Coal Management		
Scale:	Refer to Scale Bar		



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To meet these objectives, the desktop assessment and field investigations aim to:

- identify and describe the conservation significance of vegetation communities and flora species;
- identify and describe the conservation significance of fauna habitats and fauna species;
- assess the type and degree of impacts of the planned longwall mining and related activities on the flora and fauna in the Application Area, and on any threatened species, populations and ecological communities likely to occur; and
- identify mitigation measures to avoid impacts, minimise the extent of mining-induced impacts on flora and fauna or offset strategies.

1.3

DESCRIPTION OF THE APPLICATION AREA

The Application Area comprises an area of approximately 600 ha located above Longwall Panels 10 to 17 within the Glennies Creek Coal Lease (CL) 382, approximately 3 kilometres (km) north-east of Camberwell and 12 km north of Singleton in the Hunter Valley, NSW. The Application Area is defined by a 26.5° angle of draw from the extremities of the longwall panels to be extracted.

The Application Area is dominated by grazed pastures. The existing Xstrata-owned Mt Owen open cut coal mine is located immediately north of CL 382 but will extend into the Application Area with the development of the Eastern Rail Pit. Development of the Eastern Rail Pit will necessitate the diversion of Bettys Creek within the Application Area.

The topography of the site is variable, with the ephemeral Main Creek located to the south-east and Bettys Creek, and associated alluvial flats, located within the northern and western portions of the Application Area. Remnant areas of open forest are located throughout, although grazed pasture dominates.

The main surface improvement within the Application Area is the Mt Owen Rail Line and its associated infrastructure. Other surface features located within the Application Area are Forest Road, farm fences, farm dams, an underground Telstra cable, an overhead powerline, sheds and a disused residence (structure).

The soils within the study area belong to the Bayswater and Hunter soil landscapes. The Bayswater soil landscape is formed on undulating low hills from in-situ weathered sandstone, shale, mudstone, conglomerate and coal. Slopes within this landscape are susceptible to moderate sheet and gully erosion and the soils are moderately alkaline to moderately acidic (Kovac and Lawrie 1991:84-85). Soils of the Hunter soil landscape are alluvial and

deposited in association with the floodplains along Glennies and Bettys Creeks. The alluvium and clays associated with this soil landscape are weakly to moderately alkaline (Kovac and Lawrie 1991:212-213).

1.4 *AGRICULTURAL LAND SUITABILITY*

NSW Agriculture's Agricultural Land Classification system has been used to classify the agricultural suitability of the land within the Longwalls 10 to 17 Application Area. All lands within the Application Area have been assessed to be Class 3 lands, defined as "grazing land or land well suited to pasture improvement" (Hume *et al*, 2002). Class 3 lands in the area have been further defined as 3p (pastures) or 3c (cultivation).

1.5 *DESCRIPTION OF THE PROPOSAL*

The layout of the Glennies Creek Colliery workings is shown in *Figure 1.2* including the completed mine workings, main roadways and gateroads, the current area of extraction and the proposed longwall panels. Longwalls 7 to 9 are covered by an existing Subsidence Management Plan (SMP) and section 138 approval under the *Coal Mine Regulations Act 1982* (CMR Act). The area covered by this assessment lies wholly within CL 382.

Longwall Panels 10 to 17 are oriented in a north-east to south-west direction and the main headings are oriented in a north north-westerly direction. The longwall panels will be approximately 250 metres (m) wide and range in length from 470 to 2550 m. The chain pillars that separate each panel will approximate 42 to 48 m in width and 100 m in length.

Overburden depths within the Application Area vary from 380 m over Longwall 10 up to 500 m over Longwalls 13 and 14. The mining section ranges from 2.2 to 2.4 m thick and is typically around 2.3 m.

The proposal includes the installation of approximately four gas drainage boreholes per longwall panel to manage gas levels in the mine. The exact location of these gas boreholes is flexible but will avoid clearance of trees and shrubs. Each borehole will disturb an area of approximately eight metres by eight metres. Each area will be fenced and include infrastructure such as a venting stack and a fire suppression unit. Under normal circumstances only three to four boreholes will be active at any given time. Once each borehole is no longer required, the infrastructure will be removed, and the area rehabilitated.

2.1 LITERATURE REVIEW

Various sources of published information are available on the flora and fauna for the study area and surrounding areas. The following were reviewed in the preparation of this assessment

- ERM (2005) Glennies Creek Mine Longwall Panels 7 to 9 – Flora and Fauna Assessment. Prepared for Glennies Creek Coal Management, June 2005.
- ERM Mitchell McCotter (1995) Mount Owen Rail Project Statement of Environmental Effects. Prepared for BHP Australia Coal, October 1995.
- Forest Fauna Surveys (2003) Mt Owen Operations Species Impact Statement. Prepared for Hunter Valley Coal Corporation, December 2003.
- Umwelt (2003a) Mt Owen Environmental Impact Statement. Prepared for Hunter Valley Coal Corporation, December 2003.
- Umwelt (2003b) Flora and Fauna Assessment Longwall Panels Three to Six. Prepared for Glennies Creek Coal Management Pty Ltd, August 2003.

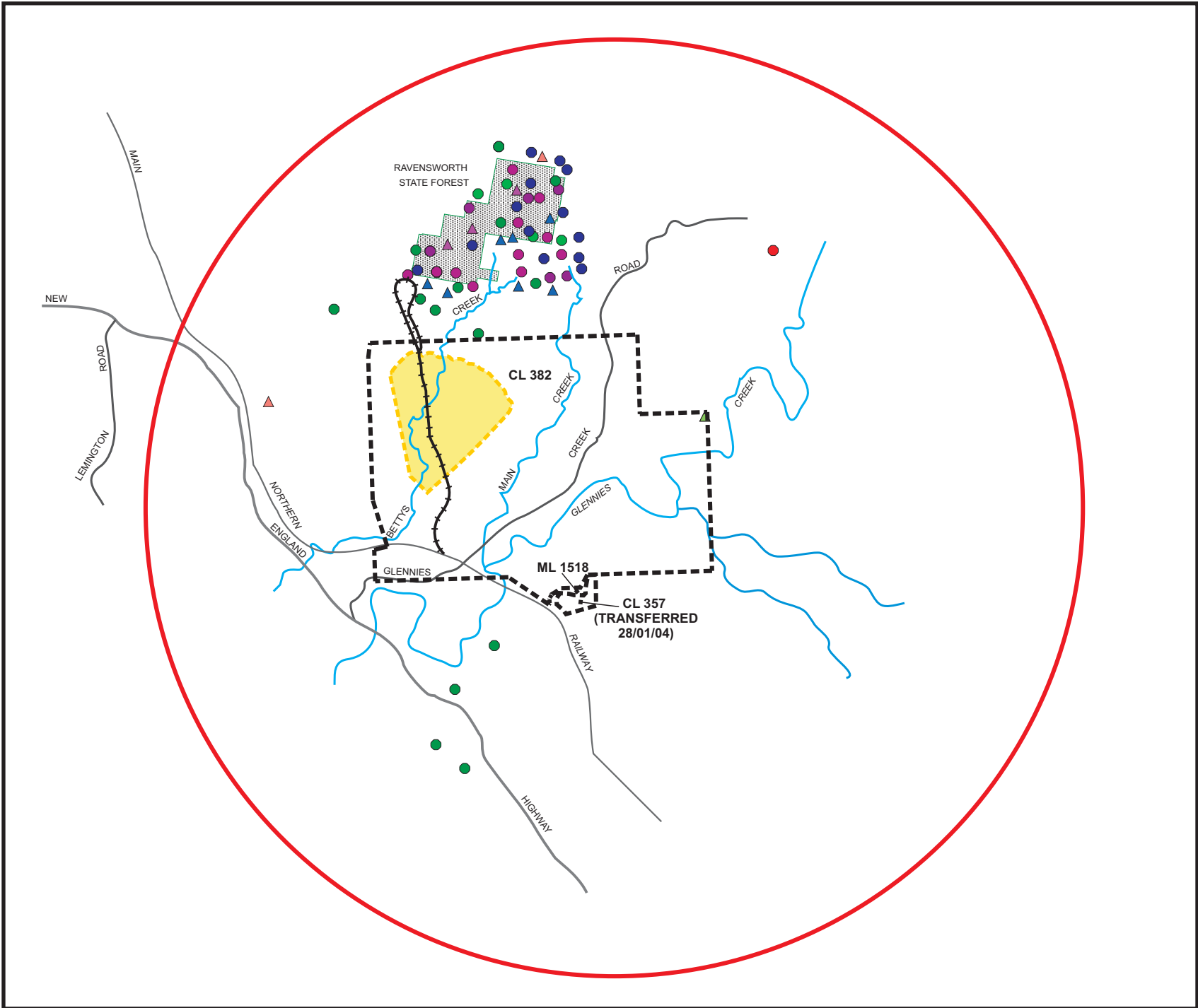
Due to accessibility issues associated with the operational areas of the Mt Owen open cut mine, the results of the Mt Owen EIS (Umwelt 2003a) have been referred to within this assessment for these areas. These results were confirmed where possible during the site inspections.

A search of the DEC Wildlife Atlas database was conducted for all recent records of threatened flora and fauna (see *Figure 2.1*) within a 10 km radius of the Application Area. A search of the on-line database maintained by the Commonwealth Department of the Environment and Heritage (DEH) was also conducted in order to identify the likely presence of nationally listed threatened and migratory species in the locality.

All flora and fauna database records were analysed to determine the likelihood that threatened flora and fauna could occur within habitats on site. It should be noted, however, that the DEH database search is based on habitat requirements rather than actual records, and the assessment is based on those listed species likely to be within the Application Area.

2.2 FLORA SURVEY METHODOLOGY

Broad vegetation communities within and adjacent to the site were initially identified and mapped using aerial photography, and subsequently verified using random meander transects to sample vegetation within the areas of open forest, riparian corridors, pasture and small dams. All vascular plant



Legend

- Barking Owl
- Black-chinned Honeyeater (eastern subsp.)
- Brown Treecreeper
- Diamond Firetail
- Eastern Bent-wing Bat
- Grey-crowned Babbler (eastern subsp.)
- Hooded Robin
- ▲ Masked Owl
- ▲ Red Goshawk
- ▲ Speckled Warbler

- ▭ Application Area
- ▭ State Forest Areas
- 10km Search Radius
- +—+—+—+— Mt Owen Rail Spur
- ▭ Glennies Creek Coal Lease 382, Coal Lease 357 & Mine Lease 1518

Figure 2.1
Threatened Fauna Species Records within 10km of the Study Area

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_Ecol_rev_03		
Date:	13/04/07	Drawing size:	A4
Drawn by:	SP	Reviewed by:	JW
Source:	NPWS Atlas Data (DEC)		
Scale:	Refer to Scale Bar		



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species within 10 m of each transect were identified and recorded, as well as the height and percentage cover of the dominant species within each structural layer. Plant species names follow Harden (1992, 1993, 2000 and 2002). The disturbance history was noted to determine the severity and timing of fire, grazing, logging/clearing, dumping and weeds.

2.3 *FAUNA SURVEY METHODOLOGY*

An assessment of the diversity and general habitat value of the site was undertaken by appraising the extent of likely habitat; searching for secondary indications of threatened species and incidental observations. Field surveys were undertaken in February and December 2005 and January 2006. Considered in this assessment were the:

- area occupied by each habitat within the site;
- continuity with similar habitat adjacent to the site, or connection with similar habitat outside the site by way of corridors;
- percentage cover of nesting/shelter/basking sites such as tree hollows, leaf litter, ground exposures, rocks, logs, vegetation, caves, rock outcrops, overhangs and crevices;
- presence of freshwater aquatic habitats such as streams, swamps and pools;
- cover abundance of dominant canopy species; and
- extent and nature of previous disturbances.

The presence of flowering eucalypts and other plants was recorded as these may provide foraging resources for threatened species such as squirrel gliders and honeyeaters.

Habitat use by fauna was documented through analysis of tracks, scats, diggings, feathers and other traces. Surveys were conducted opportunistically and included:

- searches for whitewash, prey remains and owl pellets;
- searches for obvious nests of raptors;
- investigation of any possible den sites for the tiger quoll;
- searches for characteristic scats, tracks and diggings; and
- checking trees for scratches consistent with their use by arboreal mammals.

3.1 FLORA SURVEYS

3.1.1 Vegetation Communities

The study area has been considerably disturbed by land clearing and grazing and most of the site is cleared of native forest. Five vegetation communities (spotted gum/grey box/ironbark woodland, bull oak woodland, riparian vegetation, grassland and regenerating vegetation) were identified within the study area as indicated on *Figure 3.1*.

i. Spotted Gum/Grey Box/Ironbark Woodland

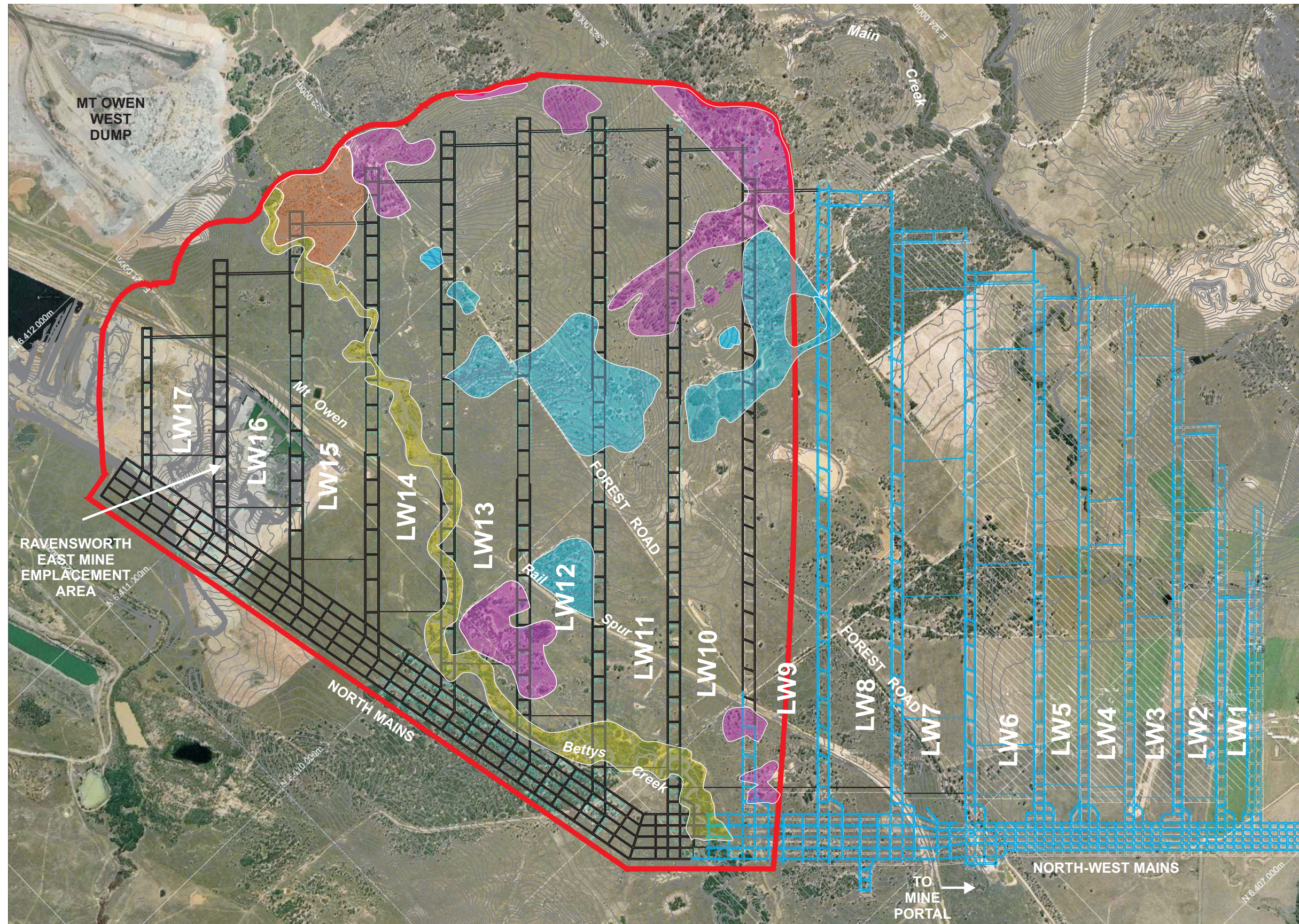
Isolated remnants of this community were identified and characterised by a dominance of *Corymbia maculata* (spotted gum), *Eucalyptus moluccana* (grey box), *Eucalyptus crebra* (narrow-leaved ironbark) and *Eucalyptus fibrosa* (broad-leaved ironbark). The canopy cover varied between 20% and 60% and 15 m to 25 m in height. These remnants showed evidence of previous disturbance and appeared to be regenerating.

The relatively sparse shrub layer included species such as *Bursaria spinosa* (blackthorn), *Pultenaea retusa*, *Cassinia aculeata*, *Daviesia genistifolia* and *Acacia amblygona*. The ground cover varied in density across this community and included *Eragrostis cilianensis*, *Solanum cinereum* (Narrawa burr), *Wahlenbergia gracilis* (native bluebell), *Lomandra longifolia*, *Cymbopogon refractus* (barbed wire grass), *Stipa* sp., *Cheilanthes sieberi* (mulga fern) and *Dichondra repens* (kidney weed). Common pasture species such as *Sporobolus creber* (slender rats tail grass), *Paspalum dilatatum* (paspalum) and *Cynodon dactylon* (common couch) were also noted.

ii. Bull Oak Woodland

The bull oak woodland community was recorded in the central and eastern portions of the site. This community was characterised by dense stands of *Allocasuarina luehmannii* (bull oak) to a height of 15 m. Also noted scattered throughout were specimens of *Eucalyptus crebra* (narrow-leaved ironbark) and *Casuarina glauca* (swamp oak).

The shrub layer was generally absent, with a very sparse ground cover as a result of the dense layers of casuarina needles. The most commonly occurring groundcover species were *Aristida ramosa* (three-awn speargrass), *Bothriochloa macra* (red grass), *Danthonia austrodanthonia* (wallaby grass) and *Dichelachne micrantha* (shorthair plumegrass). Also noted within this community was the common weed species, *Opuntia aurantiaca* (tiger pear).



- Legend**
- Study Area
 - Existing Mine Workings
 - Proposed Mine Workings (Mains and Gateroads)
 - Existing Contour (1m interval)
 - Riparian Vegetation (Open Forest Habitat)
 - Regenerating Vegetation (Open Forest Habitat)
 - Spotted Gum/Grey Box/Ironbark (Open Forest Habitat)
 - Bull Oak Woodland (Casuarina Woodland Habitat)
 - Pasture

Figure 3.1
Vegetation Communities within Study Area

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_Ecol_rev_04		
Date:	17/04/07	Drawing size:	A3
Drawn by:	JD	Reviewed by:	JW
Source:	Glennies Creek Coal Management Pty Ltd		
Scale:	Refer to Scale Bar		



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iii. *Riparian Vegetation*

This vegetation community was identified along the margins of Bettys Creek. *Casuarina glauca* (swamp oak), *Angophora floribunda* (rough-barked apple) and *Eucalyptus tereticornis* (forest red gum) dominated the canopy layer.

The shrub and ground cover species were similar to those identified within the adjacent woodland communities and included species such as *Cheilanthes sieberi* (mulga fern), *Bursaria spinosa* (blackthorn), *Aristida ramosa* (three-awn speargrass) and *Opuntia aurantiaca* (tiger pear).

iv. *Grassland*

Common pasture species such as *Sporobolus creber* (slender rats tail grass), *Stipa* sp. (speargrass), *Dichelachne micrantha* (shorthair plume grass), *Paspalum dilatatum* (paspalum), *Senecio madagascariensis* (fireweed), *Wahlenbergia gracilis* (native bluebell) and *Cynodon dactylon* (common couch) dominated this widespread vegetation community. These areas have been highly disturbed as a result of previous clearing and grazing.

v. *Regenerating Vegetation*

The regenerating vegetation community included plantings of the commonly occurring myrtaceous species identified within the locality, including *Corymbia maculata* (spotted gum), *Eucalyptus crebra* (narrow-leaved ironbark) and *Eucalyptus fibrosa* (broad-leaved ironbark). A range of *Acacia* species were also noted and included species such as *Acacia concurrens*, *A. parvipinnula* and *A. filiformis* as well as *Casuarina glauca*, *Pultenaea retusa* and *Dodonaea viscosa*.

3.1.2 *Threatened Flora Species*

The DEC database records no threatened flora species within 10 km of the site. Habitat for three threatened flora species has been recorded on the DEH database within 10 km, these species being *Diuris tricolor* (formerly known as *D. sheaffiana*) (pink donkey orchid), *Eucalyptus glauca* (slaty red gum) and *Thesium australe* (austral toadflax). *Ozothamnus tessellatus* is also reported to occur in the northern remnant of Ravensworth State Forest to the north of the site. Potential habitat is available for each of these species within the various habitat types present.

No threatened flora species were recorded on site during the recent survey period. *Bothriochloa biloba* was recorded to the south of the site during previous surveys (Umwelt, 2003a; Consol Energy Australia, 2001). This species is no longer listed as a vulnerable species under Schedule 2 of the *Threatened Species Conservation Act* (TSC Act) 1995 and the known distribution and abundance of *B. biloba* is such that it is not likely to become endangered. This species is, however, listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) 1999 and has, therefore, been assessed as a threatened species within this report (see Section 4.4).

3.1.3 *Endangered Ecological Communities*

Hunter Lowland Redgum Forest

The Hunter Lowland Redgum Forest is listed as an endangered ecological community in Schedule 1 of the TSC Act 1995 and has been identified to the north of the site along a narrow linear corridor in the headwaters of Bettys Creek (Umwelt 2003a). This occurrence of the Hunter Lowland Redgum Forest is likely to represent the western limit of the community's distribution in the Hunter Valley. The Hunter Lowland Redgum Forest extends from Muswellbrook to the Lower Hunter where it appears on gentle slopes arising from depressions. It is generally an open forest community with the most common canopy trees being *Eucalyptus tereticornis* and *Eucalyptus punctata*, although other frequently occurring canopy species are *Angophora costata*, *Corymbia maculata*, *Eucalyptus crebra* and *Eucalyptus moluccana* (NPWS 2000a).

The riparian forest and spotted gum/ironbark/grey box forest communities identified on the site are similar to the Hunter Lowland Redgum Forest as they contain some of the characteristic species. However, the quality of this community is reduced due to the obvious influences of the adjacent vegetation communities and the impacts of weed invasion.

3.1.4 *Local Conservation Significance*

The spotted gum/ironbark/grey box forest identified on the site is more consistent with the Central Hunter spotted gum-ironbark-grey box forest. This community was once extensive across the central to upper Hunter Valley area with most remnants on ridges and crests on rolling hills. Ravensworth State Forest and Belford National Park are prominent examples of the Central Hunter spotted gum-ironbark-grey box forest (NPWS 2000b). While this community is not currently listed as an endangered ecological community, it has been identified as a regionally significant (vulnerable) vegetation community within the Lower Hunter and Central Coast Region (LHCC 2003). The Lower Hunter and Central Coast (LHCC) Region does not include the Singleton local government area where this community largely occurs. The Draft Hunter Remnant Vegetation Project has described the Central Hunter spotted gum-ironbark-grey box forest as regionally significant as the extant community is approximately 18 306 ha from a modelled range of 46 753 ha. That is, approximately 61% has been cleared (Peake 2005). Further, it is poorly conserved with only approximately 293 ha conserved in Belford National Park (Peake 2005).

The riparian vegetation is likely to be a remnant of Central Hunter riparian forest. This community remains only as small heavily disturbed patches along tributaries of the Hunter Valley and has been identified as a regionally significant vegetation community within the Lower Hunter and Central Coast Region as it is estimated that only 47% of the pre-European settlement distribution remains (LHCC 2003). However this region does not include the

Singleton local government area where this community largely occurs. The Draft Hunter Remnant Vegetation Project has described the community as regionally significant as the extant community is approximately 436 ha from a modelled range of 14,142 ha, that is, approximately 98.9% has been cleared (Peake 2005).

Neither of these vegetation communities on site are likely to be impacted directly or indirectly due to subsidence impacts as a result of the proposed longwall mining activities, or the proposed gas drainage boreholes.

3.2 FAUNA

3.2.1 *Habitat Assessment*

The site contains three broad habitat types, namely open forest, *Casuarina* woodland and pasture, all of which are well represented within the locality. Both the open forest and *Casuarina* woodland habitats are well represented in the nearby Ravensworth State Forest.

The myrtaceous tree species would provide a seasonal foraging resource for nectivorous birds and mammals such as the squirrel glider and honeyeaters. The variety of tree species would also provide suitable feeding/foraging resources for foliage dependant fauna species such as the common brushtail possum and insectivorous birds such as treecreepers.

The grasses and sedges within the ground cover across the entire site would provide seeds and stems for granivorous and herbivorous species.

The forested portions of the site have a moderate layer of leaf litter (up to five centimetres deep) that may provide shelter for reptiles and small ground-dwelling mammals; while the moderate cover of fallen logs and rocks provides shelter for small ground-dwelling mammals and reptiles as well as foraging substrate for the grey-crowned babbler. The site contains a large number of mature eucalypt trees providing hollows and stags capable of providing shelter and breeding habitat for many bird, arboreal mammal and microchiropteran bat species. Bettys Creek, Main Creek and dams provide habitat for aquatic birds and amphibians. These habitat resources vary from permanent to ephemeral and provide habitat for a large number of species.

3.2.2 *Threatened Fauna Species*

During the 2005 survey period, only one threatened fauna species was directly observed within the site: *Pomatostomus temporalis* (grey-crowned babbler). Five individuals were observed foraging within the fallen timber within the areas of open forest over the northern portion of Longwall 11 (ERM, 2005). Further surveys undertaken in 2006 recorded the presence of this species on the western side of Bettys Creek above Longwalls 12 and 13 (Figure 3.2).

Grey-crowned babbler live in a structured and co-ordinated group of five to twelve individuals, and may have a home range as large as 12 ha (Frith 1982). The group forages over most of the territory for half to three quarters of the day, spending most of its time rummaging on the ground through leaf litter, probing into soils and turning over small objects (Slater 2001). They inhabit open woodland dominated by mature eucalypt trees with regrowth, tall shrubs and an intact shrub layer for breeding and foraging. Grey-crowned babbler eat a range of food items and roost at night in a dormitory very similar to their nests.

Mormopterus norfolkensis (eastern freetail-bat) has been previously recorded within the Application Area above Longwall 16 (Umwelt, 2003a). This record is reported as a roost box record and individuals have been recovered from hollows in large *Corymbia maculata* (spotted gum). This species inhabits a wide range of forested habitats and roosts in tree hollows and under loose bark.

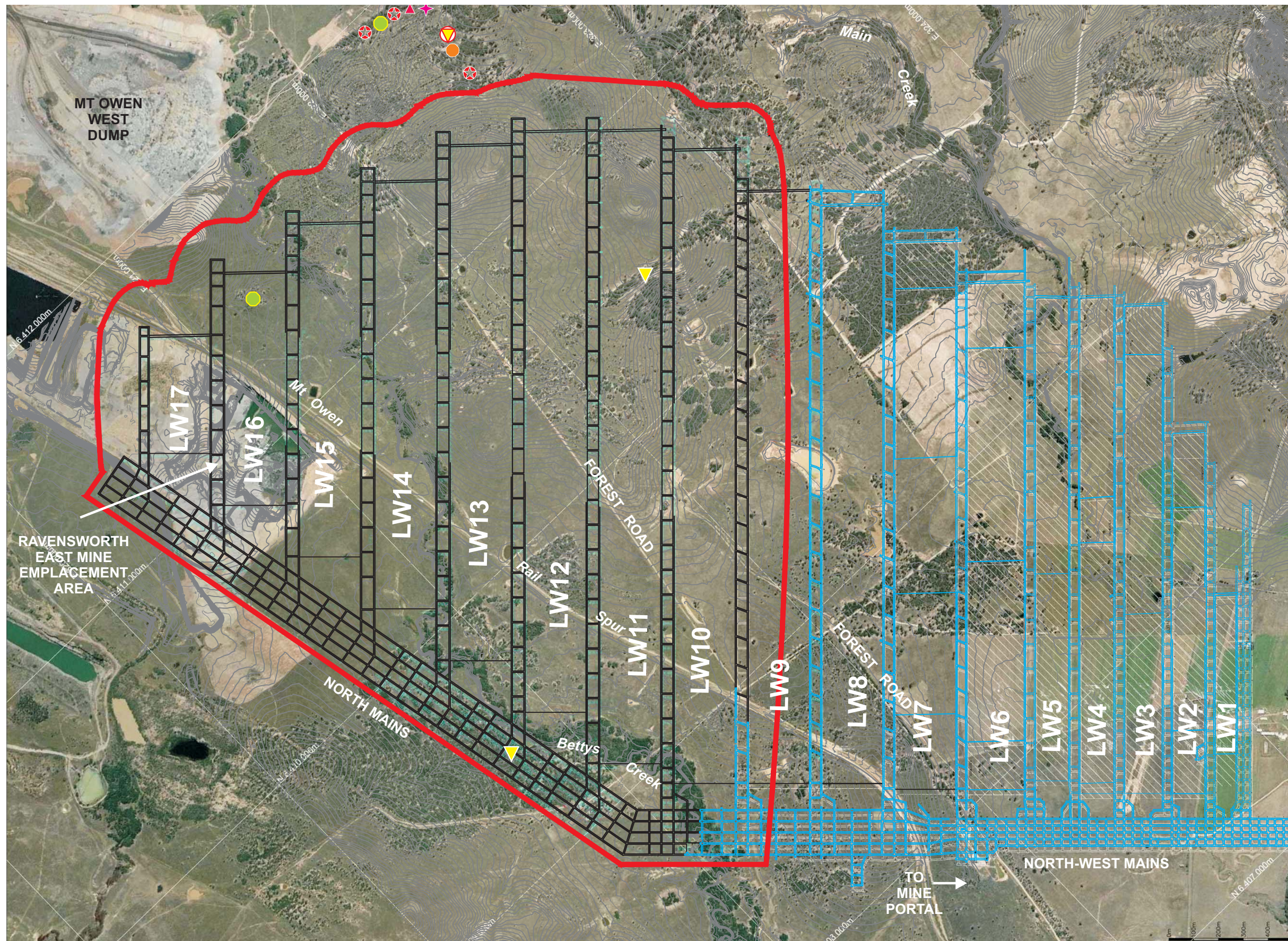
The Mt Owen EIS (Umwelt 2003a) and Species Impact Statement (Forest Fauna Surveys, 2003) also report the presence of an additional four threatened species within 500 m of the Application Area, namely the squirrel glider, grey-headed flying-fox, brown treecreeper and speckled warbler (see Figure 3.2).

Petaurus norfolcensis (squirrel glider) is reported to be widespread, but occurring in low densities, within the areas of mature woodland and open pasture with dense stands of trees/regrowth within the Mt Owen project area (Umwelt, 2003b). Within the Application Area, suitable habitat is available within the forested portions of the site with a limited amount of nesting habitat also available.

Pteropus poliocephalus (grey-headed flying-fox) has been recorded within the vicinity of the Application Area, most commonly during winter when the *C. maculata* are flowering. Seasonal foraging habitat is available within the vegetated portions of the study area, although suitable roosts sites are not present within the Application Area.

Pyrrholaemus sagittatus (speckled warbler) is reported to be uncommon in the Mt Owen project area (Umwelt, 2003a) but lives in a wide range of eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Large, relatively undisturbed remnants are required for this species to persist in an area. Within the Application Area, suitable habitat is available within the forested portions of the site, with a limited amount of nesting habitat available among fallen branches and other litter.

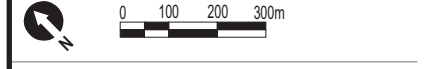
Climacteris picumnus (brown treecreeper) is reported to be abundant with the nearby Ravensworth State Forest although it is uncommon within the regenerating woodland within the Mt Owen project area (Umwelt, 2003a). This species inhabits drier forests and woodlands particularly among fallen timber. Within the Application Area, suitable habitat is available within the



- Legend**
- Study Area
 - Existing Mine Workings
 - Proposed Mine Workings (Mains and Gateroads)
 - Existing Contour (1m interval)
 - ★ Grey-headed Flying Fox (Umwelt 2003)
 - Eastern Freetail Bat (Umwelt 2003)
 - ▼ Grey-crowned Babbler (ERM 2005, 2006)
 - Grey-crowned Babbler (Umwelt 2003)
 - Brown Treecreeper (Umwelt 2003)
 - ★ Squirrel Glider (Umwelt 2003)
 - ▲ Speckled Warbler (Umwelt 2003)

Figure 3.2
Threatened Species Recorded within Study Area

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_Ecol_rev_05		
Date:	17/04/07	Drawing size:	A3
Drawn by:	JD	Reviewed by:	JW
Source:	Glennies Creek Coal Management Pty Ltd		
Scale:	Refer to Scale Bar		



Environmental Resources Management Australia Pty Ltd
 53 Bonville Avenue, Thornton, NSW 2322
 Telephone +61 2 4964 2150



forested portions of the site with a limited amount of nesting habitat also available.

Each of these species has been referred to in *Table 3.1*. An additional 18 threatened fauna species have previously recorded within 10 km of the site on the DEC and DEH databases as indicated within *Table 3.1*.

For the purpose of this assessment, all of the species assessed in *Table 3.1* except for the koala, brush-tail rock wallaby, red goshawk and southern barred frog have been considered likely to utilise the resources on site. These species has been collectively assessed within *Chapter 4*.

Table 3.1 Likelihood of Threatened Fauna Occurring in the Site

Common/Scientific Name	Status TSC	Status EPBC	Preferred Habitat	Likelihood of Occurrence
Birds				
<i>Tyto novaehollandiae</i> masked owl	V	-	Dry sclerophyll forest and woodland with a low sparse understorey, foraging in open or partly cleared land. Roosting and nest sites in large tree hollows in sheltered aspects.	Moderate to high likelihood of foraging on site. This species has been recorded to the north of the Application Area within Mt Owen Mine project area and Ravensworth State Forest ¹ .
<i>Ninox connivens</i> barking owl	V	-	Open woodlands and dry open forests, nesting in the crown of mature trees.	Moderate to high. Tentative identification in 1996 in Ravensworth State Forest ¹ .
<i>Melithreptus gularis gularis</i> black-chinned honeyeater	V	-	Dry forests and woodlands particularly along rivers.	Moderate to high along Bettys and Main Creek. This species has been recorded to the north of the Application Area within Mt Owen Mine project area and Ravensworth State Forest ¹ .
<i>Erythrotriorchis radiatus</i> red goshawk	E	V	Prefers woodlands and forests with a mosaic of vegetation types that contain permanent water. Nests may be up to 1 km away from a permanent freshwater.	Low to moderate likelihood based on lack of suitably sized water bodies.
<i>Climacteris picumnus</i> brown treecreeper	V	-	Drier forests and woodlands particularly among fallen timber.	Moderate to high. This species has been recorded within the revegetated areas 500m to the north-east of the Application Area ¹ . It is also reported to be abundant within Ravensworth State Forest and is likely to utilise the resources present within the site.

Common/Scientific Name	Status TSC	Status EPBC	Preferred Habitat	Likelihood of Occurrence
<i>Stagonopleura guttata</i> diamond firetail	V	-	Open forest woodland and wooded grassland.	Moderate to high. This species has been recorded infrequently to the north of the Application Area within Mt Owen Mine project area and Ravensworth State Forest ¹ .
<i>Pyrrholaemus sagittatus</i> speckled warbler	V	-	Open woodland.	Moderate to high. This species has been recorded within the revegetated areas to the north of the Application Area¹.
<i>Melanodryas cucullata cucullata</i> hooded robin (south-eastern form)	V		Open woodland, mallee and <i>Acacia</i> scrub, often in or near clearings or open areas. Requires structurally diverse woodland with mature trees, shrub layer and moderately tall native grass understorey.	Moderate likelihood of occurrence in woodland remnants given grazing history has lowered diversity of shrubs and grasses. This species has been regularly recorded to the north of the Application Area within Ravensworth State Forest ¹ .
<i>Lathamus discolor</i> swift parrot	E	E	Migratory species frequenting eucalypt forest and woodland, following winter flowering eucalypts (eg. swamp mahogany). Breeds in Tasmania.	Moderate to high as a seasonal visitor. Not recorded within Ravensworth State Forest although records exist from the Cessnock area ¹ .
<i>Pomatostomus temporalis</i> grey-crowned babbler	V	-	Open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs and an intact cover of grass and forbs. Also along streams in cleared areas.	High. This species has been recorded above Longwall panels 11, 12 and 13.
<i>Xanthomyza phrygia</i> regent honeyeater	E	E	Nomadic species following rich sources of nectar, primarily winter flowering species.	Moderate to high as a seasonal visitor. Not recorded within Ravensworth State Forest ¹ although records exist from the Singleton Training Area.

Common/Scientific Name	Status TSC	Status EPBC	Preferred Habitat	Likelihood of Occurrence
Mammals				
<i>Chalinolobus daerji</i> large-eared pied bat	V	V	Roosts in caves. Variety of habitat types including dry and wet sclerophyll forest and tall open eucalypt forest with a rainforest sub-canopy.	High likelihood of foraging. No roost sites expected. This species has been recorded to the north of the Application Area within Mt Owen Mine project area ¹ .
<i>Miniopterus australis</i> little bentwing-bat	V	-	Roosts in caves, old mines, stormwater channels; forages below the forest canopy.	High likelihood of foraging. No roost sites expected. This species has been recorded to the north of the Application Area within Mt Owen Mine project area ¹ .
<i>Miniopterus schreibersii oceanensis</i> eastern bentwing-bat	V	-	Roosts in caves, old mines, stormwater channels; forages above the forest canopy.	High likelihood of foraging. No roost sites expected. This species has been recorded to the north of the Application Area within Mt Owen Mine project area ¹ .
<i>Myotis adaeversus</i> large footed myotis	V	-	Roosts in caves, tunnels, under bridges and in dense vegetation. Forages over nearby lakes, rivers, large streams.	High likelihood of foraging over the dams. No roost sites expected. This species has been recorded to the north of the Application Area within Mt Owen Mine project area ¹ .
<i>Scoteanax rueppellii</i> greater broad-nosed bat	V	-	Rivers and creeks within the ranges, roosting in tree hollows.	High likelihood of foraging and roosting. This species has been recorded to the north of the Application Area within Mt Owen Mine project area ¹ .

Common/Scientific Name	Status TSC	Status EPBC	Preferred Habitat	Likelihood of Occurrence
<i>Mormopterus norfolkensis</i> eastern freetail-bat	V	-	Wide range of forested habitats including rainforest to dry open forest. Roosts in tree hollows and under loose bark.	High likelihood foraging and roosting. This species has been recorded in the northern portion of the Application Area above Longwall 16¹.
<i>Petaurus norfolkensis</i> squirrel glider	V	-	Dry sclerophyll forest and remnant woodland containing mature or mixed aged stands with gum-barked and winter flowering trees, and mature <i>Acacia</i> species. Nests socially in tree hollows.	High likelihood of foraging and nesting. This species has been recorded within 500m to the north-east of the Application Area¹.
<i>Dasyurus maculatus</i> spotted-tail quoll	V	E	Wide range of forested habitats including rainforest, open forest, coastal heath, riparian forest. Nests in caves, hollow logs or tree hollows.	High likelihood of foraging and denning. This species has been recorded to the north of the Application Area within Mt Owen Mine project area ¹ .
<i>Petrogale penicillata</i> brush-tailed rock-wallaby	E	V	Occupy north facing cliffs in dry eucalypt forest and woodland. They shelter in rock crevices, caves or overhangs during the day, feeding in grassy areas above and below the cliffs in the evening.	Low – no suitable habitat.
<i>Phascogale cinereus</i> koala	V	-	Forests typically on high nutrient soils characterised by presence of preferred feed trees.	Moderate to low likelihood. Not recorded within Ravensworth State Forest ¹ .
<i>Pseudomys oralis</i> Hastings river mouse	V	-	Damp, dense fern or sedge understorey along drainage lines, but also utilises drier areas with grassy or heathy ground cover.	Marginal habitat associated with drainage lines and immediate environs. Moderate to low likelihood of occurrence.
<i>Pteropus poliocephalus</i> grey-headed flying-fox	V	V	Forages on fruits, blossoms and nectar of eucalypts. In early summer roosts in large groups (camps) in forests or mangroves.	High likelihood of foraging. This species has been recorded within 500m to the north-east of the Application Area¹.

Common/Scientific Name	Status TSC	Status EPBC	Preferred Habitat	Likelihood of Occurrence
Frogs <i>Litoria aurea</i> green and golden bell frog	E	V	In NSW the species occupies disturbed habitats and breeds largely in ephemeral ponds.	Moderate to high given records of this species within the locality and the presence of both ephemeral and permanent water bodies. This species has been recorded to the north of the Application Area within Mt Owen Mine project area ¹ . However, it has not been recorded in the area since 1999.
<i>Mixophyes iteratus</i> southern barred frog	V	V	Forage and live amongst deep, damp leave litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest at elevations below 1000 m. Breeds around shallow, flowing rocky streams.	Low likelihood due to absence of flowing, rocky streams.

¹ = Forest Fauna Surveys (2003)

Status in NSW as per Schedules 1 and 2 of TSC Act: E = Endangered; V = Vulnerable. Status as per EPBC Act: E = Endangered; V = Vulnerable.

4.1 SUBSIDENCE IMPACTS

The most direct environmental impact of longwall mining is subsidence, which causes changes in the level of the ground surface overlying and adjacent to the area of extraction. Predicted subsidence over Longwalls 10 to 17 is shown in *Table 4.1*.

Table 4.1 Subsidence Predictions

Longwall	Predicted Subsidence (mm)	Predicted Tensile Strain (mm/m)	Predicted Compressive Strain (mm/m)	Predicted Tilt (mm)
10	1.6	6	9	12
11	1.6	6	9	12
12	1.6	6	9	12
13	1.6	6	9	12
14	1.6	6	9	12
15	1.6	6	9	12
16	1.6	6	9	12
17	0.8	6	9	12

Source: SCT 2006

The following sub-section predicts the likely impacts on flora and fauna as a consequence of tilt, strain, subsidence, clearing, cracking and alterations to watertable levels and surface water flows.

4.1.1 *Potential Impacts on Vegetation*

All of those threatened flora species likely to occur within the site as detailed in *Section 3.1.2* have been collectively addressed within this impact assessment.

Tilt

Subsidence will cause a trough centred above each longwall panel. Subsidence troughs are formed through the vertical settlement of rock into the void created as the coal is removed between the chain pillars. As a trough is formed, the ground surface is subjected to certain tilts and strains depending on the geology, depth of cover, panel dimensions and position above the panel.

Where there is a maximum predicted tilt of 12 mm as at Glennies Creek Colliery, a vertical 20 m high tree on the side of such a trough may lean by up to 240 mm. Although this would not normally be sufficient to cause instability (Waddington Kay and Associates, 2000), there is a possibility that

trees which already have a steep lean in the direction of predicted tilt will fall. Conversely any trees leaning away from the subsidence induced tilt would be straightened, however, it is unlikely that any isolated falls that may occur would significantly alter vegetation community composition.

Tilt will not affect shrubs, herbs or grasses, as they are too short to exert significant leverage on root systems. Tilting due to subsidence will therefore not cause measurable short- or long-term damage to any threatened plants or endangered ecological communities within the site.

Strain

Tensile and compressive strains pull on structures commonly damage inflexible material by stretching and rupturing. Predicted subsidence will cause maximum tensile strains of up to 6.0mm/m and maximum compressive strains of up to 9.0mm/m. Compressive and tensile strains caused by subsidence act on plant roots much the same as a high wind and will have little impact on plant roots due to their inherent flexibility. In windy weather, particularly on the leeward side of trees, roots are compressed as the trunk sways away from the wind. Roots on the windward side are placed under tension, although this alternates with compression as the trunk sways back and forth.

Ponding

Subsidence related ponding within the channel of Bettys Creek is anticipated over Longwalls 10, 11, 13, 14 and 15. Due to the relatively flat topography overlying the south-western portion of the Application Area, there are already areas which are prone to ponding after significant rainfall events. Additional obvious post-subsidence ponding is not anticipated in the elevated central and north-eastern sections of the Application Area (GeoTerra, 2006).

As prolonged ponding may substantially affect any vegetation growing in the area concerned, Glennies Creek Coal Management proposes to drain any such pond in areas outside of Bettys Creek. Assuming that this drainage occurs soon after ponding, few long term effects are predicted. Some minor disturbance to vegetation may occur in the area re-profiled to drain any pond.

Lowering of the Water Table Beyond the Reach of Plants

There have been no groundwater dependent ecosystems identified over Longwall Panels 10 to 17, although a series of small dams and billabongs supporting aquatic vegetation exist across the Application Area. Anecdotal evidence suggests that these dams are not groundwater fed and lowering of the water table will not directly impact any aquatic vegetation.

Subsiding Vegetation into the Groundwater Zone

Subsiding vegetation communities close to the water table could potentially affect individual plants. For example, subsidence of a dry community into the water table could cause dieback and a transition to those species more suited to wet conditions. Conversely, subsidence of a wet community further into the water table may extend or improve this community, although not in every case.

All plant communities to be undermined are predicted to be more than 2.45 m above the water table. This prediction is based on data available from piezometers located within the middle of Longwall Panel 6 and on the north western corner of Longwall Panel 9 (GeoTerra, 2005). As the maximum predicted subsidence is 1.6 m, plant communities would not be subsided into the groundwater and it is not anticipated that the plant communities will be affected by this potential action.

Clearing and Cracking

Surface cracking over Longwalls 10 to 17 is unlikely to be perceptible on agricultural land but is likely to be more evident on bare hard surfaces such as Forest Road. No rectification works are expected to be required and therefore no clearing of vegetation will be necessary.

Cumulative Impacts

Within the Central Hunter lowlands, agricultural land use, quarries and the nearby open cut mines have resulted in native vegetation clearance. It is not anticipated that Longwall Panels 10 to 17 will require clearance of remnant native vegetation. There is a slight chance that a tree might fall. However, this not anticipated to be at a level that would not add to the effects of the surrounding native vegetation clearance and associated impacts.

4.1.2 *Potential Impacts on Fauna*

All of those threatened fauna species likely to occur within the site have been collectively referred to within this impact assessment (refer to *Table 3.1*).

Vegetation Loss

Only minimal vegetation clearance, if any, is expected to occur within the Application Area, with any vegetation clearance restricted to rectification of indirect subsidence impacts such as ponding. The proposed longwall mining is therefore not likely to significantly isolate or reduce the extent of the local vegetation communities present. The proposal will not remove fallen timber, which provides a foraging resource for the grey-crowned babbler.

Rock Shelters and Burrows

Bats may roost in existing rock cracks and a number of burrowing animals such as wombats are known to occur within the locality. Subsidence may widen or close these fissures and burrows. It is not possible to quantify the likelihood or number of fissure closures or burrow collapses. Whilst subsidence could threaten some roosting and shelter sites, similar habitat is common within the local area. In some cases, subsidence may actually increase the total roosting and shelter habitat for threatened species within the site by widening existing fissures.

Aquatic Habitats

Mining within Longwall Panels 10 to 17 will cause little change to surface water regimes.

GeoTerra (2006) reports that Bettys Creek water quality, flow volumes and creek stability is not anticipated to be adversely affected by the proposed longwall mining activities, although some additional ponding may occur in subsidence troughs within the creek. Accordingly, aquatic animals including the green and golden bell frog, which is known to occur within the locality (albeit not identified within the study area), are unlikely to be significantly affected. It is also noteworthy that the aquatic habitats above Longwalls 14 to 17 will already have been altered as a result of the Mt Owen Eastern Rail Pit and the Bettys Creek diversion prior to their undermining.

Aquatic Habitats (Drying of Springs, Soaks and Dams)

Subsidence may cause surface cracking and a consequent reduction in yield from soaks and springs. Whilst the loss of individual springs cannot be discounted, it is unlikely there will be significant changes to the way groundwater is released to receiving watercourses. One groundwater seepage area was observed, with a small (<10m long) pool of saline water present over Longwall 14. This is located near where the proposed XMO Stage 2 diversion will re-enter Bettys Creek (GeoTerra 2007).

Dams across the site do not need draining ahead of mining and, although they have the potential to crack, they have relatively low aquatic habitat value. The dams are fed by surface runoff and should their walls crack, a proportion of the impounded water would be released. Notwithstanding, subsidence as a result of mining Longwalls 10 to 17 is unlikely to significantly impact upon this habitat resource such that a local population of threatened species would be placed at risk of extinction.

Cumulative Impacts

Agricultural land use, quarries and the nearby open cut mines have resulted in native vegetation and associated habitat clearance. The minor impacts arising from mining Longwall Panels 10 to 17 are unlikely to cumulatively increase the effects of the surrounding native vegetation and habitat clearance on fauna.

4.2 POTENTIAL IMPACT OF BOREHOLES

The proposal includes the installation of four gas drainage boreholes along each longwall panel, ie a total of 32 boreholes over the life of the Longwalls 10 to 17. The exact location of the boreholes will be determined in the field in consultation with an ecologist to avoid clearance of trees, shrubs and where possible stands of native grasses. Disturbance associated with each gas drainage borehole will be minimal (8m by 8m) and at any one time there will only be three or four boreholes operational. The installation and fencing of the boreholes will clear approximately 0.2 hectares of grassland over the life of the operation. Once the borehole is ineffective they will be rehabilitated and the long term impact of the gas drainage boreholes will be minimal.

4.3 POTENTIAL EFFECTS OF THE PROPOSAL ON THREATENED SPECIES, POPULATIONS OF ECOLOGICAL COMMUNITIES

Assessment of the potential effects of the proposal on threatened species, populations or ecological communities listed under the TSC Act follows the draft Guidelines for Threatened Species Assessment under Part 3A prepared by the Department of Environment and Conservation (DEC) and Department of Primary Industries (DPI). The assessment considers the potential effects identified in *Sections 4.1 and 4.2*.

The assessment only considers those species or communities which have been recorded on site or have a moderate or high likelihood of occurring on site as identified in *Table 3.1*. Threatened species are assessed in groups rather than individuals based on the assumption that species having similar ecological requirements are at risk from the same threats and are likely to be impacted on in similar ways by the proposal.

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

Potential habitat is available for *Diuris sheaffiana* (tricolour diuris), *Eucalyptus glauca* (slaty redgum), *Thesium australe* (austral toadflax) and *Ozothamnus tessellatus*. The lifecycle of these species is susceptible to disruption of pollination, seed set and or disruption of recruitment. The proposed longwall mining will not removed or isolated potential habitat for these species and

therefore is unlikely to impact on the life cycle of these species such that a local extinction would occur.

The boreholes will be located within the grassland and/or disturbed areas in areas of marginal habitat. Clearance of grassland is unlikely to affect lifecycle of these plants.

Birds

Pomatostomus temporalis (grey-crowned babbler) has been recorded within the Application Area and *Climacteris picumnus* (brown treecreeper) and *Pyrrholaemus sagittatus* (speckled warbler) have been recorded within the regenerating woodland to the north and north-east of the site. Habitat is also available for *Tyto novaehollandiae* (masked owl), *Ninox connivens* (barking owl), *Melithreptus gularis gularis* (black-chinned honeyeater), *Erythrorchis radiatus* (red goshawk), *Stagonopleura guttata* (diamond firetail), *Lathamus discolor* (swift parrot) and *Xanthomyza phrygia* (regent honeyeater).

These species are susceptible to reduction in foraging resources (insects, grains, nectar, or small mammals), removal of nesting and or roosting sites and fragmentation of habitat. However, no impact to the habitat and nesting resources of these species is expected as a result of the predicted subsidence and the proposed longwall mining is therefore unlikely to impact on the life cycle of these threatened birds such that a local extinction would occur.

The minor clearance of grassland required for the gas drainage boreholes will not reduce significantly grassland habitat resource such that the lifecycle of dependent species is affected.

Terrestrial Mammals

Potential habitat for *Dasyurus maculatus* (tiger quoll) is available across the entire site and surrounding habitat. The tiger quoll has been recorded to the north of the Application Area within Mt Owen Mine Lease Area and Ravensworth State Forest.

Tiger quoll is susceptible to competition of foraging resource, loss of den sites and isolation of individuals. No impact on the habitat and nesting resources of this species is expected as a result of the predicted subsidence or clearance for boreholes. The proposed longwall mining is therefore unlikely to impact on the life cycle of these threatened terrestrial mammals such that a local extinction would occur.

Arboreal Mammals

Potential foraging and nesting habitat for *Petaurus norfolcensis* (squirrel glider) is available across the entire study area and surrounding habitats. This species has been recorded within the regenerating habitat to the north-east of the Application Area. Squirrel glider is susceptible to loss of den sites, isolation of individuals and social groups and loss of foraging resource. No significant impact to areas of open forest habitat is expected as a result of

subsidence or clearance for gas drainage boreholes and consequently the proposed longwall mining operations are unlikely to impact on the life cycle of this species such that a local extinction would occur.

Microchiropteran Bats

The site provides limited hunting habitat only for the cave dependent *Chalinolobus dwyeri* (large-eared pied bat), *Miniopterus australis* (little bentwing-bat), *Miniopterus schreibersii oceanensis* (eastern bentwing-bat) and *Myotis adversus* (large footed myotis). Cave dependent bats are susceptible to loss of roost sites, changes in micro-climate of roost sites and reduction in foraging habitat.

Mormopterus norfolkensis (eastern freetail-bat) and *Scoteanax rueppellii* (greater broad-nosed bat) roost in tree hollows and the site provides both hunting and roosting habitat for these species. *Mormopterus norfolkensis* (eastern freetail-bat) has been recorded above Longwall 16.

Given their generalist hunting requirements and the low impact of subsidence on the habitat resources, the proposed longwall mining operations are unlikely to impact on the life cycle of these species such that a local extinction would occur.

Megachiropteran Bats

Potential foraging and limited roosting habitat for *Pteropus poliocephalus* (grey-headed flying-fox) is available across the entire site and surrounding habitat. This species is unlikely to be dependent on the limited amount of resources present within Application Area and no impact to the areas of open forest is expected as a result of the predicted subsidence. The proposal is therefore unlikely to impact on the life cycle of this species such that a local extinction would occur.

b) *How is the proposal likely to affect the habitat of a threatened species and/or population?*

Section 4.1 identifies the potential impacts of longwall mining, in particular, the predicted impacts of subsidence. It is not expected that subsidence will alter the structure and/or continuity of woodland and grassland habitat. The proposed longwall mining will not clear vegetation, remove or disturb key habitat features (hollow bearing trees, caves, rock crevices) or foraging resources and is therefore unlikely to affect the habitat of a threatened species. The installation of gas drainage boreholes will clear approximately 0.2 hectares of grassland over the life of the operation. The boreholes will be located in cleared grassland and will be removed and the area rehabilitated. This is not anticipated to impact on habitat of threatened species.

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

For two of the flora species assessed the study area is at the limit of their known distribution. *Diuris tricolor* occurs on the western slopes of NSW extending east to Muswellbrook in the Hunter Valley. Therefore any records in this area are at the eastern known limit of this species.

Ozothamnus tessellatus occurs in the Hunter and Central Rivers Catchment Management Area known from north of Rylstone. Any records in this area would be an eastern range extension.

d) *How is the proposal likely to affect current disturbance regimes?*

Current disturbance regimes affecting the Application Area are a result of historical land use and include grazing pressure, spread of introduced species and clearance pressures to provide for grazing land. The proposal is unlikely to alter any of these current disturbance regimes as grazing will continue over the Application Area.

e) *How is the proposal likely to affect habitat connectivity?*

The proposal does not require clearance of grassland or woodland habitat and therefore no areas of currently interconnecting or proximate areas of habitat are likely to become fragmented or isolated as result of the longwall mining. The minor clearance of grassland at gas drainage borehole locations is unlikely to disrupt or alter habitat continuity.

f) *How is the proposal likely to affect critical habitat?*

The proposal will not affect critical habitat as no areas of critical habitat as identified under the TSC Act occur in the locality.

4.4

COMMONWEALTH THREATENED AND MIGRATORY SPECIES

The Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* requires approval for actions that may have a significant impact on matters of national environmental significance or Commonwealth land. There are no World Heritage properties, National Heritage places, Ramsar wetlands, Commonwealth marine areas or nuclear actions on or near the site. There are, however, Commonwealth listed threatened species and migratory species recorded or likely to occur on the site.

One flora species and six fauna species listed as threatened in the EPBC Act have the potential to occur on site (see *Table 3.1*).

Bothriochloa biloba is an erect or decumbent caespitose perennial to one metre high, with racemes having white or purplish hairs (Harden, 1993). The species grows in woodland on poorer soils. The species was recorded to the south of the site during previous surveys although it has not been recorded in

the Application Area. The site is considered to provide potential habitat for this species. However, the proposed longwall mining activities and predicted levels of subsidence will not impact areas of potential habitat nor will it affect the life cycle or growth patterns of this species such that a local extinction would occur.

The installation and fencing of the gas draining boreholes will clear approximately 0.2 hectares of grassland over the life of the operation and may disturb potential marginal habitat (species prefers woodland where there is less competition). It is recommended that pre-clearance inspections of the boreholes sites be undertaken by an ecologist during the summer flowering period to optimise detection.

Provided the environs continue to function as a wildlife corridor and winter flowering resources are retained, the proposed longwall mining is not expected to cause detrimental impacts upon the health of the remaining vegetation on the site.

The evaluation of impacts of the proposal under state legislation (*Section 4.3*) indicates that threatened species, communities and populations are not going to be placed at risk of extinction by the proposed activity. Therefore, it is unnecessary to reassess the threatened species listed in the EPBC Act. However the evaluation of impacts presented in *Section 4.3* did not consider *Bothriochloa biloba* as it is no longer listed under state legislation. Following is an assessment of the impact of the proposal on *Bothriochloa biloba* against the Commonwealth significant impact assessment criteria.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long term decrease in the size of an important population;

No population of *Bothriochloa biloba* has been identified in the grassland or woodland habitats over longwalls 10 to 17. *Bothriochloa biloba* was recorded to the south of the site during previous surveys (Umwelt, 2003a and Consol Energy Australia, 2001). While there are records from the locality there is no information on the size of the local population to provide an assessment as to whether it is an 'important population' which is necessary for a species long term survival or recovery. Nevertheless, subsidence impacts of the proposed longwall mining operation are unlikely to clear a population of *Bothriochloa biloba*.

Pre-clearance inspections in summer to identify locations of boreholes will aim to avoid or minimise impacts on any individual clumps of *Bothriochloa biloba* that may be present at that time.

- reduce the area of occupancy of an important population;

Bothriochloa biloba occurs in grassland and woodland associations preferring heavier textured, poorer soils. Subsidence impacts of the proposed

longwall mining operation are unlikely to alter the structure or clear grassland or woodland habitat and are unlikely to reduce the area of occupancy of a population of *Bothriochloa biloba*.

Pre-clearance inspections in summer to identify location of boreholes will aim to avoid impacts on any individual clumps of *Bothriochloa biloba* that may be present at that time.

- fragment an existing important population;

Subsidence impacts are unlikely to alter the structure or disrupt any habitats such that any population would be fragmented. While clearance of areas of grassland will be required for installation of the gas drainage boreholes, pre-clearance inspections during the summer flowering period will aim to avoid disturbing any specimens of *Bothriochloa biloba*. Further, the small area of clearance at each borehole and distances between each borehole are unlikely to present a barrier between potential populations.

- adversely affect critical habitat;

Subsidence impacts and the gas drainage boreholes are unlikely to alter the structure of the grassland/woodland habitat that may provide habitat critical to the survival of a *Bothriochloa biloba* population.

- disrupt the breeding cycle of an important population;

Subsidence impacts and the gas draining boreholes are unlikely to alter the structure or clear grassland or woodland habitat such that the breeding cycle of a population of *Bothriochloa biloba* is disrupted.

- affect the availability or quality of habitat to the extent that the species is likely to decline;

Subsidence impacts and the gas draining boreholes are unlikely to affect the availability or quality of habitat for *Bothriochloa biloba* as there is only minimal clearance required for the boreholes and these areas will be regenerated following removal of the boreholes.

- result in harmful invasive species becoming established on site;

Harmful invasive species are introduced species or translocated native species that out-compete native species for space and resources. A number of native perennial grasses out-compete *Bothriochloa biloba* but in this instance they are endemic to the area and established on site. The proposal does not alter this situation. Weed management measures will be implemented to minimise establishment of invasive introduced species at each of the borehole locations.

- introduce disease that may cause decline of the species; or

Not applicable.

- interfere with the recovery of the species.

The proposal is unlikely to alter potential habitat for *Bothriochloa biloba*, fragment population or alter the life cycle of the grass. Therefore it is anticipated that the proposal will not interfere with the recovery of any population that may occur over the Application Area.

Seven migratory bird species have been identified as having the potential to occur within 10 km of the site. Five of these are terrestrial birds and two are wetland birds. Habitat for the wetland birds (Latham's snipe and painted snipe) is not present on the site and therefore these species have not been included in this assessment.

The terrestrial migratory birds are:

- *Haliaeetus leucogaster* (white-bellied sea-eagle);
- *Hirundapus caudacutus* (white-throated needletail);
- *Monarcha melanopsis* (black-faced monarch);
- *Myiagra cyanoleuca* (satin flycatcher); and
- *Rhipidura rufifrons* (rufous fantail).

These species may occasionally use the site as foraging habitat. However, the proposal will not result in the removal of any significant area of habitat and the distribution of vegetation communities is not confined to the site. As these species are wide-ranging with generalist habitat requirements, it is unlikely that the proposed longwall mining or gas drainage borehole installation will have a significant impact on these migratory species. Therefore, the proposed modification will not:

1. substantially modify, destroy or isolate an area of important habitat of the migratory species;
2. result in harmful invasive species becoming established in the site; or
3. disrupt the life cycle of an ecologically significant proportion of a population of the species.

The proposal is not expected to have a significant effect upon the health and viability of any threatened or migratory species listed under the provisions of the EPBC Act.

Given the proposed modification will not impact on matters of national environmental significance, approval from the Commonwealth Minister for the Environment is not required.

MITIGATION

The impacts of the proposed longwall mining operation and subsidence on flora and fauna are described in Section 4.1. There will be minimal to no impacts on the structure, availability and continuity of woodland or grassland habitat. As the majority of potential impacts are avoided there is no specific requirement for mitigation measures to minimise impacts on flora and fauna and their habitat.

The proposed installation of 32 gas draining boreholes has the potential to impact on a small area (0.2 hectares) of grassland habitat over the life of the operation. Siting of the boreholes in the grassland avoids impacts on woodland habitat and foraging resources. Pre-clearance inspections of locations for the boreholes during the summer flowering period of *Bothriochloa biloba* will avoid impacting directly on any individual plants. When the boreholes are no longer required, they will be removed and the area rehabilitated.

There is no requirement for any offset strategies for the proposed longwall mining operation.

CONCLUSION

The site contains five vegetation communities, namely the spotted gum/grey box/ironbark woodland, bull oak woodland, riparian vegetation, grassland and regenerating vegetation communities. The site has been subjected to considerable past disturbance, such as land clearing and grazing. None of the vegetation communities are endangered.

No threatened flora species were recorded on site during the recent survey. A Commonwealth listed species, *Bothriochloa biloba* was recorded to the south of the site above Longwall 6 during previous surveys (Umwelt, 2003a and Consol Energy Australia, 2001).

During the survey period, only one threatened fauna species was directly observed within the site being, *Pomatostomus temporalis* (grey-crowned babbler). Five individuals were observed foraging within the fallen timber in the open forest in the northern portion of Longwall 11 in 2005. Further surveys undertaken in 2006 recorded the presence of this species on the western side of Bettys Creek above Longwalls 12 and 13.

The eastern freetail-bat is also reported to occur within the Application Area, with an additional four threatened species (squirrel glider, grey-headed flying-fox, brown treecreeper and speckled warbler) being recorded in the regenerating woodland within 500 m to the north-east. With consideration given to the predicted subsidence levels, the proposed longwall mining will not significantly impact upon any of these threatened species, nor will it significantly alter their habitat resources on the site and surrounding lands.

An additional 13 threatened fauna species are likely to utilise the site and surrounding habitats. Although none were located in the Application Area during the survey period, should any be present at other times of the year, they would be unlikely to be significantly impacted directly by the proposed longwall mining operations or indirectly through significant alteration to the habitat resources on the site and surrounding lands.

The proposed longwall mining operation and borehole installation will not alter and therefore will maintain the existing biodiversity values of the Application Area. The proposal is not expected to reduce the long-term viability of a local population of threatened species. The proposal is not expected to accelerate the extinction or place at risk any threatened species. Further the proposal will not adversely affect critical habitat.

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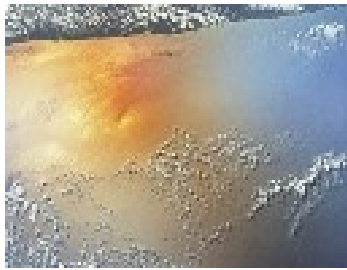
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