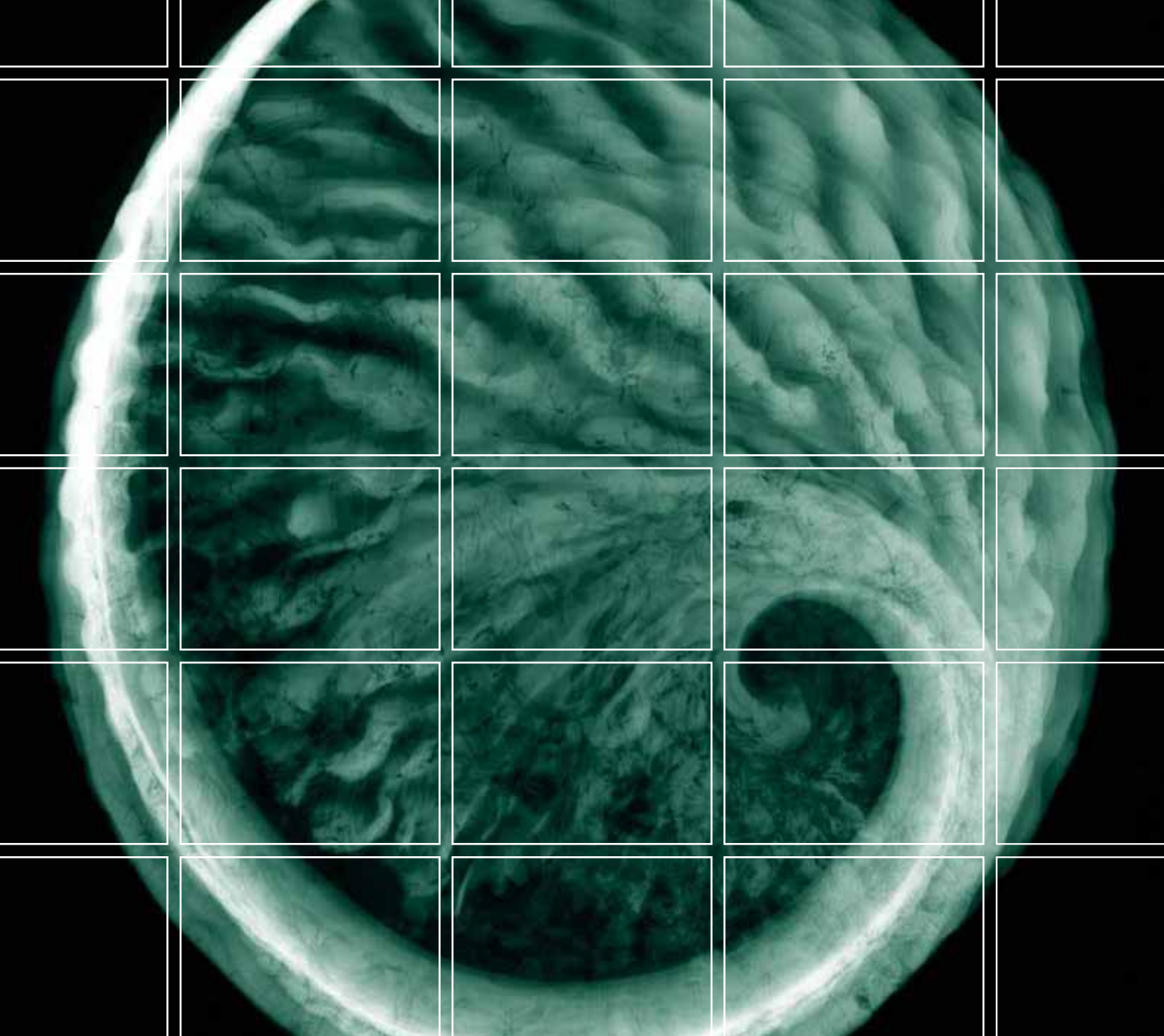


Annex L

## V Mains Terrestrial Flora And Fauna Assessment





# V Mains *Terrestrial Flora and Fauna Assessment*

for Gujarat NRE Minerals Ltd

September 2009

0090757 Ecology Final  
[www.erm.com](http://www.erm.com)

Approved by:	<u>Christine Allen</u>
Position:	Project Manager
Signed:	
Date:	<u>July, 2009</u>
Approved by:	<u>Mike Shelly</u>
Position:	Project Partner
Signed:	
Date:	<u>July 2009</u>

*Environmental Resources Management Australia Pty Ltd Quality System*

This report was prepared in accordance with the scope of services set out in the contract between Environmental Resources Management Australia Pty Ltd ABN 12 002 773 248 (ERM) and the Client. To the best of our knowledge, the proposal presented herein accurately reflects the Client's intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERM did not independently verify the accuracy or completeness of these information sources

Gujarat NRE Minerals Ltd

V-mains  
*Terrestrial Flora and Fauna  
Assessment*

September 2009

Reference: 0090757 Ecology Final

**Environmental Resources Management  
Australia**

53 Bonville Avenue,  
Thornton, NSW 2322  
Telephone +61 2 49642150  
Facsimile +61 2 49642152  
[www.erm.com](http://www.erm.com)



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## INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Gujarat NRE to assess the potential flora and fauna impacts of the proposed extraction of coal within the V-mains at NRE No. 1 Colliery (*Figure 1.1*). This will also allow Gujarat NRE to establish a reliable baseline condition of terrestrial biota and habitats prior to extraction.

The assessment will accompany the Subsidence Management Plan and has been undertaken in order to satisfy the requirements set out in the *Guideline for Applications for Subsidence Management Approval* (NSW DMR 2003).

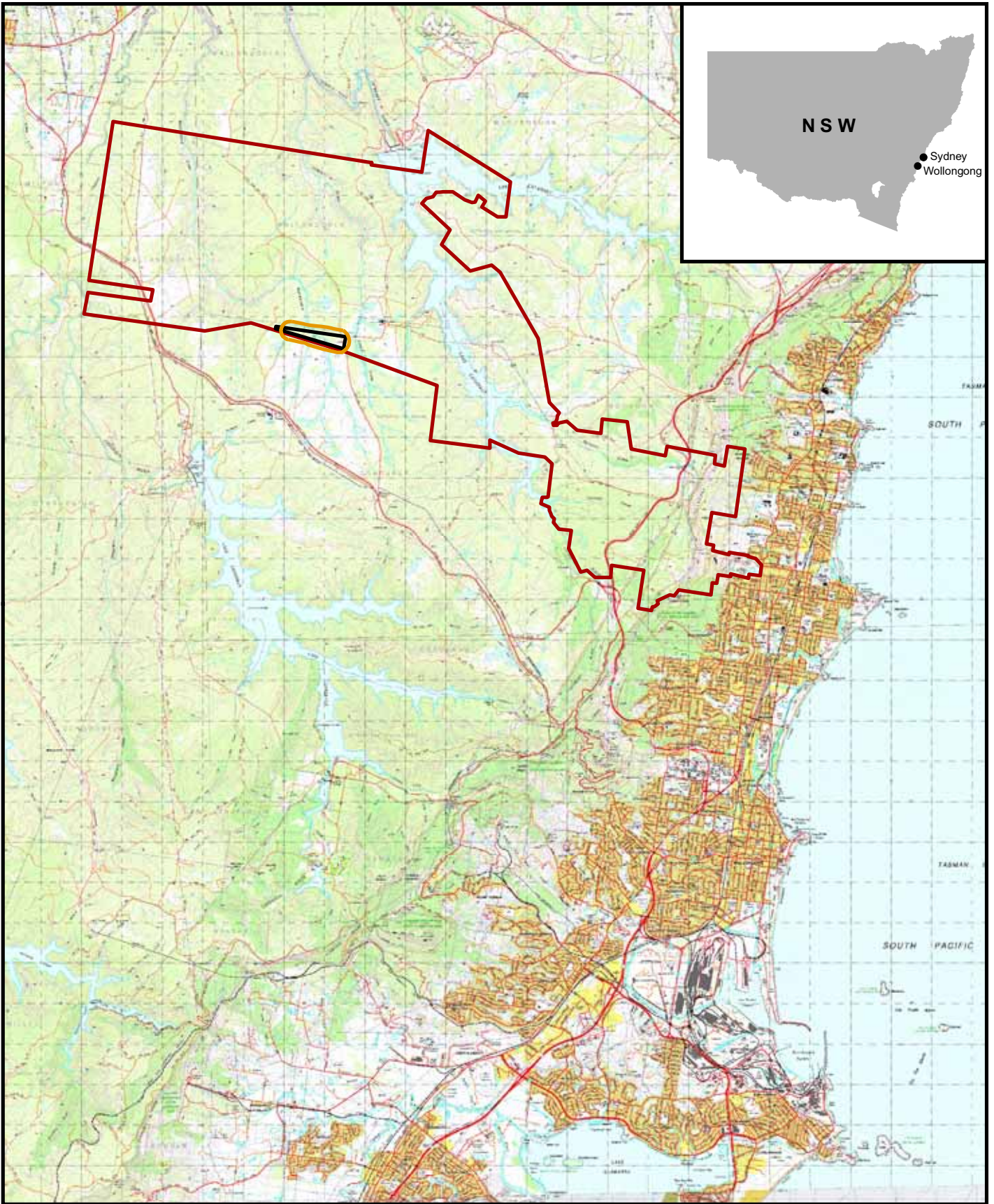
The Application Area (or subsidence impact zone) is defined by the 'Guideline for Applications for Subsidence Management Approvals' as the surface area that is likely to be affected by the proposed underground coal mining and is generally considered to be no less than the surface area defined by the depth of cover, angle of draw of 35 degrees and the limit of the proposed extraction area (NSW DMR 2003).

### 1.1




#### PURPOSE OF THE REPORT

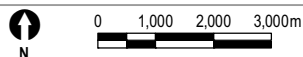
The purpose of this assessment was to:

- identify and describe the conservation significance of vegetation communities, flora species, fauna habitats and fauna species;
- assess the type and degree of impacts of mining on native flora and fauna, any threatened species, endangered populations or ecological communities considered likely to occur in the Application Area;
- identify mitigation measures to avoid or minimise the extent of potential impacts; and
- provide a benchmark against which future changes to habitats and biota can be compared.



**Legend**

-  V-Mains Application Area
-  Mine Lease Area
-  Predicted Subsidence Footprint

Client:	Gujarat NRE Ltd
Project:	V-Mains SMP
Drawing No: 0090757s_EC_GIS02_R0.mxd	
Date:	28/07/2009
Drawn by:	JF
Projection:	GCS GDA 1994
Scale:	Refer to Scale Bar
	

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**Figure 1.1**  
**Study Area Location**

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Building C, 33 Saunders St, Pyrmont, NSW 2009  
Telephone +61 2 8584 8888



## 1.2

### *DESCRIPTION OF THE APPLICATION AREA*

The proposed V-mains mining area is approximately 13 kilometres northwest of Thirroul to the north of Wollongong. The mining lease has been transferred from BHP Billiton's Cordeaux and Elouera mining lease to form part of the current mining lease for Gujarat NRE's No. 1 Colliery. The entire area overlying the extraction area is within the catchment for the Cataract Reservoir and consists mainly of natural bushland, creeks and minor wetlands. This area is designated as a Schedule 1 Restricted Access Area (Metropolitan Special Area), administered by the Sydney Catchment Authority (SCA). Bushfire has passed through most of the Application Area within the past two years (Ecology Lab 2008).

## 1.3

### *PROPOSED MINING*

Gujarat NRE proposes to mine the 2.5 m thick Bulli seam within the V-mains at a depth of between 445 m in the west and 460 m in the east of the site. Access to the V-mains will be provided via extension of the underground travelling roadways from existing workings.

Mine development in the V-mains will take place in two stages:

- Stage 1 is initial board and pillar workings to establish roadways. This would involve minimal subsidence (less than 20 millimetres) and therefore not require a Subsidence Management Plan (SMP); and
- Stage 2 is pillar extraction that will result in a goaf that is wedge shaped, approximately two kilometres long and between 75 m and 300 m wide (Seedsman Geotechnics Pty Ltd 2008). Surface subsidence above the narrower parts of the goaf (<100 m wide) will not be measurable. At widths of 300 m, predicted subsidence will increase to around 1125 mm. Associated maximum tilt is predicted to be 6 mm/m. strains are in the range of 6.5 mm/m to 3.3 mm/m respectively (Seedsman Geotechnics 2008).



## 2 *EXISTING ENVIRONMENT*

### 2.1 *SOILS AND TOPOGRAPHY*

The soils of the V-mains Application Area are a mixture of the Maddens Plains and Lucas Heights landscapes.

The Maddens Plains soil landscapes consist of moderately to gently undulating rises on plateau surfaces with widespread dells, or upland swamps/wetlands. Local relief ranges from 10 to 40 m with valley slope gradients of up to 10%. The dominant landform elements are broad, usually waterlogged drainage depressions with scattered rock outcrops (ERM 2006).

The Lucas Heights landscapes consist of gently undulating plateau surfaces and ridges 200 to 1,000 m wide, with level to gently inclined slope gradients of less than 10%. Local relief is less than 30 m and rock outcrops are absent. Lateritic podzolic soils can be present within the Lucas Heights profile, which would be a source of dissolved iron into stream waters.

The topographic map does not show any significant cliff lines within the Application Area. However, there are exposed outcrops and sandstone shelves throughout the site.

### 2.2 *CATCHMENT AND SURFACE WATER*

The Application Area is located within the Nepean River catchment, on land that forms part of Sydney's drinking water catchment. It is located approximately 2 km west of Lake Cataract and 3.5 kilometres north east of Lake Cordeaux.

The majority of the site is located within the Wallandoola Creek catchment, which flows to the Cataract River approximately one kilometre upstream of Broughtons Pass. A small section at the eastern end of the V-mains area lies within the Lizard Creek catchment, which flows to the Cataract River approximately one kilometre downstream of Appin Falls. (The Ecology Lab 2008).

Both Lizard Creek and Wallandoola Creek flow through the site in a northerly direction. Both waterways are heavily vegetated with reeds and low scrub.

### 2.3 *GROUNDWATER*

A shallow groundwater resource occurs within the unconsolidated swamp sediments, but is likely to be perched and is not hydraulically connected to the deeper groundwater resources within the bedrock aquifer (ERM 2006).

### 2.4 *REGIONAL AND LOCAL CONNECTIVITY*

The V-mains Application Area supports a large area of unfragmented woodland, heathland and swamps, and forms part of the greater Woronora catchment. The Application Area is therefore considered to be well connected to habitat for flora and fauna both locally and regionally.

### 3.1 LITERATURE REVIEW

Various sources of published information are available on the flora and fauna of the Application Area and surrounding areas. The following documents were reviewed in the preparation of this assessment.

**Biosis Research (2008):** Biosis Research prepared a Flora and Fauna Assessment to accompany a Subsidence Management Plan (SMP) application for several proposed Longwalls and the Pillar Extraction Area at NRE Wongawilli Colliery, which is to the south of the current Application Area. No threatened ecological communities were recorded in the study area. One threatened plant species, *Pultenaea aristata*, was recorded in large numbers within and adjacent to the study area and habitat was identified for a further eight threatened plant species. Nine threatened or migratory animal species were recorded in the study area. The assessments of significance undertaken by Biosis (2008) concluded that the proposal was likely to have a significant impact on local populations of Littlejohn's Tree Frog (*Litoria littlejohni*), Giant Burrowing Frog (*Heleioporus australiacus*) and the Red-crowned Toadlet (*Pseudophryne australis*). A Species Impact Statement (SIS) for those species was recommended. However, in 2009, Biosis updated these findings, and concluded that there would be no significant impacts to these species and that no SIS would be required.

**Environmental Resources Management Pty Ltd (2006):** ERM undertook a desktop assessment and field surveys within the Application Area in April 2006. Shale Sandstone Transition Forest (an Endangered Ecological Community under the NSW *Threatened Species Conservation Act 1995* (TSC Act)) was recorded in the north east and the western portion of the site. Fauna species observed included Wombats (*Vombatus ursinus*), Red-bellied Black Snake (*Pseudechis porphyriacus*), skinks (*Egernia* sp.), macropods and a variety of native birds. Follow up surveys in June and August 2006 confirmed the presence of the threatened Powerful Owl (*Ninox strenua*) and Gang-gang Cockatoo (*Calocephalon fimbriatum*) within the site.

**Kevin Mills and Associates Pty Ltd (2005):** Kevin Mills and Associates assessed the impact of mine subsidence (up to 200 mm) on flora and fauna within the No.4 Shaft, NRE Colliery at Wilton in the Shire of Wollondilly, approximately four kilometres north-east of the current Application Area. One threatened plant species, Shining Guinea Flower (*Hibbertia nitida*), was recorded. No threatened fauna species were recorded during the assessment, although they were considered likely to be present within the survey area. Kevin Mills and Associates (2005) concluded that the predicted subsidence from the proposed underground mining was unlikely to have a significant impact on flora and fauna.

**Umwelt Pty Ltd (2004):** Umwelt assessed the ecological impacts of mine subsidence (up to 880 mm) and mining induced fracturing (1.5 mm/m) within the T&W Mains, approximately four kilometres north of the current Application Area. No threatened flora or fauna species were recorded during the assessment, although the assessment area was considered to provide suitable habitat for a range of threatened species. The proposal was not expected to lead to significant impacts on diversity of the recorded flora within the assessment area. Similarly, whilst minor impacts to foraging resources and hydrology may occur, these were not expected to be significant or to impact on the survival of fauna species.

**Kevin Mills and Associates Pty Ltd (1995):** Kevin Mills and Associates undertook a flora and fauna assessment of a number of survey lines within the NRE No.1 Colliery mine lease area. The southern most survey point was approximately three kilometres north of the current Application Area. Three threatened flora species (*H. nitida*, Prickly Bush-pea (*P. aristata*) and Hairy Geebung (*Persoonia hirsuta*) were recorded.

**The Ecology Lab (2008):** The Ecology Lab undertook baseline investigations of aquatic habitat and biota in watercourses within the V Mains area of the NRE No. 1 Mine at Russell Vale in the Southern Coalfield. Water quality was found to be typical of Hawkesbury sandstone environments (relatively acidic) and showed expected seasonal variation of dissolved oxygen and temperature. Fish sampling did not capture any threatened or non-threatened fish species at any sampling sites. However, two listed threatened species, Macquarie Perch (*Macquaria australasica*) and the Sydney Hawk Dragonfly (*Austrocordulia leonardi*), are known to, or likely to be present in watercourses downstream of the mine area. The report identifies potential impacts of proposed mining activities to the aquatic habitats and water quality in the mine area as well as downstream and recommends a monitoring regime to be undertaken during and post mining.

### 3.1.1 Database Searches

A search of the Department of Environment and Climate Change (DECC) Wildlife Atlas database was conducted to obtain records of threatened flora and fauna within a 10 kilometre radius of the Application Area. A search of the on-line database maintained by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) was conducted in order to identify the likely presence of nationally listed threatened or migratory species or threatened ecological communities (or their habitats) within the locality.

All flora and fauna database records were analysed to determine the likelihood that threatened flora and fauna could occur within habitats of the Application Area.

### 3.2

#### *VEGETATION SURVEY AND MAPPING*

The NSW National Parks and Wildlife Service (NPWS) (2004) mapped the native vegetation communities present within the Woronora, O'Hare's and Metropolitan Catchment Areas and this mapping provided a basis for the vegetation surveys undertaken as part of this assessment.

Key features such as vegetation structure, dominant plant species and geological/topographical features were recorded in the field and compared to the NPWS (2004) descriptions, to confirm or not the presence of the mapped vegetation communities. The boundaries of each vegetation community were recorded in the field using a handheld GPS unit and later compared to the NPWS (2004) mapping.

Several areas of the site were difficult to access and survey due to the density of the vegetation. The distribution of vegetation communities within these areas was assessed using the NPWS (2004) mapping, aerial photograph interpretation and observations made in the field where possible.

### 3.3

#### *FAUNA HABITAT*

Habitat diversity for native fauna was assessed during the field investigations and information recorded was supplemented with existing site information. Habitat use of the site by fauna was documented through analysis of tracks, scats, diggings and other traces. Traces of threatened and significant species that might occur within the site were the focus of the surveys. Searches were conducted for the following:

- whitewash, prey remains and owl pellets;
- characteristic scats, tracks and diggings;
- trees scratches consistent with arboreal mammals; and
- other secondary indicators of fauna such as runways through vegetation.

### 3.4

#### *FAUNA SURVEYS*

Prior to fauna surveys being undertaken, an assessment of the known and potential fauna assemblages of the site was made using database records, previous reports and habitat requirements of native fauna species. Targeted surveys were then undertaken across the site in June 2006, August 2006 and November 2008. The locations of all fauna surveys are shown in *Figure 3.1* and *Figure 3.2*.

### *Terrestrial and Arboreal Mammal Trapping*

Vegetation maps and previous studies were used to identify and assess the distribution of habitat types within the Application Area. These preliminary findings were used to focus surveys in suitable habitat for threatened mammal species known, or expected to occur, within the site.

#### *Trapping*

In 2006, 40 Elliott A traps were placed along four separate transects. Thirty cage traps were also placed along four transects (seven traps per transect along two transects and eight traps per transect along two transects) (see *Figure 3.1*). All traps were set for four consecutive nights. This gave a total of 120 trap nights for the cage traps, and 160 trap nights for the Elliott A traps.

During the 2008 survey period, a total of 40 Elliott A traps were placed in suitable ground habitat along three transects (lines of traps) (one transect having twenty traps and two transects having 10 traps each), with twenty Elliott B traps mounted on brackets on trees approximately two metres above the ground along two separate transects (*Figure 3.2*). All traps were set for three consecutive nights, totalling 180 trap nights.

Traps were placed at approximately 10 metre intervals along each transect. Traps were baited with peanut butter, honey and rolled oats. The cage traps were also baited with sardines. Dry leaves and other plant material or hessian sacks were used as bedding and a plastic bag placed over the Elliott traps in inclement weather in order to keep any captured animals dry and warm.

Traps were checked early each morning, closed and then reopened at dusk to prevent any non-target animals (such as skinks) entering the traps during the day.

#### *Hair Tubes*

Forty hair tubes were set along four 100 m transects and left in situ for 14 days during the June 2006 survey period to detect the presence of bandicoots, macropods, quolls or other terrestrial mammals. This gave a total of 560 trap nights. Hair funnels were baited with a peanut butter or sardine mixture. Collected hairs were sent to Barbara Triggs of Dead Finish, Genoa, Victoria for identification.







### 3.4.2 *Microchiropteran Bat Surveys*

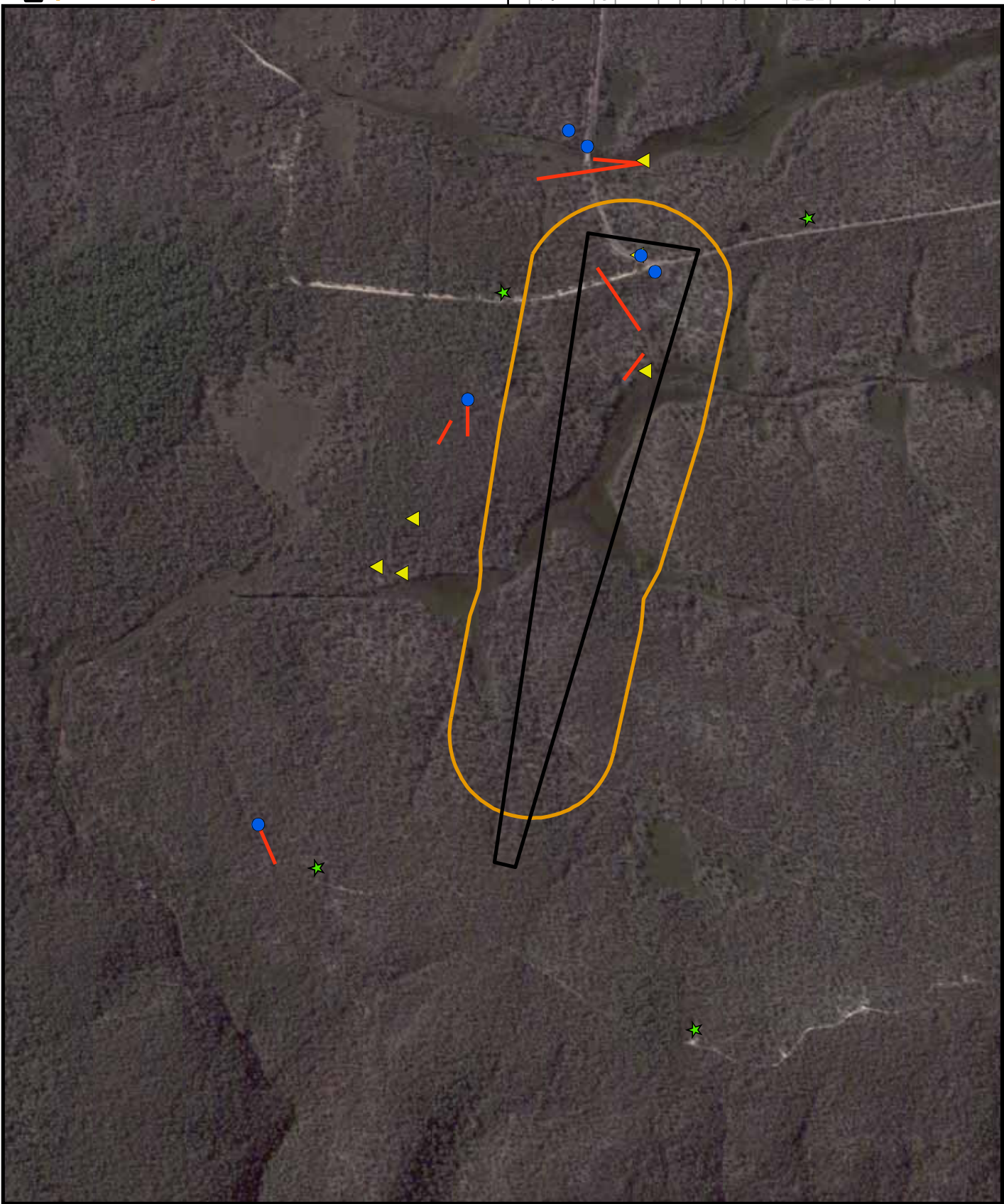
An Anabat echolocation call detector was used to record bat calls during the 2006 and 2008 survey periods. All bat surveys commenced within one hour of dusk.

Two Anabat detectors with delay units were left overnight for three consecutive nights in June 2006. The detectors were left within six separate locations adjacent to Lizard Creek and within areas of Exposed Sandstone Scribbly Gum Woodland and Shale Sandstone Transition Forest.

An Anabat detector with delay units was left overnight for two consecutive nights in November 2008 and sampled the Shale Sandstone Transition Forest and adjacent to Wallandoola Creek (*Figure 3.2*). Bat calls were analysed by Glenn Hoye of Fly By Night Bat Surveys Pty Ltd.

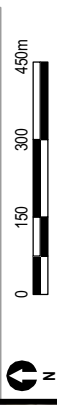
**Legend**

-  V-Mains Application Area
-  Predicted 20mm Subsidence Extent
-  Anabat Location
-  Bird Call Playback Location
-  Mammal/Amphibian Call Playback Location
-  2006 Transect Location



**Figure 3.1**  
**Spotlighting, Call Playback and Trapping Survey Locations 2006**

Client:	Gujarat NRE Minerals Limited
Project:	V-Mains SMP
Drawing No:	0090757s_EC_GIS01a_R0.mxd
Date:	07/09/2009
Drawn by:	JF
Reviewed by:	MK
Scale:	Refer to Scale Bar






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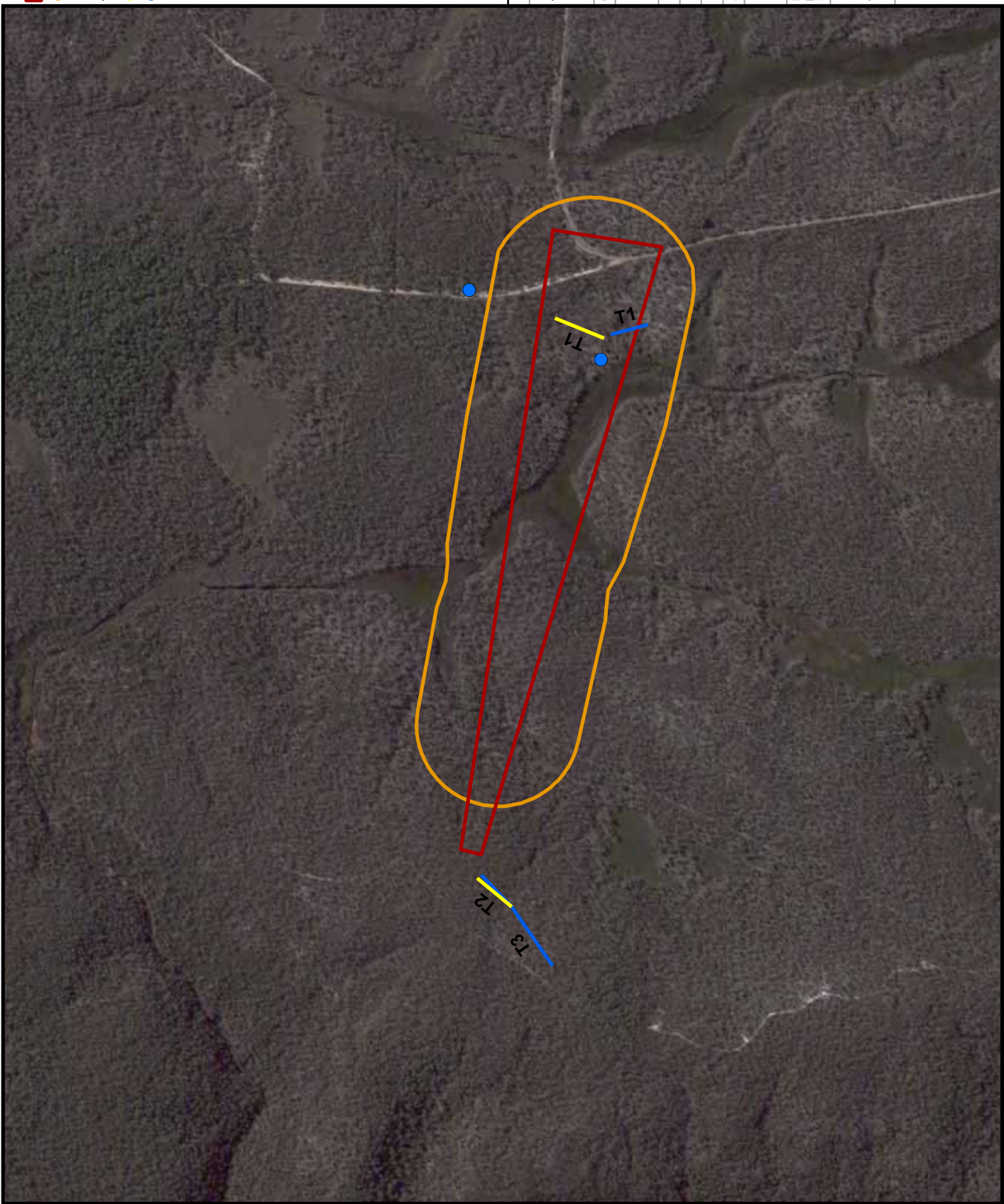


**Legend**

-  V-Mains Application Area
-  Predicted 20mm Subsidence Extent
-  Anabat Location

**Transects**

-  Arboreal
-  Ground



**Figure 3.2**  
**Spotlighting, Call Playback and Trapping Survey Locations 2008**

Client:	Gujarat NRE Minerals Limited
Project:	V-Mains SMP
Drawing No:	0090757s_EC_GIS004a_R0.mxd
Date:	07/09/2009
Drawn by:	JF
Reviewed by:	MK
Scale:	Refer to Scale Bar



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### 3.4.3 *Birds*

Diurnal avifauna transects were undertaken between 20 and 22 June 2006 and 8 to 11 August 2006. Surveys were conducted during periods of high activity, particularly early morning.

Opportunistic sightings of bird species were recorded across the site between the 20 and 22 June 2006, 8 to 11 August 2006 and 11 to 14 November 2008. All bird species heard and/or observed throughout the survey period were recorded.

#### *Owl Call Playback*

Nocturnal owl call playback sessions to detect Powerful Owl, Sooty Owl (*Tyto tenebricosa*), Barking Owl (*Ninox connivens*) and Masked Owl (*T. novaehollandiae*) were undertaken between 7 and 10 August 2006. Owl call playback was conducted in five locations (*Figure 3.1*). Forty owl call playback sessions were conducted over four nights.

Nocturnal owl call playback sessions to detect Powerful Owl, Sooty Owl and Masked Owl were undertaken between 12 and 13 November 2008. Owl call playback was conducted in two locations. Six call playback sessions were conducted over two nights.

### 3.4.4 *Amphibians*

Diurnal and nocturnal active searches for amphibians were undertaken in areas of suitable habitat between 20 and 23 June 2006 and 12 to 14 November 2008. Auditory and visual records of frogs were noted during these searches. Call playback was also undertaken.

In 2006, a total of 4.5 person hours was dedicated to active diurnal amphibian searches. Call playback was also undertaken at various sites adjacent to Wallandoola and Lizard Creeks (*see Figure 3.1*).

### 3.4.5 *Reptiles*

Reptiles were surveyed by actively searching suitable habitat over the entire survey period in both June 2006 and November 2008. Ground debris and rocks were overturned and replaced during the searches. In 2006, eight hours and forty minutes were dedicated to active herpetofauna diurnal searches. Opportunistic sightings were also recorded.

### 3.4.6

#### *Spotlighting*

Spotlighting was undertaken over four nights on the 20 to 22 June 2006 and two nights on 12 and 13 November 2008. Species targeted included the Yellow-bellied Glider, owls and microchiropteran bats. Total person hours for spotlighting in 2006 was 8.2 hours. In 2008, survey effort was approximately four hours.



#### 4.1 WEATHER CONDITIONS DURING 2008 SURVEY PERIOD

Weather data was obtained from the Bureau of Meteorology (BoM) Bellambi weather station approximately 10 kilometres to the south-east of the Application Area.

Weather during the 2008 surveys was generally fine and warm, although heavy rain fell on the evening of 14 November 2008 (recorded as 15 November by BOM). In 2006, there was rain on all days.

**Table 4.1** *Weather Conditions during the Survey Period*

Parameter	Survey Period				
	11/11/08	12/11/08	13/11/08	14/11/08	15/11/08
Temperature 9 am (°C)	20.2	20.4	21.4	21.8	16.7
Relative Humidity 9 am (%)	64	65	74	78	92
Wind Direction 9am (°)	SSE	N	NE	NE	SSE
Wind Speed 9am (km/hr)	9	24	24	19	28
Cloud Cover am (8ths of sky)	1	4	0	0	8
Min Temperature (°C)	14.9	15.7	18.5	18.9	16.6
Max Temperature (°C)	22.9	24.4	23.2	23.9	19.2
Rainfall (mm)	0	0	0	0	8.2
Temperature 3pm (°C)	22.0	23.0	22.9	21.3	19.0
Relative Humidity 3pm (%)	50	68	73	79	86
Wind Direction 3pm (°)	NE	NE	NE	N	SSE
Wind Speed 3pm (km/hr)	20	28	37	22	15
Cloud Cover pm (8ths of sky)	0	0	0	0	8
Source: Bureau of Meteorology (BoM)					

## 4.2.1

*Vegetation Communities*

Five vegetation communities were identified within the Application Area as described below. *Figure 4.1* shows the location of each vegetation community within the Application Area.

*Sandstone Gully Peppermint Forest*

This vegetation community is a tall dry shrubby forest which occurs on sheltered slopes and gullies (NPWS 2004) and was noted within the central portion of the Application Area, west of Wallandoola Creek.

Dominant overstorey species include Sydney Peppermint (*Eucalyptus piperita*) and Red Bloodwood (*Corymbia gummifera*). Common species within the diverse shrub layer include Hairpin Banksia (*Banksia spinulosa* var. *spinulosa*), Smooth Geebung (*Persoonia levis*), Narrow-leaf Geebung (*P. linearis*), Juniper Wattle (*Acacia ulicifolia*), Tooton (*Leptospermum polygalifolium*) and Sunshine Wattle (*Acacia terminalis*). Common understorey and groundcover species include Spiny-headed Mat-rush (*Lomandra longifolia*), Upright Panic (*Entolasia stricta*), Paroo Lily (*Dianella caerulea*), Variable Sword-sedge (*Lepidosperma laterale*), Woolly Xanthosia (*Xanthosia pilosa*) and Curly-wig (*Caustis flexuosa*) (NPWS 2004).

*Transitional Shale Stringybark Forest (Shale Sandstone Transition Forest)*

This community is reported to be a moderately tall forest that generally occurs in drier areas (NPWS 2004) and was noted in two small patches, at the eastern and western extents of the Application Area. It is a component of the larger endangered ecological community Shale Sandstone Transition Forest (listed as endangered under the TSC Act).

Dominant overstorey species include White Stringybark (*Eucalyptus globoidea*), Thin-leaved Stringybark (*Eucalyptus eugenioides*) and Grey Gum (*Eucalyptus punctata*). The understorey is shrubby and contains a mix of Banksias, Tea-trees, and Geebungs. Groundcover species include Spiny-headed Mat-rush (*Lomandra longifolia*), Cane Wire-grass (*Aristida ramosa*), Bordered Panic (*Entolasia marginata*) and Upright Panic (*Entolasia stricta*) (NPWS 2004).

### *Exposed Sandstone Scribbly Gum Woodland*

This vegetation community is open woodland that occurs on ridges and exposed slopes (NPWS 2004) and was noted as the dominant community across the Application Area.

Dominant trees include Scribbly Gums (*Eucalyptus racemosa*, *Eucalyptus sclerophylla*, *Eucalyptus haemastoma*) with Stringybark (*Eucalyptus oblonga*), Red Bloodwood (*Corymbia gummifera*) and Silvertop Ash (*Eucalyptus sieberi*). Mid-storey species include Hairpin Banksia (*Banksia spinulosa* var. *spinulosa*), Paperbark Tea-tree (*Leptospermum trinervium*), Juniper Wattle (*Acacia ulicifolia*) and Finger Hakea (*Hakea dactyloides*). The sparse groundcover includes species such as Blue Mat-rush (*Lomandra glauca*), Upright Panic (*Entolasia stricta*), Blue Dampiera (*Dampiera stricta*) and Curly-wig (*Caustis flexuosa*) (NPWS 2004).

### *Upland Swamps: Fringing Eucalypt Woodland*

This community occurs adjacent to Lizard Creek and Wallandoola Creek.


















It consists of very open woodland with scattered Stringybark (*Eucalyptus oblonga*), Narrow-leaved Scribbly Gum (*Eucalyptus racemosa*) and Silvertop Ash (*Eucalyptus sieberi*). Common midstorey species include Heath-leaved Banksia (*Banksia ericifolia* subsp. *ericifolia*), Fern-leaved Banksia (*Banksia oblongifolia*) and Finger Hakea (*Hakea dactyloides*). Dominant understorey species include Slender Twine-rush (*Leptocarpus tenax*) and Pink Swamp Heath (*Sprengelia incarnata*) (NPWS 2004).

### *Upland Swamps: Sedgeland-Heath Complex*

This community contains a low dense cover of sedges and small shrubs in low depressions or adjacent to upland swamps (NPWS 2004) and was noted along Wallandoola Creek and its tributaries, and along the banks of Lizard Creek.

Dominant shrub species include *Baekkea imbricata*, Pink Swamp Heath (*Sprengelia incarnata*), Blunt-leaf Heath (*Epacris obtusifolia*), *Symphionema paludosum* and Swamp Boronia (*Boronia parviflora*). Common understorey species include Slender Twine-rush (*Leptocarpus tenax*), Zig-zag Bog-sedge (*Schoenus brevifolius*) and *S. paludosus* (NPWS 2004).

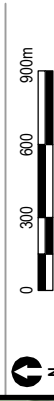
**Legend**

-  V-Mains Application Area
-  Predicted Subsidence Footprint
- Vegetation Community**
-  Artificial Wetlands
-  Cleared
-  Exposed Sandstone Scribbly Gum Woodland
-  Nepean Sandstone Gully Forest
-  O'Hares Creek Shale Forest
-  Rock Plate Heath-Mallee
-  Sandstone Gully Peppermint Forest
-  Transitional Shale Dry Ironbark Forest
-  Transitional Shale Open Blue Gum Forest
-  Transitional Shale Stringybark Forest
-  Upland Swamps: Banksia Thicket
-  Upland Swamps: Fringing Eucalypt Woodland
-  Upland Swamps: Sedgeland-Heath Complex
-  Upland Swamps: Tea-Tree Thicket
-  Weeds and Exotics

Source:  
The Native Vegetation of the Woronora, O'Hares and Sydney Metropolitan Catchments (NPWS, 2003)

**Figure 4.1**  
**Vegetation Communities within the Site**

Client:	Gujarat NRE Minerals Limited
Project:	V-Mains SMP
Drawing No:	0090757s_EC_GIS01a_R0.mxd
Date:	07/09/2009
Drawn by:	JF
Reviewed by:	MK
Scale:	Refer to Scale Bar



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Building C, 33 Saunders St, Pymont, NSW 2009  
Telephone +61 2 8584 8888



#### 4.2.2

#### *Threatened Flora Species*

Figure 4.2 shows threatened flora species previously recorded within a ten kilometre radius of the site, whilst Table 4.2 indicates the likelihood of their occurrence within the Application Area.

No threatened flora species have been observed within the Application Area during the various surveys although it is recognised that potential habitat is available for the following nine flora species:

- *Acacia baueri* subsp. *aspera*;
- Bargo Geebung (*Persoonia bargoensis*);
- *Epacris purpurascens* var. *purpurascens*;
- Deane's Melaleuca (*Melaleuca deanei*);
- Hairy Geebung (*Persoonia hirsuta* subsp. *evoluta*);
- Needle Geebung (*Persoonia acerosa*);
- Prickly Bush-pea (*Pultenaea aristata*);
- Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*); and
- Woronora Beard-heath (*Leucopogon exolasius*).

#### 4.2.3

#### *Endangered Ecological Communities*

The Transitional Shale Stringybark Forest recorded within the Application Area forms part of the Shale Sandstone Transition Forest complex as listed under Part 3 of Schedule 1 of the TSC Act.
















Shale-Sandstone Transition Forest occurs at the edges of the Cumberland Plain where shale rock and clay soils gradually change to sandstone. The dominant canopy species are Forest Red Gum (*Eucalyptus tereticornis*), Grey Gum (*E. punctata*), stringybarks (*E. globoidea*, *E. eugenoides*) and ironbarks (*E. fibrosa* and *E. crebra*).

Before European settlement, Shale-Sandstone Transition Forest was extensive at the edges of the Cumberland Plain and covered 43,990 hectares. Today, it is reduced to 22.6 percent of its original extent in an area bounded by Sackville to the north, Mulgoa to the west, Wilton to the south and Revesby to the east (NPWS 2004). Shale-Sandstone Transition Forest occurs in the Bankstown, Baulkham Hills, Blacktown, Campbelltown, Hawkesbury, Liverpool, Parramatta, Penrith, Sutherland and Wollondilly local government areas.

The greatest threat to Shale-Sandstone Transition Forest is clearing for agriculture and urban/rural residential development. Other threats include grazing, mowing, rubbish dumping, weed invasion and frequent fire (NPWS 2004).

The proposal is not expected to impact on this community. No other endangered ecological communities occur within the Application Area.

**Legend**

-  V-Mains Application Area
-  10km Buffer of V-Mains
-  Predicted Subsidence Footprint
-  *Acacia bauei* subsp. *aspera*
-  *Epacris purpurascens* var. *purpurascens*
-  *Persoonia hirsuta* subsp. *evoluta*
-  Bargo Geebung
-  Brown Pomaderris
-  Bynoe's Wattle
-  Hairy Geebung
-  Needle Geebung
-  Prickly Bush-pea
-  Rainforest Cassia
-  Small-flower Grevillea
-  Woronora Beard-health

Source:  
NSW National Parks and Wildlife Service  
Atlas of NSW Wildlife

**Figure 4.2**  
**Threatened Flora Species**  
**within 10Km of the Site**

Client:	Gujarat NRE Minerals Limited
Project:	V-Mains SMP
Drawing No:	0090757s_EC_GIS03a_R0.mxd
Date:	07/09/2009
Drawn by:	JF
Reviewed by:	MK
Scale:	1:250,000



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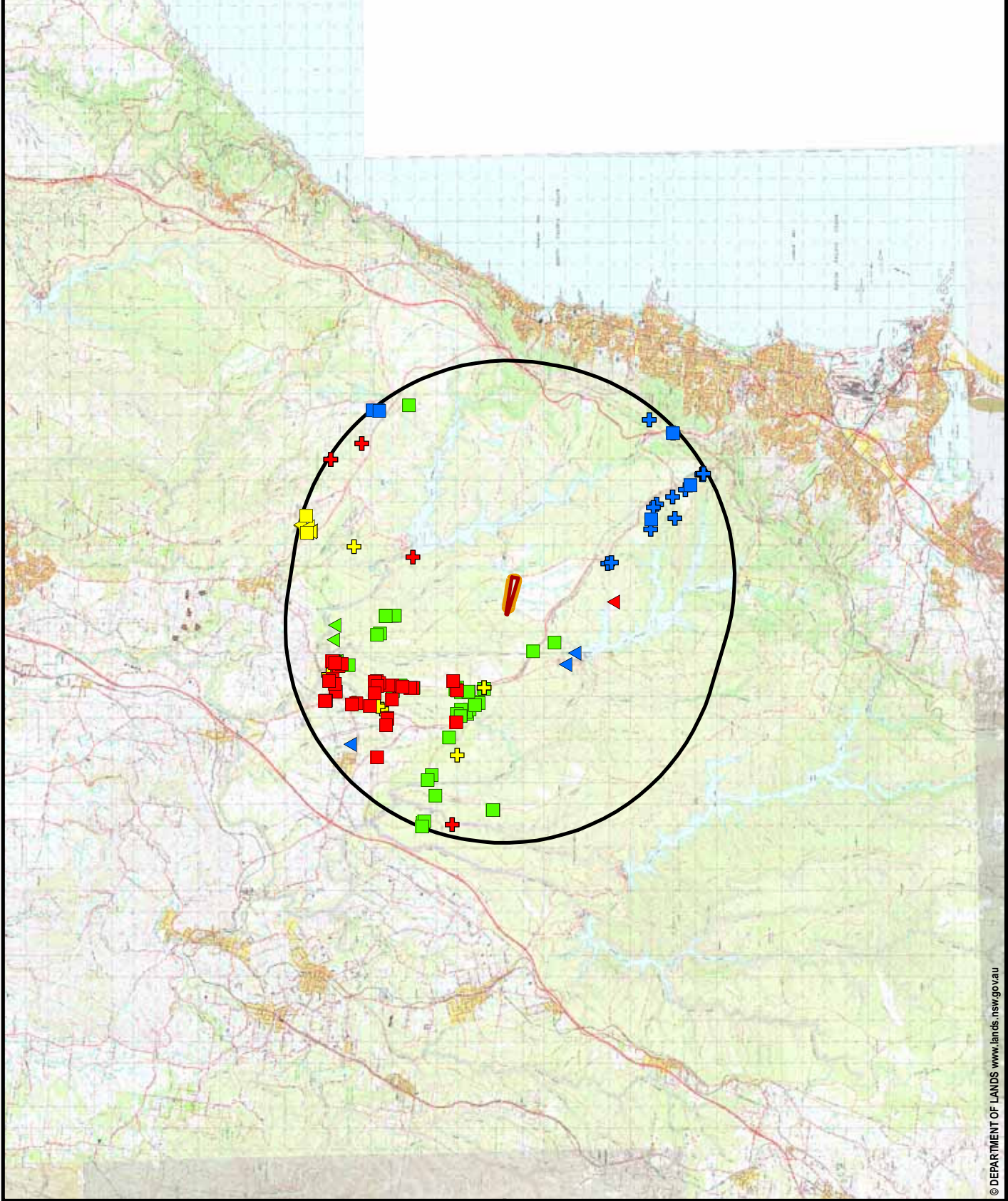


Table 4.2 Likelihood of Threatened Flora Species and Communities

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Potential for Impact	7-part Test Required?
<b>Flora</b>					
<i>Acacia baueri</i> subsp. <i>aspera</i>	V	V	Populations occur in low, damp heath, often on exposed rocky outcrops over a wide range of climatic and topographical conditions between 400-900 m AHD. Appears to require open conditions - rarely observed where there is any shrub or tree canopy development. Habitat characteristics vary considerably between sites in the Blue Mountains and the coastal sandstone plateaus.	Moderate. The species is found in damp heath on rocky outcrops and could occur within the study area. However, all of the damp heath areas within the study area have a dense growth of rushes, shrubs and fringing woodland and do not provide preferred habitat conditions. The species has also been assessed by NPWS (2003) as being unlikely to be significantly impacted by subsidence.	No.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	V	-	This species is found in a wide range of habitats most of which have a strong shale soil influence. These include drainage depressions supporting wet heath within or adjoining shale cap communities.	Moderate. The species is found within drainage depressions supporting wet heath and these could be impacted by cracking and draining due to subsidence. However the species is found in a wide range of habitats and therefore it would be unlikely to rely solely on the drainage lines of the site or be impacted by subsidence (NPWS 2003).	No.
Small-flower Grevillea <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V	V	Crests or upper slopes in lightly clayey soils in woodlands, often with laterite soils. It has been recorded in a range of ecological communities including Shale Sandstone Transitional Forest (Endangered Ecological Community).	Moderate. There is suitable habitat within the site. However, the habitats in which the species would be found will not be significantly impacted by subsidence.	No.

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Potential for Impact	7-part Test Required?
Bargo Geebung <i>Persoonia bargoensis</i>	E	V	Restricted to a small area on the western edge of the Woronora Plateau. Grows in woodland to dry sclerophyll forest on sandstone and clayey laterite on heavier, well drained, loamy, gravelly soils of the Hawkesbury Sandstone and Wianamatta Shale in the catchments of the Cataract, Cordeaux and Bargo River. Species often associated with light disturbance and found along vehicle tracks and cleared areas.	Moderate. There is suitable habitat within the site. However, the habitats in which the species would be found will not be significantly impacted by subsidence.	No.
Hairy Geebung <i>Persoonia hirsuta</i>	E	E	Occurs in woodlands and dry sclerophyll forest on sandstone or very rarely on shale. This species is patchily distributed on the Central Coast and Tablelands of NSW, in an area bounded by Putty, Glen Davis and Gosford in the North, and Royal National Park and Hill Top in the South.	Moderate. There is suitable habitat within the site. However, the habitats in which the species would be found will not be significantly impacted by subsidence.	No.
Brown Pomaderris <i>Pomaderris brunnea</i>	V	V	Open forest, confined to the Colo and upper Nepean River Catchments.	Low. Lack of preferred habitat and if present, habitat would not be impacted by subsidence.	No
Bynoe's Wattle <i>Acacia bynoeana</i>	E	V	Occurs in heath and dry sclerophyll forest, typically on sand and sandy clay, often with ironstone gravels and is usually very infertile and well-drained. Often grows among rock platforms. Also found in open and slightly disturbed sites such as trail margins, edges of roadsides, grading spoil mounds and in recently burnt patches.	Low. Lack of preferred habitat and if present, habitat would not be impacted by subsidence.	No.

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Potential for Impact	7-part Test Required?
Needle Geebung <i>Persoonia acerosa</i>	V	V	Grows in heath, low woodland or dry sclerophyll forest on sandstone, in well drained soils. Prefers ridgetops and plateaux. Species frequently occurs on disturbance margins, such as roadsides.	Moderate. There is suitable habitat within the site. However, the habitats in which the species would be found will not be significantly impacted by subsidence.	No.
Rainforest Cassia <i>Senna acclinis</i>	E		Grows in or on the edges of subtropical and dry rainforest.	Low. Lack of suitable habitat and does not occur in habitats that could be impacted by subsidence.	No.
Woronora Beard-heath <i>Leucopogon exolasius</i>	V	V	Prefers woodlands on sandstone and is often associated with rocky hillsides and creek lines.	Moderate. The species is not reliant on the habitats that could be impacted by subsidence. i.e swamps and creeks or ridgelines, being found in a range of habitats.	No.
Deane's Melaleuca <i>Melaleuca deanei</i>	V	V	Grows in heath on sandstone.	Moderate. There is suitable habitat within the site. However, the habitats in which the species would be found will not be significantly impacted by subsidence.	No.
Prickly Bush-pea <i>Pultenaea aristata</i>	V	V	Grows in moist, dry sclerophyll woodland to heath on sandstone; Helensburg to Mt Keira. Flowering has been recorded in winter and spring.	High. Potential habitat may be impacted by surface cracking and water loss as a result of subsidence due to longwall mining. The species is also vulnerable to track clearing activities.	Yes.
<b>Endangered Ecological Community</b>					
Cumberland Plain Woodland	E	Cr E	Occurs on the clay soils derived from shale on the undulating Cumberland Plain in central New South Wales.	Low. Not recorded within the site.	No
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	E	E	Occurs in moderately wet sites, with an annual rainfall of 800-1100 mm per year, and on clay soils derived from Wianamatta shale.	Low. Not recorded within the site.	No

Common/Scientific Name	TSC Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Potential for Impact	7-part Test Required?
Shale/Sandstone Transition Forest	E	E	Occurs on areas transitional between the clay soils derived from Wianamatta Shale and the sandy soils derived from Hawkesbury Sandstone on the margins of the Cumberland Plain.	Low. Community is present. This community is independent of groundwater and not likely to be significantly impacted by subsidence. Changes to species composition are unlikely to occur. Therefore not considered likely to be impacted.	No
<p><i>* preferred habitat is a summary of literature reviewed and is not the sole information relied on for assessment of occurrence or impact</i></p> <p><i>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; Cr E = Critically Endangered</i></p>					

### 4.3 FAUNA

A list of species recorded at the site is provided as *Annex A* and are discussed below.

#### 4.3.1 *Species Recorded on Site (2006 and 2008 Assessment)*

##### *Mammals*

A total of 19 mammal species were recorded by ERM within the Application Area during the 2006 and 2008 site assessments. Macropod scats were found within all habitats, with the most commonly observed species being the Eastern Grey Kangaroo (*Macropus giganteus*) and Swamp Wallaby. Wombat scats were also common across the site.

Sugar Gliders (*Petaurus breviceps*) were recorded within the forested portions of the site, with Eastern Pygmy-possum (*Cercartetus nanus*) records restricted to the areas of Scribbly Gum woodland. The Eastern Pygmy-Possum is a threatened species listed under the TSC Act and has been further assessed in *Table 4.3*. These species were detected by spotlighting and arboreal trapping.

A range of insectivorous bats were detected across the site including Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Little Forest Bat (*Vespadelus vulturnus*), White-striped Mastiff Bat (*Tadarida australis*) and Long-eared Bat (*Nyctophilus* sp.).

The Eastern Freetail Bat (*Mormopterus norfolkensis*), Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*), Eastern Falsistrelle (*Falsistrellus tasmaniensis*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*) were also recorded and are all threatened species. These bats have been further assessed in *Table 4.3*.

Two introduced species were recorded within the site; European Red Fox (*Vulpes vulpes*) was recorded through scat analysis and one House Mouse (*Mus musculus*) was trapped in the 2006 surveys.

##### *Birds*

A total of 63 bird species were recorded on the site (refer to *Annex A*). The majority of these species are widespread and/or abundant species that commonly occur in woodland, heathland, regrowth vegetation and various other habitats. No introduced species were recorded.

Four threatened birds have been confirmed within the Application Area during the various surveys; Brown Treecreeper (*Climacteris picumnus*), Gang-gang Cockatoo, Powerful Owl and Marbled Frogmouth (*Podargus ocellatus*). The presence of these species on site has been further assessed in *Table 4.3*.

#### *Reptiles and Amphibians*

Very few reptiles were detected (refer to *Annex A*), which may reflect the sites recent fire history. Species detected include the Red-bellied Black Snake, Eastern Brown Snake (*Pseudonaja textilis*), Copper-tailed Skink (*Ctenotus taeniolatus*) and Lesueur's Velvet Gecko (*Oedura lesueurii*).

Amphibian activity was high along the creeks, swamps and ephemeral pools that had formed along the small tracks. Species recorded were Common Eastern Froglet, Eastern Banjo Frog, Peron's Tree Frog (*Litoria peronii*), Red-backed Brood Frog (*Pseudophryne coriacea*), Leseur's Frog (*Litoria lesueurii*) and Smooth Toadlet (*Uperoleia laevis*). None of these species are listed as threatened. No threatened frogs were recorded by ERM on the site.




#### **4.3.2** *Threatened Fauna Species*

A number of threatened fauna species have been previously recorded within 10 kilometres of the site (*Table 4.3*), with nine species confirmed to occur within the Application Area in the 2006 and 2008 surveys. The threatened species recorded were:

- Eastern Pygmy Possum;
- Brown Treecreeper;
- Gang-gang Cockatoo;
- Marbled Frogmouth;
- Powerful Owl;
- Eastern Bent-wing Bat;
- Eastern False Pipistrelle;
- Eastern Freetail Bat; and
- Greater Broad-nosed Bat.

All of the above species are listed as Vulnerable under the TSC Act and have been further assessed in *Table 4.3*. None of the species are listed as threatened under the EPBC Act.

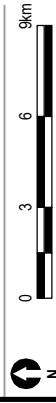
**Legend**

-  V-Mains Application Area
-  10km Buffer of V-Mains
-  Predicted Subsidence Footprint

**Source:**  
 NSW National Parks and Wildlife Service  
 Atlas of NSW Wildlife

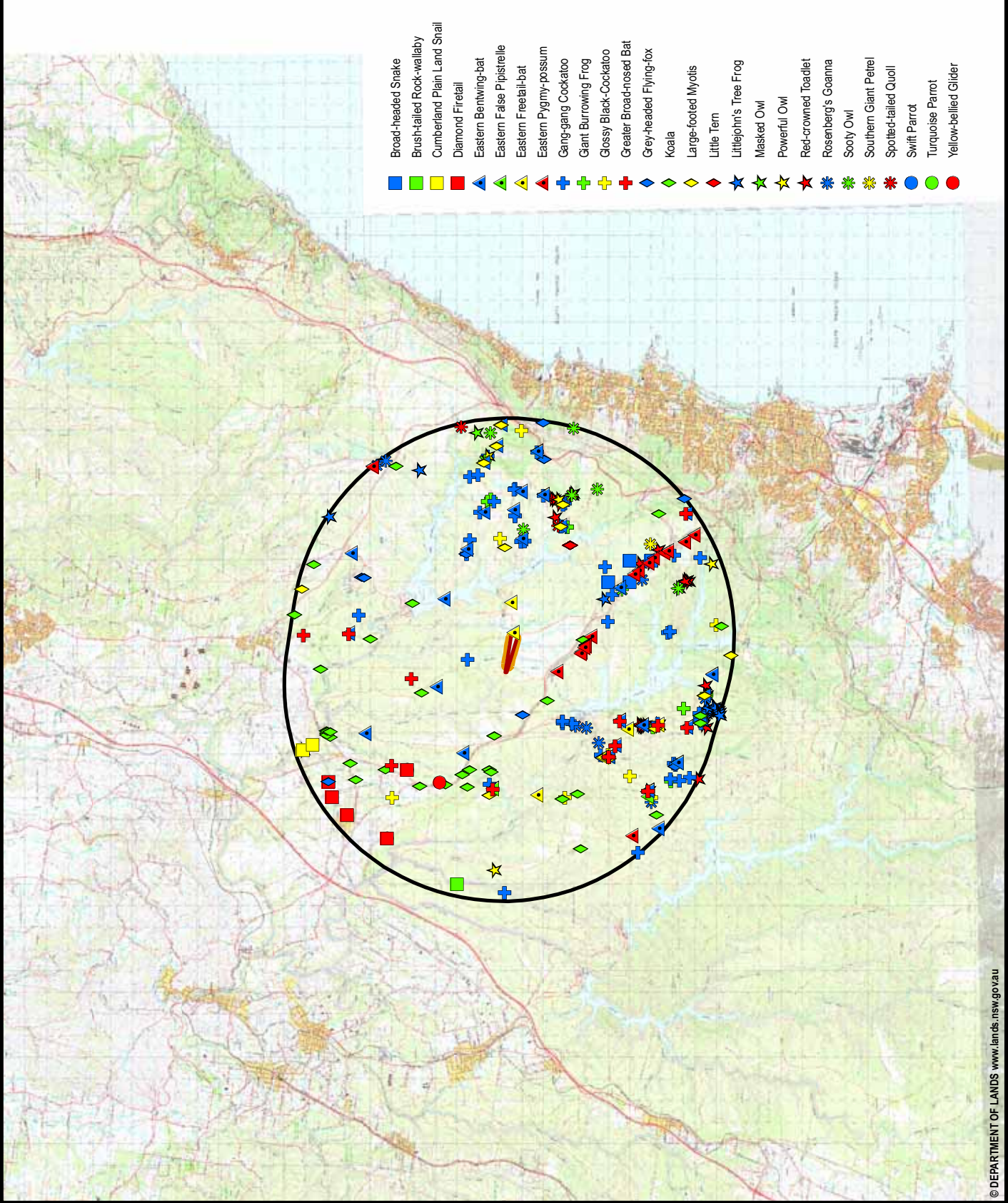
**Figure 4.3**  
**Threatened Fauna Species**  
**within 10Km of the Site**

**Client:** Gujarat NRE Minerals Limited  
**Project:** V-Mains SMP  
**Drawing No:** 0090757s\_EC\_GIS06a\_R0.mxd  
**Date:** 07/09/2009 **Drawing size:** A4  
**Drawn by:** JF **Reviewed by:** MK  
**Scale:** 1:250,000



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 Telephone +61 2 8584 8888






























-  Broad-headed Snake
-  Brush-tailed Rock-wallaby
-  Cumberland Plain Land Snail
-  Diamond Firetail
-  Eastern Bentwing-bat
-  Eastern False Pipistrelle
-  Eastern Freetail-bat
-  Eastern Pygmy-possum
-  Gang-gang Cockatoo
-  Giant Burrowing Frog
-  Glossy Black-Cockatoo
-  Greater Broad-nosed Bat
-  Grey-headed Flying-fox
-  Koala
-  Large-footed Myotis
-  Little Tern
-  Littlejohn's Tree Frog
-  Masked Owl
-  Powerful Owl
-  Red-crowned Toadlet
-  Rosenberg's Goanna
-  Sooty Owl
-  Southern Giant Petrel
-  Spotted-tailed Quoll
-  Swift Parrot
-  Turquoise Parrot
-  Yellow-bellied Glider

Table 4.3 Likelihood of Threatened Fauna Species occurring On Site

Common/Scientific Name	TSC Act	FM Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Impact	7-part Test Required?
<b>Birds</b>						
Brown Treecreeper <i>Climacteris picumnus</i>	V		-	Drier forests and woodlands particularly among fallen timber.	<b>Present.</b> Potential impacts on vegetation within drier woodlands and forests within the Application Area are considered to be minimal, but may include tree tilt or fall. These impacts are considered unlikely to significantly affect the habitat available for foraging, roosting or shelter.	No
Diamond Firetail <i>Stagonopleura guttata</i>	V		-	Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Moderate. Potential impacts on vegetation within woodlands and riparian areas within the Application Area are considered to be minimal, but may include tree tilt or fall. These impacts are considered unlikely to significantly affect the habitat available for foraging, roosting or shelter.	No
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	V		-	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, this species moves to lower altitudes, preferring more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. This species favours old growth attributes for nesting and roosting.	<b>Present.</b> Impacts may include loss of foraging habitat (through tree tilting/ collapse caused by subsidence) and nesting and roosting habitat (loss of hollow bearing trees through tilting/ collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion of the total available habitat for the species.	No
Glossy Black-cockatoo <i>Calyptrorhynchus lathami</i>	V		-	Found in forests on sites with low soil-nutrient status, reflecting distribution of <i>Casuarina</i> spp. and <i>Allocasuarina</i> spp. Prefers drier forest types with less rugged landscapes. Feeds exclusively on seeds from the wood cones of she-oaks. Requires forest with tree hollows for breeding.	Moderate. Impacts may include loss of foraging habitat (through Sheoak tilting/ collapse caused by subsidence) and nesting and roosting habitat (loss of hollow bearing trees through tilting/ collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion of the total habitat available.	No

Common/Scientific Name	TSC Act	FM Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Impact	7-part Test Required?
Marbled Frogmouth <i>Podargus ocellatus</i>	V		-	Subtropical rainforest in deep, wet, sheltered gullies. Less frequently occurs in higher elevation temperate rainforests and wet eucalypt forest with a well-developed rainforest understorey.	<b>Present.</b> Impacts may include loss of foraging, roosting and nesting habitat (through tree tilting/collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion the total available habitat.	No
Masked Owl <i>Tyto novaehollandiae</i>	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.	Low. Impacts may include loss of foraging habitat (through tree tilt/ collapse caused by subsidence) and nesting and roosting habitat (loss of hollow bearing trees through tilting/ collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion the total available habitat.	No
Powerful Owl <i>Ninox strenua</i>	V			Mountain forests, gullies and forest margins; sparser hilly woodlands, coastal forests, woodland, scrub.	<b>Present.</b> Impacts may include loss of foraging habitat (through tree tilt/ collapse caused by subsidence) and nesting and roosting habitat (loss of hollow bearing trees through tilting/ collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion the total available habitat.	No
Regent Honeyeater <i>Xanthomyza phrygia</i>	E		E,M	Nomadic species following rich sources of nectar, primarily winter flowering species.	Low. Preferred seasonal habitat is limited within the Application Area and this species is unlikely to be dependant on the resources present.	No
Sooty Owl <i>Tyto tenebricosa</i>	V		-	Closed and tall open forests with dense understorey, especially gullies. Active in the canopy, avoids cleared areas.	Low. Due to the large home range of the Sooty Owl and the limited amount of potential habitat disturbance (i.e tree tilt/ fall).	No.
Swift Parrot <i>Lathamus discolor</i>	E		E	Migratory species frequenting eucalypt forest and woodland, following winter flowering eucalypts (eg. swamp mahogany). Breeds in Tasmania.	Low. Preferred seasonal habitat is limited within the Application Area, with no breeding habitat available. The potential impact of the proposed development is considered to be minor given the high mobility of this species and the limited amount of habitat disturbance (tree loss/ tilt).	No

Common/Scientific Name	TSC Act	FM Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Impact	7-part Test Required?
Turquoise Parrot <i>Neophema pulchella</i>	V		-	Eucalypt woodland and open forest with groundcover of grasses and low understorey of shrubs. Usually associated with mixed assemblage of native pine Callitris and a variety of Eucalyptus spp. including White Box, Yellow Box, Blakey's Red Gum, Red Box, Red stringy-bark, Bimble box and Mulga Ironbark. Nests in hollows of small trees, dead eucalypts or in holes, stumps or fenceposts.	Low. Preferred seasonal habitat is limited within the Application Area, with no breeding habitat available. The potential impact of the proposed development is considered to be minor given the high mobility of this species and the limited amount of habitat disturbance (tree loss/ tilt).	No
<b>Mammals</b>						
Eastern Bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V		-	Roosts in caves, old mines, stormwater channels; forages above the forest canopy.	<b>Present.</b> Potential impact on roosting habitat within caves through cliff collapse, rockfall and cracking.	Yes.
Eastern False Pipistrelle <i>Falstirellus tasmaniensis</i>	V		-	Uncommon resident in tall forest on the Great Dividing Range and adjacent coastal plains. Roosts in tree hollows.	<b>Present.</b> Impacts may include loss of roosting habitat (loss of hollow bearing trees through tilting/ collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion the total habitat available for Eastern False Pipistrelle	No
Eastern Freetail-bat <i>Mormopterus norfolkensis</i>	V		-	Wide range of forested habitats including rainforest to dry open forest. Roosts in tree hollows and under loose bark.	<b>Present.</b> Impacts may include loss of roosting habitat (loss of hollow bearing trees through tilting/ collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion the total habitat available for Eastern Freetail-bat.	No
Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	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.	Moderate. Potential impact on roosting habitat within caves through cliff collapse, rock fall and cracking.	Yes
Large-footed Myotis <i>Myotis adversus</i>	V		-	Roosts in caves, tunnels, under bridges and in dense vegetation. Forages over nearby lakes, rivers, large streams.	Moderate. Potential impact on roosting habitat within caves through cliff collapse, rock fall and cracking.	Yes
Eastern Pygmy Possum <i>Cercartetus nanus</i>	-		V	Wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath.	<b>Present.</b> Habitats for the species are considered unlikely to be significantly impacted by subsidence.	No

Common/Scientific Name	TSC Act	FM Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Impact	7-part Test Required?
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	V		-	The open canopy above rivers and creeks utilised during foraging and roosting occurs in tree hollows.	<b>Present.</b> Impacts may include loss of foraging habitat (through tree tilt/ collapse caused by subsidence) and nesting and roosting habitat (loss of hollow bearing trees through tilting/ collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion the total available habitat	No
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	V		V	Forages on fruits, blossoms and nectar of eucalypts. In early summer roosts in large groups (camps) in forests or mangroves.	Moderate. Foraging habitat unlikely to be significantly impacted.	No
Brush-tailed Rock-wallaby <i>Petrogale penicillata</i>	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. Lack of suitable habitat.	No
Koala <i>Phascolarctos cinereus</i>	V		-	Forests typically on high nutrient soils characterised by presence of preferred Eucalypt feed trees.	Moderate. Preferred feed trees, particularly Scribbly Gums were noted across much of the Application Area. Impacts may include loss of foraging habitat (loss of feed trees through tilting/ collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area (particularly given the large amount of Scribbly Gum Woodland present on the site), and to represent only a small proportion the total habitat available for Koala.	No
Long-nosed Potoroo (SE Mainland) <i>Potorous tridactylus tridactylus</i>	V		V	Coastal heath and wet and dry sclerophyll forests. Major habitat requirement is thick ground cover where soil is light and sandy. Digs small holes in earth while foraging (Strahan 1995).	Moderate. Habitat present but the species unlikely to be impacted by subsidence.	No
Southern Brown Bandicoot <i>Isodon obesulus obesulus</i>	E		E	Heathy forest, shrubland and woodland which is usually supported by well-drained soils. A mosaic of post-fire vegetation is an important component of the species' habitat.	Moderate. Habitat present but the species unlikely to be impacted by subsidence.	No.
Spotted-tail Quoll <i>Dasyurus maculatus</i>	V		V	Wide range of forested habitats including rainforest, open forest, coastal heath, riparian forest. Nests in caves, hollow logs or tree hollows.	Moderate. Potential impact on nesting habitat within caves through cliff collapse, rock fall and cracking.	Yes

Common/Scientific Name	TSC Act	FM Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Impact	7-part Test Required?
Yellow-bellied Glider <i>Petaurus australis</i>	V		-	Tall open sclerophyll forest with mature trees that provide tree hollows for breeding; a mix of eucalypts, eucalypt nectar and sap, honeydew, manna, pollen and invertebrates under decorticated bark.	Moderate. Impacts may include loss of foraging and breeding habitat (loss of trees through tilting/collapse caused by subsidence). Tree loss through subsidence is anticipated to be minor within the Application Area, and to represent only a small proportion the total habitat available for Yellow-bellied Glider.	No
<b>Reptiles</b>						
Broad-headed Snake <i>Hoplocephalus bungaroides</i>	E		V	Woodland, open woodland/ heath communities on Sandstone within the Sydney Basin. They utilise rock crevices and exfoliating sheets of weathered sandstone on exposed cliff edges during autumn, winter and spring, and shelter in hollows in large trees within 200 m of escarpments in summer.	High. Suitable habitat present within rock crevices and exfoliating sheets of weathered sandstone on exposed cliff edges. Potential impact on foraging habitat through cliff collapse, rockfall and cracking and alteration or destruction of rock shelters through surface cracking.	Yes
Rosenberg's Goanna <i>Varanus rosenbergi</i>	V		-	Ground-dwelling species. Termite mounds used as breeding chambers. Inhabits coastal heaths. Shelters in burrows, hollow logs and rock crevices. Coastal heaths, humid woodlands and wet and dry sclerophyll forests. Isolated population in coastal NSW.	High. Suitable shelter and foraging habitat present within rock crevices, burrows etc. Potential impact on rock shelters and burrows through surface cracking.	Yes
<b>Frogs</b>						
Giant Burrowing Frog <i>Heleioporus australiacus</i>	V		V	Northern population in sandstone ridgetop habitat and broader upland valleys in these locations it is associated with small headwater creek lines and along slow flowing to intermittent creeklines. The vegetation is woodland, open woodland and heath and can also be associated with 'hanging swamp' seepage lines and where small pools form from the collected water.	High. Potential impact on creek lines due to surface cracking caused by subsidence.	Yes
Green and Golden Bell Frog <i>Litoria aurea</i>	E		V	In NSW the species occupies disturbed habitats and breeds largely in ephemeral ponds.	Unlikely. Lack of suitable habitat.	No
Littlejohn's Tree Frog <i>Litoria littlejohni</i>	V		V	Restricted to sandstone woodland and heath communities at mid to high altitude. It lives in both the tree canopy and on the ground, and it has been seen sheltering under rocks on high exposed ridges during summer.	Moderate. Potential impact on rock shelters through surface cracking.	Yes

Common/Scientific Name	TSC Act	FM Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Impact	7-part Test Required?
Red-crowned Toadlet <i>Pseudophryne australis</i>	V		-	Known only from Triassic sandstones of the Sydney Basin. Favoured habitats for shelter are between flat sandstone rocks (bush-rock). Prefer permanent soaks with dense vegetation rather than permanently flowing streams (feeder-creeks).	Moderate. Potential impact on rock shelters through surface cracking and on permanent soaks.	Yes.
Stuttering Frog <i>Mixophyes balbus</i>	E		V	Rainforest, Antarctic beech and wet sclerophyll forests (Cogger 2000). The species depends on freshwater streams and riparian vegetation for breeding and habitation. The southern portion of the Stuttering Frog's range is separated from the northern portion by the Hunter Valley.	Unlikely. Lack of suitable habitat	No.
<b>Fish</b>						
Macquarie Perch <i>Macquaria australiasica</i>	V		E	A riverine, schooling species. It prefers deep, rocky holes with considerable cover. Spawning occurs just above riffles (shallow running water). Populations may survive in impoundments if able to access suitable spawning sites.	Unlikely. Numerous substantial barriers to fish passage in the form of waterfalls over sandstone cliffs exist between the Cataract River and Lizard and Wallandoola Creeks. Macquarie Perch unlikely to be present upstream of these barriers (The Ecology Lab 2008)	No
Trout Cod <i>Maccullochella macquariensis</i>	E		E	Found close to cover and in relatively fast currents, especially in fairly deep water close to the bank, and often congregate around large woody debris (snags).	Unlikely. Lack of suitable habitat.	No
<b>Invertebrates</b>						
Cumberland Plain Land Snail <i>Meridolum corneovirens</i>				Primarily inhabits Cumberland Plain Woodland (an endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. Snail lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	Unlikely. Lack of suitable habitat.	No
Sydney Hawk Dragonfly <i>Austrocordulia leonardi</i>		E		Deep, cool, slow-flowing water in rocky rivers with steep sides. Relative environmental stability appears to be an important habitat feature, with rapid variation in water level and flow rate likely to have a negative effect on the suitability of habitat for larvae.	Low. The nearest watercourse to the Application Area containing suitable habitat for the Sydney Hawk Dragonfly is likely to be the Cataract River, which is beyond the influence of significant subsidence impacts (The Ecology Lab 2008).	No

Common/Scientific Name	TSC Act	FM Act	EPBC Act	Preferred Habitat*	Likelihood of Occurrence and Impact	7-part Test Required?
Giant Dragonfly <i>Petalura gigantean</i>	E			Occurs in permanent wetlands, both coastal and upland, permanent swamps and bogs with some free water and open vegetation. Larvae occupy permanent long chambered burrows, built under swamps. The larvae emerge from the terrestrial entrances at night and in wet weather, in search of insects and other arthropods to eat. Larvae are not known to swim and avoid open water.	High. Suitable habitat in swamps for adults and larvae.	Yes
<p>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; M = Migratory</p> <p>* preferred habitat is a summary of literature reviewed and is not the sole information relied on for assessment of occurrence or impact</p> <p>NB: Pelagic and Marine species have been omitted from consideration due to lack of habitat</p>						

#### 4.4

#### *MAJOR HABITAT FEATURES*

The V-mains Application Area is relatively undisturbed and provides a mosaic of habitat types for native flora and fauna. Disturbance is generally limited to minor access tracks and the No. 8 fire trail, which provides access to the No.4 Shaft and SCA lands to the north. All vegetated areas of the site are dominated by native flora.

Forest and woodland areas provide habitat for a diversity of fauna species. Trees are of various ages, providing fauna with a range of shelter and foraging resources. Tree hollows were observed within both forest and woodland areas and provide nesting and shelter habitat for a range of arboreal mammals and birds.

Fallen branches and logs are relatively abundant within the forest and woodland areas, providing resources for ground-dwelling mammal, birds and reptiles. The occurrence of dense ground vegetation interspersed with open areas provides preferred habitat for ground mammals such as bandicoots and small bird species.

Lizard and Wallandoola Creeks flow northwards through the site. The presence of fringing vegetation and pools of various depths along the length of the watercourses provides a diversity of habitats for amphibian and aquatic species, as well as fresh water resources for terrestrial species. Aquatic habitat in these creeks has been assessed separately by The Ecology Lab (2008).

The habitats for threatened terrestrial and arboreal fauna that are most likely to be impacted by subsidence include creeks, streams and their tributaries, upland swamps and rocky habitats. These habitat types are discussed in more detail below.

#### 4.4.1

#### *Creeks, Streams and Tributaries*

Wallandoola Creek, Lizard Creek and associated ephemeral tributaries occur within the Application Area. Both creeks are in good condition and provide a range of habitats and resources for birds, small ground-dwelling mammals, reptiles and amphibians.

The creeks contain numerous and varied habitat features, including snags, overhanging bank vegetation, cascade-riffles, rock crevices and earthen banks. These features provide suitable habitat for aquatic species such as fish (galaxids and smelt) and freshwater crayfish (*Euastacus* sp.). Freshwater crayfish were observed within both Wallandoola Creek and Lizard Creek and numerous burrows were present along the stream banks (The Ecology Lab 2008). Dense riparian vegetation along the creeks provides preferred habitat for a variety of amphibians and reptiles.

Wallandoola Creek and Lizard Creek provide permanent aquatic habitat, in the form of deep pools, whilst the tributaries of these creeks are ephemeral and contain limited aquatic habitat (The Ecology Lab 2008).

#### **4.4.2 Upland Swamps**

Upland swamps within the site provide foraging and sheltering habitat for birds (e.g. Eastern Spinebill), mammals (e.g. Swamp Wallaby (*Wallabia bicolor*) and Common Wombat) and frogs (e.g. Common Eastern Froglet (*Crinia signifera*) and Eastern Banjo Frog (*Limnodynastes dumerilii*). Upland swamps also provide breeding habitat for species such as the Giant Dragonfly (*Petalura gigantea*). Reliance of fauna on upland swamps also increases during low rainfall periods (NSW Scientific Committee 2005), increasing their significance in the local area.

#### **4.4.3 Rocky Habitats**

Rocky sandstone outcrops and overhangs are found throughout the Application Area, particularly along the creek edges. Cliffs and overhangs provide shelter and nesting sites for a number of fauna species. Rocky outcrops provide shelter for snakes and geckos. Similarly, rock overhangs may provide habitat for mammals such as insectivorous bats and Brown Antechinus. Bird species may nest on elevated sandstone ledges (e.g. Superb Lyrebird) or under overhangs (e.g. Rock Warbler).



The Southern Coalfield's significant natural features include rivers and higher order streams, associated sandstone river gorges, major cliff lines and upland swamps. The area also contains important flora, fauna and aquatic ecosystems, many listed threatened species, populations and endangered ecological communities and a significant number of Aboriginal heritage sites (DoP 2008). Aquatic ecosystems and Aboriginal heritage have been assessed separately by specialist consultants.

The most direct environmental impact of underground mining is subsidence, which causes changes in the level of the ground surface. Predicted maximum subsidence is up to 1000 millimetres (Seedsman Geotechnics 2009). Seedsman Geotechnics (2009) states that maximum tilts of six millimetres/metre and horizontal strains of 3.3 millimetres/metre in tension and 6.5 millimetres/metre in compression are expected to develop over part of the Application Area as a result of the proposed mining.

As described in the *Strategic Review of the Impacts of Underground Coal Mining on Natural Features in the Southern Coalfields of NSW* (DoP 2008), subsidence impacts are principally tensile and shear cracking of the rock mass and localised buckling of strata caused by valley closure and upsidence but also include subsidence depressions or troughs. As a depression/ 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.

It is generally recognised that the impacts of subsidence due to longwall mining on terrestrial ecosystems (including Transitional Shale Stringybark Forest) are likely to be less significant than those experienced by aquatic dependant ecosystems (DECC 2007a). Primary effects of subsidence on such communities are likely to be associated with changes in soil-moisture content, and the relationships between this indicator and subsidence are still poorly understood (DECC 2007a). Similarly, impacts to threatened flora from subsidence due to longwall mining are not predicted to be as significant as those for threatened fauna.

Potential impacts to flora and fauna from subsidence include tree tilt, alterations to watertable levels, impacts to water quality and surface water flows and cracking and/or collapse of cliffs and rocky areas. Potential direct and indirect impacts from subsidence are discussed in greater detail in *Table 5.1*.

**Table 5.1 Potential Impacts to Flora and Fauna from Subsidence**

Natural Feature	Physical Subsidence Impact	Potential Impact to Flora/ Fauna
Vegetation	Permanent tree tilt of up to 6mm/m due to subsidence.	Tree tilt/ fall causing damage to adjacent vegetation and loss of fauna habitat.
Rivers (creeks, streams, tributaries).	Surface cracking due to subsidence.	<p>Loss of surface flows or water levels (increased frequency, duration and magnitude of drying aquatic habitats).</p> <p>Drying of river pools, instream macrophyte beds and wetlands leading to loss of aquatic or instream habitats.</p> <p>Loss of longitudinal connectivity (connectivity between pools and riffles) may reduce fauna migration opportunities.</p> <p>Changes to water quality (increased iron oxides, manganese, sulphides and electrical conductivity, and lower dissolved oxygen).</p> <p>Reduced diversity of instream habitat due to the growth of iron-oxidising bacteria which can also be seen as a rusty-coloured mass in the water.</p> <p>Release of gas into the water column - oxidation of gas may lead to death of riparian vegetation and instream fauna.</p> <p>Changes in water quality / quantity in streams and creeks</p>
	Water-rock chemical interactions along new flow pathways. Tilting of stream beds.	Stream bank and bed erosion which may lead to: <ul style="list-style-type: none"> <li>• Toppling of trees due to tilt.</li> <li>• Impacts on tree roots from strain.</li> </ul>
	Ponding in subsidence troughs	Waterlogging of vegetation.
Upland Swamps	Draining of perched water table and loss of swamp soil moisture due to cracking of clay or shale seals which typically underlie upland swamps.	<p>Loss of swamp vegetation dependent on high soil moisture or change of species composition</p> <p>Loss of fauna, including threatened species dependent on swamp ecosystems.</p> <p>Loss of water purification and flow regulation function for downstream ecosystems.</p> <p>Increased susceptibility to fire which may increase impacts to swamp dependent species.</p> <p>Gullyng and erosion of swamps, exacerbating the draining of water from swamp soils.</p>

Natural Feature	Physical Subsidence Impact	Potential Impact to Flora/ Fauna
Groundwater	Localised upsidence in the stream below swamp.	Change in swamp vegetation communities
	Depressurisation of groundwater from the coal seam	Lowering of the watertable beyond the reach of plants
	Cracking of rock bars, draining of rock pools.	Subsiding vegetation into the groundwater zone
Rocky habitats	Surface cracking within cliffs	Loss of habitat for cliff dependent species and damage to riparian vegetation.
	Cliff collapse and rockfall	Large cracks may act as temporary pitfall for reptiles and small mammals.
	Cracking and movement within rocks below swamps	Loss of habitat for cliff dependent species (e.g. loss of roosts for bats and nest sites for cliff-nesting birds).
		Potential drop in perched water table leading to:
		<ul style="list-style-type: none"> <li>• Loss of standing pools, with impacts on amphibians and fish.</li> <li>• Change in swamp vegetation communities.</li> <li>• Draining/ drying of springs, soaks and dams.</li> </ul>
	Surface cracking	Alter and possibly destroy rock shelters and burrows.

## 5.1 *POTENTIAL IMPACTS TO SIGNIFICANT NATURAL FEATURES WITHIN THE APPLICATION AREA*

### 5.1.1 *Creeks, Streams and Tributaries*

In general, the majority of subsidence impacts to significant natural features are associated with valley closure and upsidence effects, leading to impacts to rivers and significant streams, and in particular the cracking of stream beds and underlying strata.

The streams of the Southern Coalfields are considered a high priority for protection if they have some or all of the following characteristics: perennial or intermittent/ephemeral with pools; a diverse array of instream habitats that provide for feeding, breeding or drought refugia and/or they support threatened species, iconic species or a high diversity of species (DECC 2007a). The reaches of Wallandoola and Lizard Creek within the Application Area are generally characterised by extended pools backed up behind isolated exposed sandstone ledges, often with less than 0.5 metre drop from the upstream to the downstream pools. Neither creek shows significant erosion or bank stability (Geoterra 2009). Lizard Creek, Wallandoola Creek and its tributaries are all considered to be significant natural features and are considered a high priority for protection.

Within the Application Area the subsidence deformations induced by mining will be applied to relatively flat terrain with very few rock outcrops. Therefore, systematic impacts will dominate and there will be few dis-ordered movements. Similarly, there will be no identifiable valley closure or upsidence deformations. The predicted strains are in the range of +3 mm/m to -6 mm/m. These levels are not sufficient to cause tensile cracking in solid rock. The tensile strains may cause existing joints in sandstone to open slightly (approximately 2 mm) (Seedsman Geotechnics 2009).

Without cracking of solid rock, there is no potential for loss of surface water and it is highly unlikely that there would be any observable flow-on effects on aquatic habitats, or their biota, within or immediately downstream of the Application Area (Cardno Ecology Lab 2009). In addition, the depth of the extraction is such that there will be no inter-connected cracks from the seam to the surface (Seedsman Geotechnics 2009).

There is a possibility of a localised increase in the natural stream gradient due to the maximum predicted tilt exceeding the gradient of the creeks flowing through the Application Area (Cardno Ecology Lab 2009). This could lead to an increase in flow rate, migration of flow channels, erosion of the stream bank and bed, and reduction in the volume and retention time of pools (Cardno Ecology Lab 2009). The changes in pool volume and retention time could decrease the connectivity between habitats, particularly during periods of low flow. Cardno (2009) states that the impacts to aquatic biota within the Application Area could be locally significant within a small 300m reach of the watercourse directly above the mine area, because there are only a few small, permanent pools within this section of Wallandoola Creek. However, this represents only a very small proportion of the local aquatic habitat (Cardno Ecology Lab 2009).

### 5.1.2 *Upland Swamps*

Upland Swamps are defined by the Department of Natural Resources (DNR) (2009 online) as vegetated freshwater wetlands that occur in shallow basins, being located in low hills or mountains. They include shallow marshes, sedge swamps, "hanging" swamps, wet heaths and peat swamps. Hanging swamps are those formed where groundwater discharge occurs as a result of impermeable layers in the bedrock. Swamps may also occur on valley-fill deposits eroded from the surrounding ridges (DNR online 2009). No hanging swamps have been identified within the application area.

Upland swamps rely on groundwater, rainfall and runoff from a local catchment for their source of water. They may hold water permanently, or may fill on a seasonal or intermittent basis.

Upland swamps are important parts of catchments because they absorb water and allow runoff for long periods after rainfall has ceased. Clearing and draining of swamps alters wetland hydrology and habitat values (DNR online). Swamps have a major role in regulating the flow and water quality of perennial streams. Upland swamps in this region are diverse and are key habitats for a wide variety of fauna including many threatened species such as the Giant Burrowing Frog and Red-crowned Toadlet.

DECC (2007a) has recognised four large clusters of upland swamps on the plateau areas that are considered to have particular significance in providing large contiguous areas of related habitat. Wallandoola Creek forms one of these important clusters and includes those areas mapped within the Application Area. The effect of mining-induced surface cracking on upland swamps can be severe, where the swamps are in effect perched water tables dependent on ponded rainfall on top of thin clay or shale floors. Rupturing of these seals is likely where they rest on bare rock rather than deep soil, or where they occur close to cliffs (DECC 2007a). These perched water tables are easily fractured and drained by the tensile strains above an advancing subsidence wave, putting at risk upland swamps and other groundwater dependent ecosystems in its path (DECC 2007a).

Geoterra (2009) indicates that “in-valley” upland swamps are located along the riparian channel periphery of Wallandoola Creek. There are no “hanging” swamps within the Application Area (Geoterra 2009).

The impacts from the mining of the Application Area are not expected to crack solid rock (Seedsman Geotechnics 2009), with impacts predicted to be the slight opening of existing sandstone joints. Without cracking of solid rock, there is no potential for loss of surface water and it is highly unlikely that there would be any observable flow-on effects on aquatic habitats, or their biota, within or immediately downstream of the Application Area (Cardno Ecology Lab 2009). In addition, the depth of the extraction is such that there will be no inter-connected cracks from the seam to the surface (Seedsman Geotechnics 2009), and therefore impacts to groundwater and groundwater dependent ecosystems (swamps) within the area are not expected. Consequently the species that rely on these swamps for habitat such as the Giant Dragonfly (if it occurs there) should not experience significant impacts from subsidence.

### 5.1.3 *Rocky Habitats*

The Application Area contains small cliffs/ledges and rocky outcrops that provide potential habitat for the threatened Broad-headed Snake, and other species of reptile.

Seedsman Geotechnics (2009) predicts the strains on the rocky outcrops to be in the range of +3 mm/m to -6 mm/m. These levels are not sufficient to cause tensile cracking in solid rock. The tensile strains may cause existing joints to open slightly.

This report has considered the general impacts of the proposal to native flora and fauna (impacts including tilt, strain, clearing, erosion and alterations to surface water flows) in Chapter 5. This chapter of the report provides a summary of the findings of Seven-part tests conducted to assess the impacts of the proposal to threatened flora, threatened fauna and endangered ecological communities. *Annex B* provides the detailed seven part tests.

## 6.1

### INTRODUCTION

A number of threatened flora and fauna are considered likely, or moderately likely to occur within the site (see *Table 4.2* and *Table 4.3*). However, many of these species are unlikely to be impacted by alterations to habitats as a result of subsidence. Consequently, the decision to assess a threatened species under Part 5(a) of the EP& A Act is a combination of the likelihood of occurrence, and the likelihood of impact.

The threatened species identified as occurring (or likely to occur) within the site and potentially impacted by the proposal include:

- Broad-headed Snake;
- Red-crowned Toadlet;
- Rosenberg's Goanna;
- Giant Burrowing Frog;
- Littlejohn's Tree Frog;
- Spotted-tailed Quoll;
- Giant Dragonfly;
- Large-footed Myotis;
- Large-eared Pied Bat; and
- Eastern Bentwing-bat.

These species were subsequently assessed using the seven-part test of significance. The results of the seven-part test assessments concluded no significant impacts expected for all species.



This section of the report provides the management and mitigation measures to be implemented as part of the proposal in order to avoid, minimise and mitigate potential impacts to native flora and fauna. A concluding statement is also provided.

*7.1**AVOIDANCE*

There are currently minimal feasible economic alternatives to mining in the proposed Application Area. However, the pillar extraction mining method as proposed has the potential to be modified should subsidence impacts significantly change from what has been predicted. In 2007 a map of 'ecological risk management zones' was provided to NRE for consideration and these areas included upland swamp communities, creek lines and riparian zones, significant fauna habitats and endangered ecological communities and an additional buffer zone of 250 metres around these areas. The risk management zones provide/d the subsidence engineers and mine managers with an understanding of the locations of sites of ecological significance within the Application Area and an opportunity to reassess the mine plans based upon this information.

*7.2**MITIGATION*

Measures to mitigate potential impacts from subsidence are recommended to assist in the amelioration of impacts. These include:

- if fracturing does occur, remediation should be implemented as soon as possible. Methods could include grouting. All remediation works undertaken should be controlled in an Environmental Management Plan (EMP);
- if fracturing occurs leading to loss of surface water these areas should be prioritised for remediation;
- if significant cracking occurs in vegetated areas then measures such as temporary fencing should be implemented. This will ensure that fauna are not injured or trapped; and
- prior to any remediation works, advice should be sought from an ecologist regarding the potential impacts of such remediation works to plant and animal populations within the area.

A distinct advantage of the type of mining method (pillar extraction) is that progressive monitoring can be used to limit further extraction should the need or opportunity arise. The nature and extent of any remediation will be determined by monitoring and direct consultation with relevant government agencies including DECC and SCA. The potential for remediation measures to induce a greater adverse impact over and above that attributable to mine subsidence must be balanced with the potential for natural remediation to occur.

### 7.2.1 *Monitoring*

Monitoring of the important habitat areas (such as the upland swamps, creeks and rocky habitats) should occur pre and post mining. Although not expected, this will enable the detection of any significant impacts to these habitats, and allow for targeted remediation.

Additional fauna surveys in suitable seasons to detect the threatened frogs and the Giant Dragonfly, the species predicted to be most at risk if impacts from subsidence do occur, should be undertaken to obtain population information and distributions, should any of the species be detected. This will also allow for targeted remediation and adaptive management if subsidence does impact important areas for these species and varies from impact level as predicted.

## 7.3 *CONCLUSION*

Based on the Seedsman (2009), Geoterra (2009), Cardno (2009) and ERM field survey and assessments, the current proposal is not expected to have significant impacts on threatened species. Additional surveys and pre and post mining monitoring are recommended to assist in the identification of any impacts and targeted remediation, if impacts occur.

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Annex A

## Fauna Species Recorded Within Site



Common Name	Scientific Name
<b>Birds</b>	
Australian King-Parrot	<i>Alisterus scapularis</i>
Australian Magpie	<i>Gymnorhina tibicen</i>
Australian Raven	<i>Corvus coronoides</i>
Australian Wood Duck	<i>Chenonetta jubata</i>
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
Brown Thornbill	<i>Acanthiza pusilla</i>
Brown Treecreeper	<i>Climacteris picumnus</i>
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>
Chestnut-rumped Heathwren	<i>Hylacola pyrrhopygia</i>
Crimson Rosella	<i>Platycercus elegans</i>
Diamond Dove	<i>Geopelia cuneata</i>
Eastern Rosella	<i>Platycercus eximius</i>
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Eastern Yellow Robin	<i>Eopsaltria australis</i>
Fairy Martin	<i>Hirundo ariel</i>
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>
Golden Whistler	<i>Pachycephala pectoralis</i>
Grey Butcherbird	<i>Cracticus torquatus</i>
Grey Currawong	<i>Strepera versicolor</i>
Grey Fantail	<i>Rhipidura fuliginosa</i>
Grey Shrike-thrush	<i>Colluricincla harmonica</i>
Laughing Kookaburra	<i>Dacelo novaeguineae</i>
Lewin's Honeyeater	<i>Meliphaga lewinii</i>
Little Wattlebird	<i>Anthochaera chrysoptera</i>
Marbled Frogmouth	<i>Podargus ocellatus</i>
Masked Lapwing	<i>Vanellus miles</i>
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>
Noisy Friarbird	<i>Philemon corniculatus</i>
Noisy Miner	<i>Manorina melanocephala</i>
Olive-backed Oriole	<i>Oriolus sagittatus</i>
Pheasant Coucal	<i>Centropus phasianus</i>
Pied Currawong	<i>Strepera graculina</i>
Powerful Owl	<i>Ninox strenua</i>
Quail	<i>Coturnix sp.</i>
Red Wattlebird	<i>Anthochaera carunculata</i>
Scarlet Robin	<i>Petroica multicolor</i>
Silvereye	<i>Zosterops lateralis</i>
Southern Boobook	<i>Ninox novaeseelandiae</i>
Southern Emu-wren	<i>Stipiturus malachurus</i>

Common Name	Scientific Name
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>
Spotted Pardalote	<i>Pardalotus punctatus</i>
Striated Pardalote	<i>Pardalotus striatus</i>
Tree Martin	<i>Hirundo nigricans</i>
Variiegated Fairy-wren	<i>Malurus lamberti</i>
Wedge-tailed Eagle	<i>Aquila audax</i>
Weebill	<i>Smicrornis brevirostris</i>
Welcome Swallow	<i>Hirundo neoxena</i>
White-browed Scrubwren	<i>Sericornis frontalis</i>
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>
White-eared Honeyeater	<i>Lichenostomus leucotis</i>
White-naped Honeyeater	<i>Melithreptus lunatus</i>
White-throated Nightjar	<i>Eurostopodus mystacalis</i>
White-throated Treecreeper	<i>Cormobates leucophaeus</i>
White-winged Chough	<i>Corcorax melanorhamphos</i>
Willie Wagtail	<i>Rhipidura leucophrys</i>
Yellow Thornbill	<i>Acanthiza nana</i>
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>
Yellow-tufted Honeyeater	<i>Lichenostomus melanops</i>
<b>Mammals</b>	
Chocolate Wattled Bat	<i>Chalinolobus morio</i>
Eastern Bent-wing Bat	<i>Miniopterus schreibersii oceanensis</i>
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>
Eastern Falsistrelle	<i>Falsistrellus tasmaniensis</i>
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>
Eastern Grey Kangaroo	<i>Macropus giganteus</i>
Eastern Pygmy-possum	<i>Cercartetus nanus</i>
European Red Fox	<i>Vulpes vulpes</i>
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>
House Mouse	<i>Mus musculus</i>
Large Bent-wing Bat	<i>Miniopterus schreibersii</i>
Large Forest Bat	<i>Vespadelus darlingtoni</i>
Little Forest Bat	<i>Vespadelus vulturnus</i>
Long-eared Bat	<i>Nyctophilus sp.</i>
Sugar Glider	<i>Petaurus breviceps</i>
Swamp Wallaby	<i>Wallabia bicolor</i>
White-striped Mastiff Bat	<i>Tadarida australis</i>
Common Wombat	<i>Vombatus ursinus</i>

Common Name	Scientific Name
<b>Reptiles</b>	
Copper-tailed Skink	<i>Ctenotus taeniolatus</i>
Eastern Brown Snake	<i>Pseudonaja textilis</i>
Lesueur's Velvet Gecko	<i>Oedura lesueurii</i>
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>
Skink	<i>Egernia sp.</i>
Unidentified Elapid	
<b>Amphibians</b>	
Common Eastern Froglet	<i>Crinia signifera</i>
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>
Lesueur's Frog	<i>Litoria lesueuri</i>
Peron's Tree Frog	<i>Litoria peronii</i>
Red-backed Brood Frog	<i>Pseudophryne coriacea</i>
Smooth Toadlet	<i>Uperoleia laevigata</i>



Annex B

## Seven Part Tests



## B.1

### **BROAD-HEADED SNAKE (*HOPLOCEPHALUS BUNGAROIDES*) (ETSC ACT, VEPBC ACT)**

The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 kilometres of Sydney. The species is nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during Autumn, Winter and Spring. In Summer, the species moves from sandstone rocks to shelters in hollows in large trees within 200 metres of escarpments, breeding during January to March.

This assessment identified potential habitat for the Broad-headed Snake as rock crevices and flat sandstone rocks and tree hollows within areas of Sandstone Gully Peppermint Forest and Exposed Sandstone Scribbly Gum Woodland in the Application Area.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

The subsidence deformations induced by the mining will be applied to relatively flat terrain with very few rock outcrops. The predicted strains are not sufficient to cause tensile cracking in solid rock. However, may cause existing joints to open slightly (Seedsman 2009). If impacts on wintering habitat through surface cracking of sandstone outcrops were to occur, there is a large amount of habitat (exposed sandstone outcrops) available for the Broad-headed Snake within the Application Area.

This habitat is found along the length of the creeklines within areas mapped as Sandstone Gully Peppermint Forest and Exposed Sandstone Scribbly Gum Woodland (See *Figure 4.1*) The extent of disturbance from subsidence to these habitats is predicted to be low. In combination with the abundance of the habitat type within the immediate area, it is considered unlikely that the proposal will significantly impact the winter habitats of the species.

Hollow-bearing trees used as summer habitat are not expected to be impacted by the proposal.

It is considered unlikely that the proposal will have an adverse effect on the life cycle of Broad-headed Snake to the extent that a viable local population is likely to be placed at risk of extinction.

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to a species.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
- (i) *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (ii) *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable to a species.

- d) *In relation to the habitat of a threatened species, population or ecological community:*
- (i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The proposed activities will not involve the removal of Exposed Sandstone Scribbly Gum Woodland and Sandstone Gully Peppermint Forest within the Application Area. If these habitats were modified through mine subsidence, the impacts are expected to be minor (e.g tree tilt or minor depressions) although the location and extent of potential subsidence is unknown.

- (ii) *Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

It is unlikely that the proposal would result in areas of habitat becoming isolated for the Broad-headed Snake. The opening of existing joints will not result in areas that could not be traversed by the species. Habitat connectivity will be retained within the Application Area and locality.

- (iii) *The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

The Application Area contains suitable sheltering, foraging and breeding resources for Broad-headed Snake in the form of exposed sandstone outcrops, rocky crevices and overhangs and hollow-bearing trees (and prey species). The sheltering habitats, in particular the rocky areas, although considered extensive within the study area, are naturally restricted in their distribution. Therefore any confirmed areas of habitat would be considered important in both the regional and local context, particularly as the species also has a restricted distribution.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for the species.

f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There is currently no recovery plan or threat abatement plan for the Broad-headed Snake. However, the DEC has prepared 22 Priority Actions to help recover this species. Those relevant to the proposal are outlined below:

- Habitat Rehabilitation/Restoration and/or Regeneration: undertake artificial or replacement rock initiatives to replace or supplement lost habitat; and
- Retain woodland adjacent to sandstone escarpments, particularly large hollow-bearing trees.

Subsidence will not lead to a loss of habitat through opening of existing joints within sandstone outcrops and no surface rock will be removed from the Application Area. Artificial or replacement rock initiatives are not considered necessary as part of the current proposal.

g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

'Alteration of habitat following subsidence due to longwall mining' is listed as Key Threatening Processes (KTP) under the TSC Act.

The proposal is likely to result in the operation of this KTP in relation to Broad-headed Snake habitat (rocky outcrops) within the Application Area. However, as indicated, there is a large amount of exposed sandstone outcrop habitat available within the Application Area, and the level of disturbance from subsidence to rocky outcrops is anticipated to be low.

It is considered unlikely that this KTP would significantly impact Broad-headed Snake individuals or populations within the Application Area.

## **B.2**

### ***RED-CROWNED TOADLET (PSEUDOPHRYNE AUSTRALIS) (VTSC ACT)***

The Red-crowned Toadlet prefers periodically wet drainage lines below sandstone ridges on which the predominant vegetation is dry open forests. Breeding occurs in dense vegetation and debris beside ephemeral creeks and gutters, where eggs are laid in moist leaf litter. The Red-crowned Toadlet disperses outside the breeding season to shelter under rocks and logs on sandstone ridges and to forage amongst thick piles of leaf litter (DEC 2009). The species utilisation of the ground litter layer may result in them being significantly affected by fire and other activities that cause the destruction of the leaf litter layer (NPWS 2001).

Red-crowned Toadlets are sensitive to changes in pH outside of the range 5.5 to 6.5 and have not been recorded breeding in sites that are even mildly polluted nor in permanently flowing watercourses. Most of this species' life is spent under some form of cover, such as rocks, deep leaf-litter, or in rock crevices (NPWS 2001).

It is known that sandstone exfoliations are particularly important to this species, so activities that impact on this habitat have the potential to affect the species (NPWS 2001).

The Red-crowned Toadlet requires specific breeding conditions: small nests are formed within moist leaf litter, then rain flushes the embryos from the nest and tadpoles complete development within transient pools (NPWS 2001). The timing of follow up rain events and duration of temporary pools is critical to reproductive success (NPWS 2001). Recruitment is usually low.

The presence of Wallandoola and Lizard Creeks and associated tributaries, sandstone ridges and leaf litter within the Application Area provides potential foraging, breeding and sheltering habitat for the Red-crowned Toadlet. Plant communities that may provide potential habitat for this species include Exposed Sandstone Scribbly Gum Woodland, Upland Swamps: Banksia Thicket and Upland Swamps: Fringing Eucalypt Woodland.

Impacts to this species may include loss of habitat through alterations in water flow regimes, reduced water quality through sedimentation, and loss of connectivity between pools.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

The Red-crowned Toadlet has a specialised terrestrial reproductive strategy and a reliance on ephemeral water flow means that it may be particularly vulnerable to a range of activities that impact on hydrology or water quality. This includes impacts of runoff, pollution and changes in pH (NPWS 2001).

Red-crowned Toadlets do not usually live along permanent flowing water courses, instead preferring permanently moist soaks or areas of dense ground vegetation or litter along or near non-perennial first or second order drainage systems that are adjacent to ridges, are ephemeral in nature, and commonly called 'feeder-creeks'. These feeder creeks channel water from ridges, benches, cliffs and slopes to perennial streams in the gullies below. Such watercourses are dry or reduced to scattered shallow pools or ponds for much of the year, and have sustained flow for only a few weeks following thunderstorms. Under natural conditions these feeder creeks have high water quality and low nutrient loads (NPWS 2001).

Given these preferences, the area of potential habitat for the Red-crowned Toadlet within the Application Area would include the areas of drainage that feed Wallandoola Creek, riparian vegetation, sandstone outcrops and Upland Swamps. These habitats provide potential foraging, sheltering and breeding resources for the Red-crowned Toadlet.

Potential impacts to the species could occur through a loss of habitat (eg drying of a swamp or ephemeral creeklines) or significant alterations to habitats (through pollution or other environmental changes). Seedsman Geotechnics (2009) states that the predicted strains from the proposed works are not sufficient to cause tensile cracking in solid rock; without cracking there is no potential for loss of surface water. In addition, the depth of the extraction is such that there will be no inter-connected cracks from the seam to the surface. Therefore no impacts to the upland swamps or feeder creeks are expected.

There is a possibility of a localised increase in the natural stream gradient within the upper section of Wallandoola Creek, due to the maximum predicted tilt exceeding the gradient of the creeks flowing through the Application Area (Cardno Ecology Lab 2009). This could result in localised alterations in water flow regimes, reduced water quality through sedimentation, and loss of connectivity between pools.

However, it is unlikely that the Red-crowned Toadlet would rely on these permanent pools, as it prefers ephemeral water flow. In addition there is an abundance of pools in the upper reaches of the creek and it is unlikely that all pools will be affected. Given the extent of potential habitat within the Application Area and localisation of the impact area the proposal is not considered to have an adverse effect on the lifecycle of Red-crowned Toadlet.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to a species.

- c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
- (i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable to a species.

d) *In relation to the habitat of a threatened species, population or ecological community:*

(i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

Potential habitats for the Red-crowned Toadlet occur in the Sandstone Gully Peppermint Forest, Upland Swamps Exposed Sandstone Scribbly Gum Woodland and Rock Plate Heath-Mallee within the Application Area. The exact location and extent of potential subsidence impacts to Red-crowned Toadlet habitats within the Application Area is unknown. However based on the subsidence predictions it is highly unlikely that all of this habitat would be impacted by subsidence.

(ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

The area predicted to be impacted is located within the upper section of Wollandoola Creek. Due to the Red-crowned Toadlet's reliance on ephemeral water flow and the extent of potential habitat downstream and in the surrounding swamps, an area of Red-crowned Toadlet habitat is not considered to become fragmented or isolated from other areas of habitat.

(iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the Locality.*

The catchment of the Woronora Plateau has been identified by the DECC (2005) as being of extreme importance to the overall survival of the Red-crowned Toadlet and it is considered that "any future declines from this stronghold will jeopardise the survival of the species as a whole" (DEC 2005).

Cardno Ecology lab (2009) states that the impact to aquatic biota within the Application Area could be locally significant within a small 300m reach of the watercourse directly above the mine area, due to there being only a few small, permanent pools within this section of Wallandoola Creek. However, the Red-crowned Toadlet does not rely on permanent pools, preferring ephemeral water flow and feeder creeks. Therefore, given the extent of preferred habitat within the Application Area, the area to be impacted is not considered to be of high importance.

e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for the species.

f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There is currently no recovery plan or threat abatement plan for the Red-crowned Toadlet. However, the DECC has prepared 14 Priority Actions to help recover this species. Those relevant to the proposal are outlined below:

- Retain and protect habitat and buffers around habitat, particularly vegetation on upper slopes and ridges; and
  - Habitat Rehabilitation/restoration and/or regeneration.
- g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

*'Alteration of habitat following subsidence due to longwall mining'* is listed as Key Threatening Processes (KTP) under the TSC Act. Seedsman Geotechnics (2009) state that the subsidence deformations induced by the mining will be applied to relatively flat terrain with very few rock outcrops. Therefore, systematic impacts will dominate and there will be few dis-ordered movements and alteration of habitat for the Red-crowned Toadlet.

*'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'* is also listed as KTP under the TSC Act. Geoterra (2009) stated that there is no potential for loss of surface water within the Application Area and as there will be no cracking or surface water loss, impacts of cracking and drying to groundwater and swamps are not expected.

### **B.3 SPOTTED-TAILED QUOLL (*DASYURUS MACULATUS*) (VTSC ACT, E EPBC ACT)**

The Spotted-tailed Quoll uses a variety of habitats such as sclerophyll forest and woodlands, heath and rainforest. Its habitat requirements include den sites, an abundance of food and large areas of intact vegetation (DECC 2005a). The Spotted-tailed Quoll nests in caves, hollow logs, rock crevices, boulder piles, rocky cliff faces and tree hollows. The Spotted-tailed Quoll is highly mobile, with females occupying home ranges up to about 750 hectares and males up to 3500 hectares. The species usually traverse their ranges along densely vegetated creek lines (DECC 2005a).

Potential foraging, shelter and den site habitat for Spotted-tailed Quoll within the Application Area includes caves, hollow logs, rock crevices, rocky cliff faces, boulder piles and tree hollows within areas of Sandstone Gully Peppermint Forest, Exposed Sandstone Scribbly Gum Woodland, Upland Swamps: Fringing Eucalypt Woodland, Upland Swamps: Sedgeland-Heath Complex, Upland Swamps: Banksia Thicket and Upland Swamps: Tea-Tree Thicket. The Spotted-tailed Quoll could traverse the Application Area via Wallandoola and Lizard Creeks and associated tributaries.

- a) *in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

The Spotted-tailed Quoll uses hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Surface cracking within cliffs and overhangs and rock fall has the potential to destroy sheltering and den sites. However, Seedman Geotechnics (2009) state that the predicted strains are not sufficient to cause tensile cracking in solid rock.

The proposed activities will not involve the removal of Sandstone Gully Peppermint Forest or Exposed Sandstone Scribbly Gum Woodland. However, hollow bearing trees within these vegetation communities may be modified through tree tilt/ loss caused by mine subsidence. It is anticipated that any loss of hollow-bearing trees (and therefore current or potential den sites) would only represent a small proportion of available hollow-bearing trees within the Application Area. In addition, the Spotted-tailed Quoll is a very mobile species with the ability to use a diverse range of habitats for sheltering and dens.

It is considered that the life cycle of the Spotted-tailed Quoll will not be affected by the proposal.

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to a species.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
- (i) *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
  - (ii) *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*
  - (iii) *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable to a species.

- d) *in relation to the habitat of a threatened species, population or ecological community:*
- (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The proposal will not involve the direct removal of habitat for the Spotted-tailed Quoll. Habitats that may be modified by the proposal include sheltering and den sites and foraging habitat. However, habitat modification (for example, loss of hollow bearing trees) is expected to be minor and localised. Spotted-tailed Quoll is a highly mobile species, and it is anticipated that individuals could readily relocate to unmodified areas of habitat.

(ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

Given the mobility of the Spotted-Tailed Quill it is considered unlikely that the potential impacts of the proposal will result in fragmentation or isolation of habitats for the species.

Given that the proposal will not involve the direct removal of Spotted-tailed Quoll habitat, habitat connectivity will be retained within the Application Area and locality.

(iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

The Application Area represents a large area of intact vegetation. It also contains suitable sheltering, foraging and breeding resources for this species in the form of hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. However, potential habitat within the study area is not considered vital to the long-term survival of Spotted-tailed Quoll in the locality. In addition, any potential impacts from the proposal to areas of potential habitat are considered to be minimal for this species.

e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for the species.

f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There is currently no recovery plan or threat abatement plan for the Spotted-tailed Quoll. However, the DECC has prepared 32 Priority Actions to help recover this species. Those relevant to the proposal are outlined below:

- Retain and protect large, forested areas with hollow logs and rocky outcrops, particularly areas with thick understorey or dense vegetation along drainage lines; and
- Habitat requirements of Spotted-tailed Quolls to be adequately conserved within environmental planning instruments and through other legislative protection mechanisms.

- g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

'Alteration of habitat following subsidence due to longwall mining' is listed as Key Threatening Processes (KTP) under the TSC Act.

The proposal is likely to result in the operation of this KTP in relation to Spotted-tailed Quoll sheltering habitat and den sites within the Application Area. However, the level of disturbance to rock crevices and hollow-bearing trees from subsidence is anticipated to be low and to be localised.

'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands' is also listed as KTP under the TSC Act. Localised increase in natural stream gradient potentially leading to an increase in flow rate and migration of flow channels may potentially impact on Spotted-tailed Quoll foraging habitat. However, any impacts are anticipated to be localised and unlikely to significantly impact on Spotted-tailed Quoll given the mobile nature of this species.

It is considered unlikely that either KTP would significantly impact Spotted-tailed Quoll individuals or populations within the Application Area.

#### **B.4**

#### **ROSENBERG'S GOANNA (*VARANUS ROSENBERGI*) (VTSC ACT)**

Rosenberg's Goanna is found in heath, open forest and woodland (DECC 2005a). The species shelters in hollow logs, burrows (which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens), rock crevices and sandstone outcrops. Termite mounds are a critical habitat component for Rosenberg's Goanna as the species nests in termite mounds (DECC 2005a). Individuals require large areas of habitat.

Potential habitat within the Application area includes hollow logs, sandstone outcrops and rock crevices within areas of Sandstone Gully Peppermint Forest and Exposed Sandstone Scribbly Gum Woodland.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

Termite mounds are a critical habitat component for Rosenberg's Goanna as the species nests within the mounds. Rosenberg's Goanna also shelters in hollow logs, burrows, rock crevices and sandstone outcrops.

The subsidence deformations induced by the mining will be applied to relatively flat terrain with very few rock outcrops. Seedman Geotechnics (2009) states that the predicted strains are not sufficient to cause tensile cracking in solid rock and may cause existing joints to open slightly. If impacts on habitat through rock falls and fracturing of sandstone outcrops were to occur, there is a large amount of habitat (exposed sandstone outcrops) available for the Rosenberg's Goanna within the Application Area. Nesting habitat such as termite mounds is considered unlikely to be significantly impacted by the proposal.

It is considered unlikely that the proposal will have an adverse effect on the life cycle of Rosenberg's Goanna to the extent that a viable local population is likely to be placed at risk of extinction.

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to a species.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
- (i) *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

Not applicable to a species.

- (ii) *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable to a species.

- d) *In relation to the habitat of a threatened species, population or ecological community:*
- (i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The proposed activities will not involve the removal of Exposed Sandstone Scribbly Gum Woodland, Upland Swamps: Banksia Thicket and Upland Swamps: Fringing Eucalypt Woodland, or direct disturbance to creek lines, sandstone ridges and leaf litter within the Application Area. However, these habitats may be modified through mine subsidence. Although the location and extent of potential subsidence is unknown based on the subsidence predictions it is highly unlikely that all of this habitat would be impacted by subsidence.

- (ii) *Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

The proposal is unlikely to cause fragmentation or isolation of vegetation communities given that no vegetation removal will occur. Similarly, rocky and sandstone habitats are currently isolated throughout the Application Area. The proposal is considered unlikely to result in further fragmentation or isolation of rocky or sandstone habitats.

Given that the proposal will not involve the direct removal of Rosenberg's Goanna habitat, habitat connectivity will be retained within the Application Area and locality.

- (iii) *The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

Rosenberg's Goanna has not been recorded within the Application Area. However, the species has been recorded within the locality. The Application Area contains large areas of undisturbed vegetation communities such as Exposed Sandstone Scribbly Gum Woodland which provide habitat resources for the species.

Given the large area of available habitat (and potential habitat resources) within the Application Area it is considered that the Application Area would be considered important to the species, if it occurs there.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for the species.

- f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There is currently no recovery plan or threat abatement plan for the Rosenberg's Goanna. However, the DECC has prepared nine Priority Actions to help recover this species. Those relevant to the proposal are outlined below:

- Do not fragment known habitat with clearing, roads or other development;
- Retain and protect heath, woodland and forest remnants within the known distribution of the species; and
- Ensure remnant populations remain connected or linked to each other; in cases where remnants have lost connective links, re-establish links by revegetating sites to act as stepping stones for dispersal.

- g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

'Alteration of habitat following subsidence due to longwall mining' is listed as Key Threatening Processes (KTP) under the TSC Act.

The proposal has the potential to result in the operation of this KTP in relation to Rosenberg's Goanna sheltering habitat within the Application Area. However, the level of disturbance to rock crevices and burrows from subsidence is anticipated to be low and to be localised.

## B.5

### **GIANT BURROWING FROG (*HELEIOPOROUS AUSTRALIACUS*) (VTSC ACT)**

The Giant Burrowing Frog is found in hanging swamps on sandstone shelves and beside perennial non-flooding creeks (Daly 1996; Webb 1993) in the northern part of its range. The species is also associated with sandy soil on sandstone ridges that support heath vegetation (Mahony 1993). Giant Burrowing Frog is found in sand or rock based streams and less frequently in constructed dams. Giant Burrowing Frog has been reported to occur in a wide range of forest communities in the southern part of its range. The species often spends significant periods of time underground during unfavourable conditions and to avoid detection during the day (NPWS 2001).

Foraging, sheltering and breeding habitat for the Giant Burrowing Frog within the Application Area includes heath vegetation, feeder creeks and soaks associated with Wallandoola and Lizard Creeks and Upland Swamps.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

The Giant Burrowing Frog breeds throughout the year, generally following heavy rains (Penman *et al.* 2004). Mating occurs in ephemeral pools and slow or standing water such as small soaks formed in eroded sandstone drainage lines (Mahony 1993; Watson & Martin 1973).

Seedsman Geotechnics (2009) states that the predicted strains from the proposed works are not sufficient to cause tensile cracking in solid rock, without cracking there is no potential for loss of surface water. In addition, the depth of the extraction is such that there will be no inter-connected cracks from the seam to the surface.

There is a possibility of a localised increase in the natural stream gradient, within a few small permanent pools within the upper section of Wallandoola Creek. This is due to the maximum predicted tilt exceeding the gradient of the creeks flowing through the Application Area (Cardno Ecology Lab 2009), which could result in alterations in water flow regimes, reduced water quality through sedimentation, and loss of connectivity between pools. The abundance of pools within the upper reaches of the creek means that it is highly unlikely that all pools would be affected by tilt and drying, and downstream pools will be unaffected. The Giant Burrowing Frog would not rely solely on the area predicted to be to be affected in Wallandoola Creek.

However, given the extent of potential habitat within the Application Area, localisation of the impact area and the ability of the species to live underground in unfavourable conditions, it is considered unlikely that the predicted tilt impacts will have an adverse effect on the lifecycle of the Giant Burrowing Frog to the extent that one or more populations within the Application Area may be placed at risk of local extinction.

- b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to a species.

- c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
  - (i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

Not applicable to a species.

- (ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable to a species.

- d) In relation to the habitat of a threatened species, population or ecological community:*
  - (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The subsidence deformations induced by the mining will be applied to relatively flat terrain with very few rock outcrops. Seedman Geotechnics (2009) states that the predicted strains are not sufficient to cause tensile cracking in solid rock. However the strain may cause existing joints to open slightly. If impacts to non-breeding shelter were to occur, there is a large amount of habitat (exposed sandstone outcrops) available for the Giant Burrowing Frog within the Application Area.

Tilting may lead to a localised increase in the natural stream gradient, within a few small permanent pools within the upper section of Wallandoola Creek, resulting in alterations in water flow regimes and reduced water quality through sedimentation.

(ii) *Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

The area to be impacted is located within the upper section of Wollandoola Creek containing only a permanent pools and is considered unlikely to result in fragmentation or isolation of rocky or sandstone habitats.

The Giant Burrowing Frog can travel several hundred metres from non-breeding areas to creeks to breed (NPWS 2001). Therefore, an area of Giant Burrowing Frog habitat will not become fragmented or isolated from other areas of habitat.

(iii) *The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

The Giant Burrowing Frog is considered an uncommon resident within the Greater Southern Sydney region (DECC 2005b). In addition, DECC (2005b) states that the protection of Upland Swamps and associated creeks is paramount to the survival of the Giant Burrowing Frog on the Woronora Plateau. Given the above, Giant Burrowing Frog habitat within the Application Area would be considered to be of high importance to the long-term survival of the species, if it occurs there.

e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for the species.

f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There is currently no recovery plan or threat abatement plan for the Giant Burrowing Frog. However, the DECC has prepared 24 Priority Actions to help recover this species. Those relevant to the proposal are outlined below:

- Retain native vegetation and minimise ground disturbance where the species occurs.

- g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

'Alteration of habitat following subsidence due to longwall mining' is listed as Key Threatening Processes (KTP) under the TSC Act. Giant Burrowing Frog breeding, foraging and sheltering habitats such as creeks and rocky habitats are particularly susceptible to the impacts of subsidence. However, the level of disturbance subsidence is anticipated to be low and to be localised.

'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands' is also listed as KTP under the TSC Act. Loss of stream flow and reduced surface water pondage may potentially impact on Giant Burrowing Frog breeding habitat. However, the area to be impacted is located within the upper section of Wallandoola Creek containing only a few small permanent pools.

## **B.6**

### ***LITTLEJOHN'S TREE FROG (LITORIA LITTLEJOHNI) (V TSC ACT, E EPBC ACT)***

The Littlejohn's Tree Frog inhabits forest, coastal woodland and heath (White & Ehmann 1997), but the species is not associated with any specific vegetation types (Lemckert 2004). Breeding habitat includes temporary pools in forested areas, deep permanent pools of slow creeks (in hanging swamps) or slow, rock-lined rivers (White and Ehmann 1997).

Non-breeding habitat is unknown, but may include leaf litter and low shrubs. Littlejohn's Tree Frog may also be arboreal (Hero *et al.* 2002). Potential habitat within the Application Area includes pools in Wallandoola and Lizard Creeks and associated tributaries and leaf litter and shrubs in adjacent vegetation communities.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

Littlejohn's Tree Frog breeds in temporary pools in forested areas, deep permanent pools of slow creeks (in hanging swamps) or slow, rock-lined rivers (White and Ehmann 1997).

Seedsman Geotechnics (2009) states that the predicted strains from the proposed works are not sufficient to cause tensile cracking in solid rock, without cracking there is no potential for loss of surface water. In addition, the depth of the extraction is such that there will be no inter-connected cracks from the seam to the surface.

There is, however, a possibility of a localised increase in the natural stream gradient, within a few small permanent pools within the upper section of Wallandoola Creek, due to the maximum predicted tilt exceeding the gradient of the creeks flowing through the Application Area (Cardno Ecology Lab 2009). This could result in alterations in water flow regimes, reduced water quality through sedimentation, and loss of connectivity between pools.

It is unknown whether Wallandoola Creek or Lizard Creek would currently constitute preferred habitat, as despite the presence of some deep pools, in the upper reaches the water is not slow-flowing during periods of rain. The species would be more likely to inhabit areas downstream, where the creekbeds widen and the water flow is less rapid.

It is predicted that the reach of the Wallandoola creek to be potentially impacted by the proposal would be unlikely to constitute preferred habitat for the species. If the species did currently use the pools in the upper reaches for breeding, it is possible that it could be impacted by drying of pools or reduced retention time of water. However, there is also an abundance of pools within the upper reaches and if impacts did occur, they would not impact on all potential breeding sites. The species could move to other suitable pools, or to downstream habitats.

Therefore the life cycle of the species is unlikely to be impacted to such an extent such that a viable local population of the species is likely to be placed at risk of extinction,

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to a species.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
  - (i) *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

Not applicable to a species.

- (ii) *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable to a species.

- d) *In relation to the habitat of a threatened species, population or ecological community:*

- (i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The extent of modification to Littlejohn's Tree Frog habitat within the Application Area is unknown. However it is predicted to occur only in the upper reaches of Wallandoola Creek.

- (ii) *Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

Littlejohn's Tree Frog dispersal is limited (DECC 2005b). Accordingly, Littlejohn's Tree Frog is considered a localised species and small scale fragmentation or isolation within or adjacent to areas of breeding habitat may impact this species. However, the extent to which the species could move along Wallandoola Creek is not known and the species could move to other areas downstream, within Lizard Creek, or into adjacent pools.

- (iii) *The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

Littlejohn's Tree Frog is extremely rare within the Woronora Plateau DECC (2005b). DECC (2005b) also states that known Littlejohn's Tree Frog breeding sites should be treated as being of high conservation value and clearing and disturbance to breeding habitat or degradation of water quality should be avoided.

Whilst Littlejohn's Tree Frog has not been recorded within the Application Area, it is known to contain potential habitat for this species. Accordingly, habitat for Littlejohn's Tree Frog within the Application Area is considered of high importance to the species.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for the species.

- f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There is currently no recovery plan or threat abatement plan for the Little John's Tree Frog. However, the DECC has prepared 13 Priority Actions to help recover this species. Those relevant to the proposal are outlined below:

- Retain riparian native vegetation.

- g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

'Alteration of habitat following subsidence due to longwall mining' is listed as Key Threatening Processes (KTP) under the TSC Act. Littlejohn's Tree Frog breeding habitats such as creeks are particularly susceptible to the impacts of subsidence.

'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands' is also listed as KTP under the TSC Act. Alterations to water flow regimes may potentially impact on Littlejohn's Tree Frog breeding habitat.

## **B.7 GIANT DRAGONFLY (*PETALURA GIGANTEAN*) (E TSC ACT)**

Giant Dragonfly is found in permanent swamps and bogs with some free water and open vegetation (DECC 2005). Adults Giant Dragonfly spend most of their time settled on low vegetation on or adjacent to the swamp (DECC 2005b). Eggs are deposited in moist soils amongst swampy vegetation and larvae dig long branching burrows under the swamp (DECC 2005b).

Potential habitat for Giant Dragonfly within the Application Area includes upland swamps and associated vegetation communities such as Fringing Eucalypt Woodland, Banksia Thicket, Sedgeland-Heath Complex and Tea-Tree Thicket.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

Giant Dragonfly deposit eggs in moist soils amongst swampy vegetation and build burrows under upland swamps (DECC 2005b). The proposed activities will not involve the removal of, Tea-Tree Thicket, Upland Swamps: Banksia Thicket and Upland Swamps: Fringing Eucalypt Woodland, or loss of surface water or ground water. Therefore, the proposal is unlikely to have an adverse effect on the lifecycle of the Giant Dragonfly to the extent that one or more populations within the Application Area may be placed at risk of local extinction.

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to a species.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

- (i) *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

Not applicable to a species.

- (ii) *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable to a species.

- d) *In relation to the habitat of a threatened species, population or ecological community:*

- (i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The proposed activities will not involve direct removal, disturbance or modification to potential habitat of the Giant Dragonfly, upland swamps, within the Application Area.

- (ii) *Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

Giant Dragonfly dispersal is limited (DECC 2005b) and may not occur between swamps. However, upland swamp habitats are already currently isolated from other swamps by eucalypt woodlands and forests throughout the Application Area. There are no predicted impacts to swamps within the Application Area.

The proposal is therefore considered unlikely to result in further fragmentation or isolation of upland swamp habitats.

- (iii) *The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

Giant Dragonfly has not been recorded within the Application Area. However, upland swamps within the Application Area contain suitable breeding habitat for this species. Accordingly, habitat for Giant Dragonfly within the Application Area would be considered of high importance to the species, should it occur there.

- e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for the species.

- f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There is currently no recovery plan or threat abatement plan for the Giant Dragonfly. However, the DECC has prepared 15 Priority Actions to help recover this species. Those relevant to the proposal are outlined below:

- Prepare EIA guidelines addressing the impacts of developments (including degradation of groundwater resources) upon sensitive wetland habitats.

g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

*'Alteration of habitat following subsidence due to longwall mining'* is listed as Key Threatening Processes (KTP) under the TSC Act. Giant Dragonfly breeding, foraging and sheltering habitats within upland swamps are particularly susceptible to the impacts of subsidence. However, the level of disturbance subsidence is anticipated to be low and to be localised.

*'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'* is also listed as KTP under the TSC Act. The area to be impacted is located within the upper section of Wollandoola Creek containing only a few small permanent pools and will not result in the draining of perched water table and loss of swamp soil moisture impacting on potential breeding habitat for the Giant Dragonfly.

## B.8

### **CAVE DWELLING MICROBATS: EASTERN BENTWING-BAT (*MINIOPTERUS SCHREIBERSII OCEANENSIS*), LARGE-EARED PIED BAT (*CHALINOLOBUS DWERYI*) AND LARGE-FOOTED MYOTIS (*MYOTIS ADVERSUS*) (V TSC ACT, V EPBC ACT (LARGE-EARED PIED BAT))**

The Eastern Bentwing-bat, Large-eared Pied Bat and Large-footed Myotis are cave-roosting bat species. The Eastern Bentwing-bat and Large-eared Pied Bat also raise young in maternity roosts. These species have been grouped together due to their similar habitat requirements.

The Eastern Bentwing-bat roosts in caves, derelict mines, storm-water tunnels, buildings and other man-made structures and forages over the forest canopy (DECC 2005a). It can disperse up to 300 kilometres of maternity caves during non-breeding periods (DECC 2005a).

Large-eared Pied Bat occurs in most vegetation types provided there are caves or tunnels available for roosting. The species frequents low to mid-elevation dry open forest and woodland and well-timbered areas containing gullies (DECC 2005a), but has also been recorded in *Callitris* dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country (EA 1999). Daytime roosts include caves, abandoned mine tunnels and disused Fairy Martin nests (Ayers *et al.* 1996).

The Large-footed Myotis roosts close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage (DECC 2005a). It forages over nearby lakes, rivers, large streams (DECC 2005a).

Potential sheltering habitat for these species within the Application Area includes caves, rocky overhangs and rocky crevices.

- a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

The Eastern Bentwing-bat, Large-eared Pied Bat and Large-footed Myotis are cave-roosting bat species. The proposed activities will not result in tensile cracking in solid rock, or the removal of forest or woodland communities within the Application Area, and impacts to bat foraging habitat are anticipated to be minor. In addition, each bat species is highly mobile with the ability to use a diverse range of habitats for foraging and roosting.

The Large-footed Myotis is a fishing bat, and as creeks may be affected by the proposal, the foraging habitat for this species may be impacted. However, the potential impacts to creeks and drainage lines within the Application Area if they occur will be localised, and there are large areas of foraging habitat within the Application Area and within the larger locality. It is unlikely that foraging activities of the other bats would be affected by the proposal, given that they feed on insects over areas of vegetation.

It is considered that the life cycle of the cave dwelling microbats will not be affected by the proposal.

- b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to a species.

- c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
- (i) *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

Not applicable to a species.

- (ii) *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable to a species.

d) *In relation to the habitat of a threatened species, population or ecological community:*

(i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The location and extent of modification to cave dwelling microbat roosting habitat within the Application Area is unknown. However, it is anticipated that any impacts to potential roosting habitat would represent a small proportion of available habitat within the Application Area. In addition, Eastern Bentwing-bat, Large-eared Pied Bat and Large-footed Myotis are highly mobile species, and it is anticipated that individuals could readily relocate to unmodified areas of habitat if required.

(ii) *Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

The proposal is considered unlikely to result in fragmentation or isolation of caves and rocky habitats for these mobile species.

Given that the proposal will not involve the direct removal of Eastern Bentwing-bat, Large-eared Pied Bat and Large-footed Myotis roosting or foraging habitat, habitat connectivity will be retained within the Application Area and locality.

(iii) *The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

The Application Area contains intact vegetation and watercourses for foraging and caves and rocky overhangs for roosting as required by Eastern Bentwing-bat, Large-eared Pied Bat and Large-footed Myotis. These resources are also available in the wider locality. As such, it is considered unlikely that each species would be entirely dependent on the habitat resources within the Application Area given the mobility of each species. Similarly, the Application Area is not known to contain any large maternity caves.

The Application Area is consequently considered to be moderately important to the species.

e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for the species.)

f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

There is currently no recovery plan or threat abatement plan for the Eastern Bentwing-bat, Large-eared Pied Bat and Large-footed Myotis.

- g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

*'Alteration of habitat following subsidence due to longwall mining'* is listed as Key Threatening Processes (KTP) under the TSC Act. Eastern Bentwing-bat, Large-eared Pied Bat and Large-footed Myotis roosting habitat may be impacted by rock movement due to subsidence. However, it is anticipated that any impact to caves and overhangs (and therefore current or potential roosting habitat) would only represent a small proportion of available habitat within the Application Area.

It is considered unlikely that the proposal would have a significant impact on Eastern Bentwing-bat, Large-eared Pied Bat and Large-footed Myotis populations within the Application Area.



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### **Environmental Resources Management**

Building C, 33 Saunders Street  
Pyrmont NSW 2009  
Locked Bag 24,  
Broadway NSW 2007

T: 61 2 8584 8888  
F: 61 2 8584 8800  
[www.erm.com](http://www.erm.com)

