WHITEHAVEN COAL

Narrabri Coal Operations Pty Ltd

ABN: 15 129 850 139

Narrabri Coal Mine
Stage 2 Longwall Project

Flora and Fauna Impact Assessment

Prepared by:

Ecotone Ecological Consultants Pty Ltd

November 2009

Specialist Consultant Studies Compendium
Volume 2, Part 4

Narrabri Coal Operations Pty Ltd

ABN: 15 129 850 139

Narrabri Coal Mine
Stage 2 Longwall Project

Flora and Fauna Impact Assessment

Prepared for:
R.W. Corkery & Co. Pty. Limited
Level 1, 12 Dangar Road
PO Box 239
BROOKLYN NSW 2083

Tel: (02) 9985 8511
Fax: (02) 9985 8208
Email: brooklyn@rwcorkery.com

On behalf of:
Narrabri Coal Operations Pty Ltd
Level 9, 1 York Street
PO Box R1113
SYDNEY NSW 1225

Tel: (02) 8507 9700
Fax: (02)8507 9701
Email: thaggarty@whitehaven.net.au

Prepared by:
Ecotone Ecological Consultants Pty Ltd
39 Platt Street
WARATAH NSW 2298

Tel: (02) 4968 4901
Fax: (02) 4968 4960
Email: info@ecotoneconsultants.com.au

November, 2009

CONTENTS

Page

CONTENTS

Page

APPENDICES

FIGURES

TABLES

CONTENTS

Page

This page has intentionally been left blank

Executive Summary

This report presents the results of a flora and fauna impact assessment undertaken for the Narrabri Coal Mine Stage 2 Longwall Project (the "Longwall Project"), approximately 30km south-southeast of Narrabri. Mining is proposed within a large lease area of approximately 5 210 hectares in area and stretching approximately 8.6 km from north to south and 4.8 km to 7.9 km from east to west.

An assessment of the impacts on flora and fauna in relation to the Longwall Project has been made based on a combination of literature review and field surveys for both flora and fauna. The resulting information has been used to address Part 3A of the *Environmental Planning and Assessment Act 1979, Environment Protection and Biodiversity Conservation Act 1999* and other relevant legislation or planning instruments.

No rare, threatened or locally significant flora species were recorded within the study area, although at least one vulnerable species, *Bertya opponens*, is considered likely to occur within the western part of the Mine Site. Two additional listed flora species are considered to have some potential to occur, and one or more ROTAP species have potential to occur but none are considered highly likely. Minor impacts on threatened flora species may occur due to the minor clearing required and subsidence effects, but are unlikely to be significant.

Three endangered ecological communities (EECs) listed under the TSC Act were recorded within the study area during field surveys. "Inland Grey Box Woodland" was found to be the dominant vegetation community within the flat plains area in the eastern two thirds of Mine Site. It occurred as modified and generally disturbed (grazed) remnant patches within the relevant area. A small, disturbed remnant patch of Myall Woodland occurred along a dirt road at the eastern end of the Mine Site (east of the Mining Area) and patches of marginal "Brigalow" EEC occurred in the pilliga community in the undulating western third of the Mine Site. The latter two EECs are also listed under the Commonwealth EPBC Act as "Weeping Myall Woodland" and "Brigalow (*Acacia harpophylla* dominant and co-dominant)" respectively. Minor impacts are expected on at least the Inland Grey Box Woodland and Brigalow EECs, but not to the extent that they would be at risk of local extinction. Offsets would ensure local conservation of the EEC's and other vegetation types.

Fifteen threatened species listed on the TSC Act were recorded during field surveys. The fifteen species were the pale-headed snake, glossy-black cockatoo, turquoise parrot, superb parrot, speckled warbler, grey-crowned babbler, varied sittella (preliminary determination), diamond firetail, koala, eastern pygmy possum, black-striped wallaby, yellow-bellied sheathtail-bat, little pied bat, eastern long-eared bat and delicate mouse. An additional two threatened species, the squirrel glider and spotted-tailed quoll are likely to occur but were not recorded during field surveys. Six threatened or migratory species listed on the EPBC Act were recorded during field surveys, namely, the superb parrot, white-throated needletail, rainbow bee-eater, yellow-bellied sheathtail-bat, eastern long-eared bat and delicate mouse. Potentially suitable habitat exists on the Mine Site for a further 18 threatened or migratory species that were not identified during field surveys. While impacts are expected to be minor on all species, there is potential for the loss of some individual delicate mice, eastern pygmy possums and pale-headed snakes. Such losses may occur if individuals fall into surface cracks caused by mine subsidence or are unable to climb out of the surface cracks. The potential for impact on these species will need to be monitored regularly throughout the life of the mine.

The following mitigation measures are recommended and would mitigate the potential impacts of the proposal on the flora and fauna of the Mine Site.

- Establishment of offsets to compensate for cleared habitat.
- Development of weed management procedures.
- Rehabilitation and revegetation of disturbed areas with native and locally occurring species
- Preparation and implementation of an annual fauna monitoring program
- Establishment and implementation of tree felling procedures
- Completion of habitat hollow provision assessment prior to each vegetation clearing campaign.
- Implementation of erosion/sediment control.
- Implementation of control protocols for root-rot fungus.

1 Introduction

1.1 Background and Scope

This Flora and Fauna Impact Assessment Report has been prepared at the request of R.W. Corkery & Co. Pty Limited on behalf of the Proponent (Narrabri Coal Operations Pty Ltd or NCOPL). As part of the preparation of a development application to be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Narrabri Coal Mine Stage 2 Longwall Project ('The Longwall Project'), this report provides a specialist flora and fauna assessment of the Mine Site and assesses the potential ecological impacts of the proposed development.

The general objectives of this assessment are to:

- provide a literature search of all possible threatened or migratory species that are known to occur or likely to occur on the Mine Site;
- undertake field surveys to:
  - record the structure and floristics of each vegetation community present,
  - survey for threatened flora species that may be present,
  - survey for endangered ecological communities (EEC's) that may be present,
  - record the fauna species present within the dominant vegetation communities present,
  - survey for threatened and migratory species that may be present (following the literature review), and
  - survey and map the dominant habitat types present;
- identify the potential impacts of the proposal for any threatened species, EEC's or populations that occur or could be likely to occur in the Mine Site;
- assess the potential impacts of the proposal on the flora and fauna of the Mine Site by application of the provisions of the relevant NSW and Commonwealth legislation; and
- provide discussion on measures to manage potential impacts and effects of the proposal, using the principles of "avoid, minimise and mitigate" in that order of preference.

The environmental studies have been conducted in three stages:

1. A desktop review of available literature pertaining to the site and surrounding locality;
2. A field survey of the proposed site; and
3. Assessment of impact of the Longwall Project on flora and fauna in accordance with the relevant NSW and Commonwealth legislation and planning instruments.

Within this report, reference is given to the relevant sections of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); NSW *Threatened Species Conservation Act 1995* (TSC Act); *National Parks and Wildlife Act 1974* (NP&W Act); *Environmental Planning and Assessment Act 1979* (EP&A Act; and subsequent amendments to these. Specific consideration is given to Section 5A of the EP&A Act.

For this report:

- the *mining area* is the area directly affected by subsidence, occurring above and adjacent to the proposed longwall panels,
- the *Mine Site* is defined as the area within ML 1609 (an area of 5 210 ha),
- the *proposed Pipeline Corridor* area is a maximum 10 metre wide corridor along existing road easements between the Mine Site and the Namoi River approximately seven kilometres to the north,
- the *study area* consists of the Mine Site and proposed Pipeline Corridor plus the immediately surrounding land and watercourses that could be potentially affected, directly or indirectly by the proposed Longwall Project; and
- the *study locality* is the area of land within a twenty (20) kilometre radius of the centre of the Mine Site. Note that due to the large size of the Mine Site (approximately 8.7 km long and 7.5 km wide) the study locality was increased from the standard 10 km radius to a 20 km radius to ensure that the search area extended at least 10 km from all boundaries of the Mine Site.

1.2 General Description of the Mine Site, Study Area and Study Locality

A broad description of the prominent natural and developed features of the study area and study locality is provided in **Table 1** below. The location of the study area within the study locality is shown in **Figure 1**.

Table 1
Description of the Mine Site, Study Area and Study Locality

Page 1 of 2

Client	R.W. Corkery & Company Pty Ltd on behalf of the Proponent (NCOPL).
Location	Narrabri Coal Mine is approximately 30km south-southeast of Narrabri and 10km north-northwest of Baan Baa west of the Kamilaroi Highway. See Figure 1. 8837 Narrabri 1:100 000 & 8836 Baan Baa 1:100 000 map sheets Approximate site centre: 776000E 6620000N (AGD66 Grid 55) [200680E 6620200N Grid 56]
LGA	Narrabri LGA
Zoning	General Rural (1a) – Narrabri LEP 1992
Bioregion	Brigalow Belt South Bioregion
Botanical Subregion	North Western Plains
CMA Region	Namoi
CMA Subregions	Liverpool Plains (Part B) – eastern part of study area Pilliga (Part A) – western part of study area
Geology	Two main soil types comprise the Mine Site, splitting the Mine Site into approximate eastern and western halves. The eastern half is comprised of conglomerate, quartz sandstone, shale largely obscured by Quaternary talus material. The western half of the Mine Site is comprised of quartz sandstone, conglomerate and claystone, largely obscured by Quaternary sands and talus material. Isolated patches un-obscured by Quaternary sands and talus material also occur in the western half (NSW Department of Mines 1971 – 1: 250 000 Narrabri Geological Series Sheet SH 55-12).

Table 1 (cont'd)
Description of the Mine Site, Study Area and Study Locality

Elevation	From approximately 250 m AHD on the low-lying eastern area; to approximately 350 m AHD on the ridge-top area in the western part of the site.
Mine Site Description	Approximately the eastern two thirds of the Mine Site is comprised of agricultural grazing and cropping land. The western third of the Mine Site is comprised of regenerating woodland most often with a dense shrub layer. The majority of the woodland area is privately owned, however the south western corner is part of Pilliga East State Forest and a small section of Jacks Creek State Forest occurs within the north western boundary of the Mine Site.
Current Land Use and General Condition	The Mine Site consists of a number of farms, with a corner in the south west consisting of state forest. Agricultural activities include grazing (horses, cattle and sheep) and grain crops. Intermittent forestry activities occur in the Jacks Creek State Forest section of the Mine Site.
Significant Features	The Mine Site drains to the east into the Namoi River via ephemeral creek/drainage lines (Pine Creek, Pine Creek Tributary 1, Pine Creek Tributary 2, Kurrajong Creek Tributary 1 and Kurrajong Creek).
Surrounding Land Use	Land use in the areas surrounding the Mine Site is principally dedicated to farming activities - grazing and grain crops similar to that within the Mine Site. The site adjoins Jacks Creek State Forest for most of the western boundary. A transport corridor (road and rail) borders the site on the eastern side.

1.3 Description of the Proposed Longwall Project

Activities and impacts of the Longwall Project (**Figure 2**) that could impact on the flora and fauna of the Mine Site are as follows.

- The construction of additional surface infrastructure within the Pit Top Area (over an area of 2.7ha of previously cleared land.
- The development of a Reject Emplacement Area (up to 25ha in area) on the north-facing side of a low ridge immediately to the west of the box cut on previously cleared land.
- The development of a Brine Storage Area (of up to 160ha in area) to the immediate north of Kurrajong Creek Tributary 2 on predominantly cleared land
- Underground mining by longwall mining methods. A total of 26 panels, each 305m wide would be mined resulting in subsidence of up to 2.17m in the east and 2.44m in the west of the Mine Site (DGS, 2009). Surface cracking resultant from the tilts and strains generated by the subsidence at surface is anticipated to be restricted to approximately 80m in each panel from the retained chain pillar between longwall panels.
- Construction of infrastructure required to drain the coal seam gas, both prior to longwall mining (pre-drainage) and from the collapsed goaf of the each completed panel (goaf gas drainage).
  - Up to three pre-drainage sites requiring an area of up to 3.5ha would be required for each panel.

  - Goaf gas drainage sites of approximately 0.25ha each would be spaced at roughly 200m intervals at surface roughly 30m in-panel from the tailgate chain pillar of each completed longwall panel.

- Three ventilation shaft areas, each of 5.0ha would be required above the West Mains of the underground workings. Additional rear of panel ventilation shafts (requiring an area of approximately 0.25ha each) would also be constructed at the rear of every third to fourth longwall panel.
- Access tracks and service corridors (of combined width up to 10m) would be developed to access these gas drainage and mine ventilation sites.
- A 30m wide power line corridor would also be developed to service the ventilation fans within each ventilation shaft area. The northern power line corridor would be aligned along the rear (north) of panels 1 to 13. A second corridor located on predominantly cleared agricultural land would run north-south over longwall panel 21.
- Construction of a 13 kilometre long and 10 metre wide pipeline corridor from the mine site to the Namoi River (north of the Mine Site).

The various components of the project referred to in this report are shown in **Figures 2** and **2A.**

2 First Stage Ecological Investigation – Preliminary Assessment

2.1 Review of Local Threatened Species and Other Records

A review of the documented records of the locations of threatened flora and fauna species within the study locality has been undertaken. Threatened species records were accessed from the Department of Environment and Climate Change (DECC) Atlas of NSW Wildlife Database for the Narrabri 8837, Boggabri 8936, Baan Baa 8836 and Horton 8937 1:100 000 map sheets (updated to 25th February 2009).

2.1.1 Flora

2.1.1.1 Rare or Threatened Flora

From the review, a total of 17 threatened flora species listed by legislation are known to occur within the area covered by all four map sheets within which the study locality occurs. These are listed in **Table 2** below. Nine of these are listed as vulnerable species by the NSW TSC Act, and ten are listed as vulnerable on the Commonwealth EPBC Act. Six are listed as endangered on the TSC Act and two as endangered on the EPBC Act. Of all listed species, only two have been recorded in the study locality itself. Twenty-seven additional species previously recorded in the area covered by the four map sheets are not protected under State or Commonwealth legislation but are listed under the national database known as ROTAP *Rare or Threatened Australian Plants* (Briggs & Leigh 1996). Of the ROTAP records, only three have been recorded in the study locality.

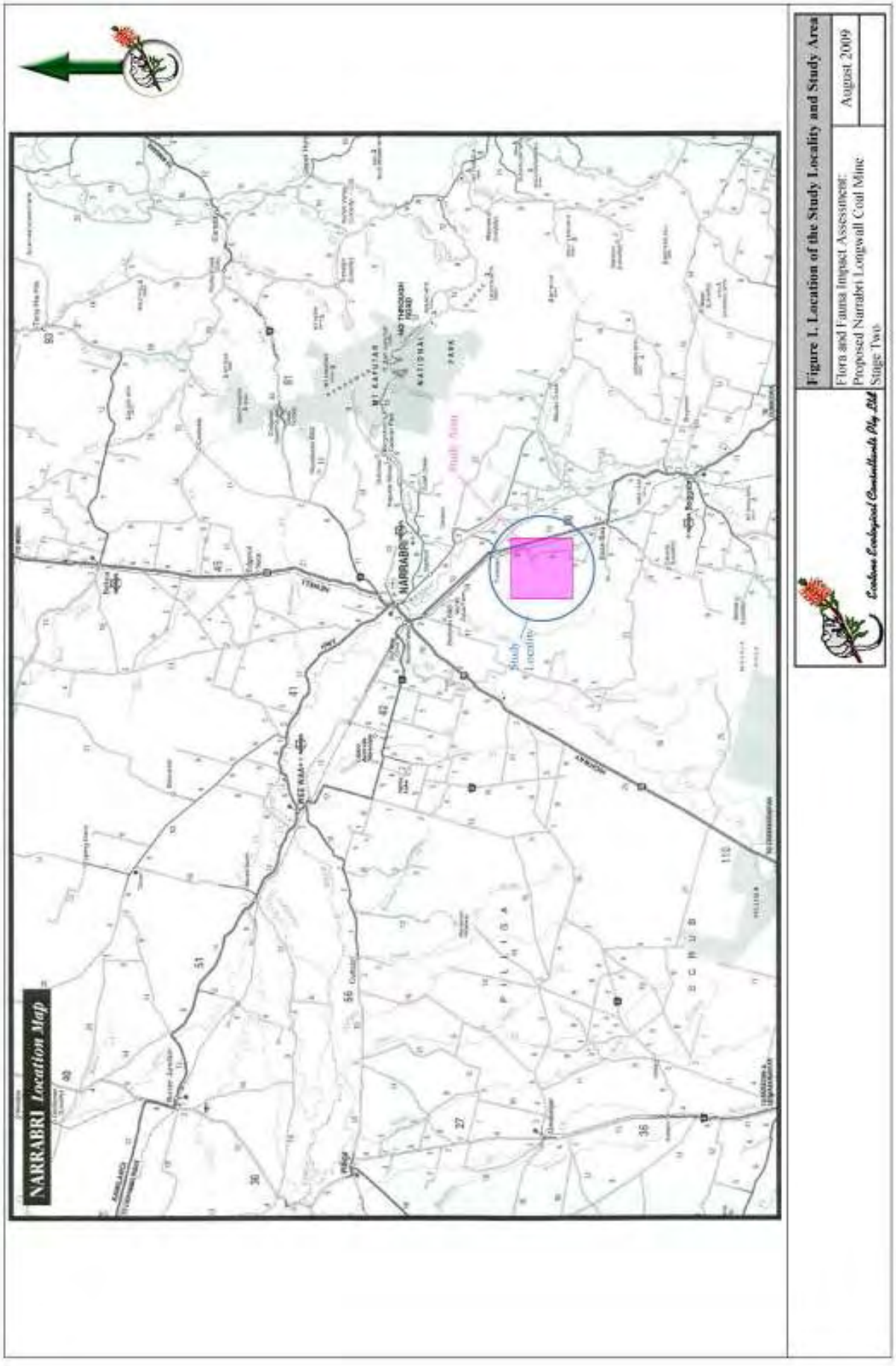

NARRABRI Location Map
NARRABRI
Study Area
Study Locality
Figure 1. Location of the Study Locality and Study Area
Flora and Fauna Impact Assessment:
Proposed Narrabri Longwall Coal Mine
Stage Two
August 2009
Ecotone Ecological Consultants Pty Ltd


Figure 2.1
INDICATIVE MINE SITE LAYOUT
REFERENCE
Mine Site Boundary
Pit Top Area Boundary
Limit of Longwall Mining Area
Longwall Panel No.
Underground Gate Road
Water Pipeline Route
Cadastral Boundary
Contour (m AHD)(Interval = 10m)
Creek / Drainage Line
Approved Disturbance within the Pit Top Area
Area of Proposed Stage 2 Surface Disturbance
Proposed All Weather Unsealed Access Road
Proposed Stage 2 Access Rd/ Gas Drainage
Proposed Power Line
Proposed Power Line Adversing with Mine
Ventilation Shaft Area
Proposed Ventilation Shaft Location
Proposed Rear of Panel Ventilation Shaft
Figure 2. Stage Two Surface Facilities
Flora and Fauna Impact Assessment:
Proposed Narrabri Longwall Coal Mine
Stage Two
August 2009
Ecotone Ecological Consultants Pty Ltd
SCALE 1:40,000
TN
MN

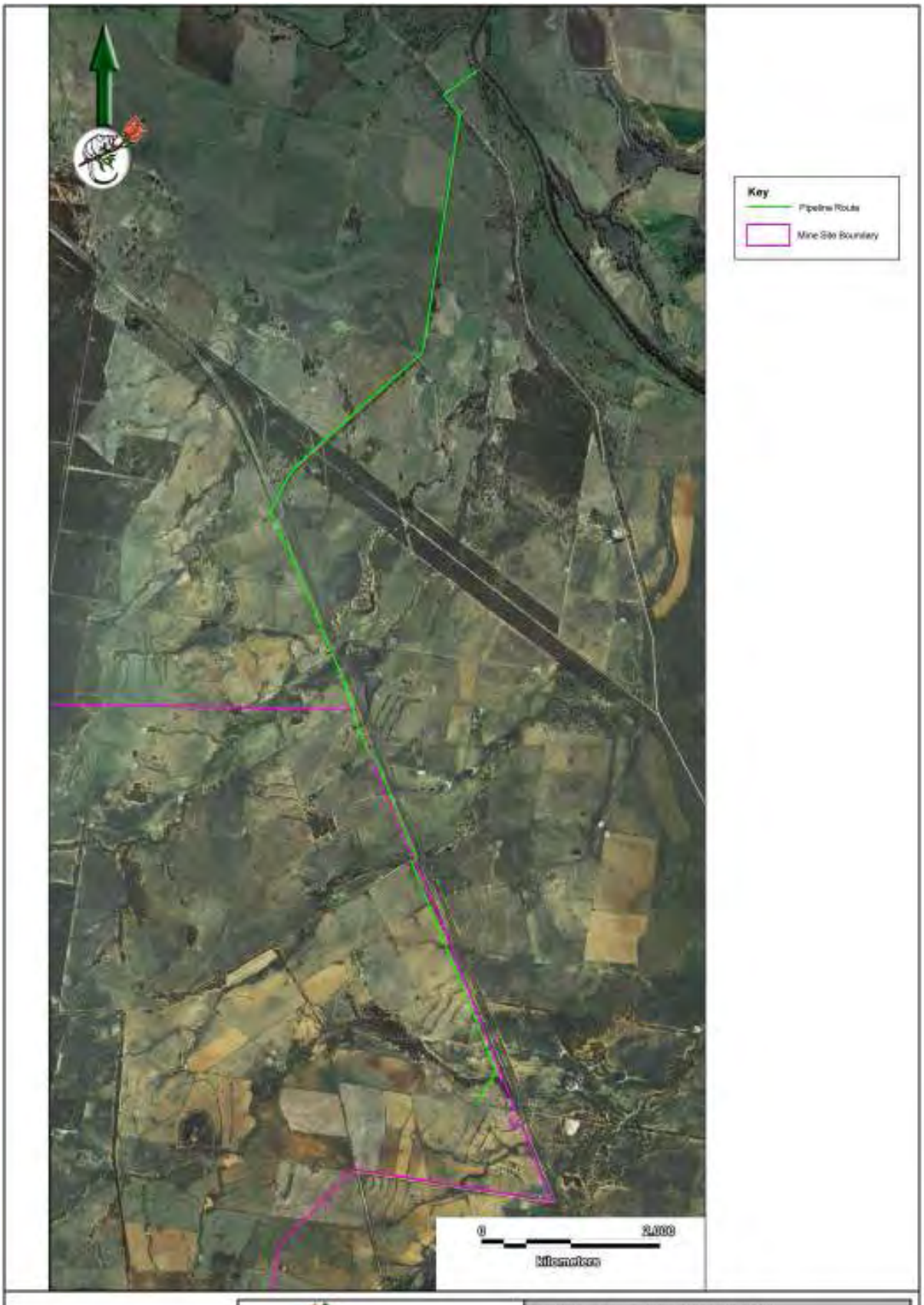

Key
Pipeline Route
Mine Site Boundary
0
2,000
kilometers
Aerial Photo Source: Google Maps
http://maps.google.com.au
Ecotone Ecological Consultants Pty Ltd
Figure 2a. Proposed Pipeline Corridor
Flora and Fauna Impact Assessment:
Proposed Narrabri Longwall Coal Mine
Stage Two
August 2009

Table 2
Rare or Threatened Flora Previously Recorded Within the Study Locality
Page 1 of 2

Scientific Name	Status TSC Act	Status EPBC Act	ROTAP Risk Code	First Date	Last Date	No. Records (All 4 mapsheets)	No. Records (20km)
Bertya opponens (=*Bertya sp. A Cobar-Coolabah*)	V	V	~	1788	2001	5	4
Boronia ruppii	E1	~	~	1912	1912	1	0
Bothriochloa biloba	U	V	3V	1941	1979	3	0
Cadellia pentastylis	V	V	3RCa	1907	2008	41	9
Cyperus conicus	E1	~	~	1976	2006	2	0
Dichanthium setosum	V	~	C-	1885	1885	1	0
Digitaria porrecta	E1	E	3E	1995	1995	3	0
Hakea pulvinifera	E1	E	2ECi	1966	2006	9	0
Haloragis exalata	V	V	3VCa	1976	1976	2	0
Homopholis belsonii	U	V	3R	1993	1994	4	0
Lepidium aschersonii	V	V	3VCa	1899	2006	28	0
Philotheca ericifolia	V	V	3RC-	1913	1973	2	0
Polygala linariifolia	E1	~	~	2006	2006	1	0
Pomaderris queenslandica	E1	~	~	1926	1926	1	0
Pterostylis cobarensis	V	V	3V	1989	1989	1	0
Rulingia procumbens	V	V	3V	1999	1999	3	0
Swainsona murrayana	V	V	3VCi	1886	1886	1	0
ROTAP Only							
Atkinsonia ligustrina	U	~	2RCa	1989	1989	1	0
Boronia rubiginosa	P13	~	2RCa	1978	1978	1	0
Brachyscome lineariloba	U	~	Ci	2007	2007	1	0
Chiloglottis palachila	P13	~	3RC-	1976	2002	3	0
Cryptocarya dorrigoensis	U	~	2RCa	1959	1959	3	0
Discaria pubescens	U	~	3RCa	1954	2000	17	0
Dodonaea rhombifolia	U	~	3RCa	1998	1998	1	0
Eucalyptus elliptica	U	~	3KC-	1909	1992	3	0
Eucalyptus nandewarica	U	~	3RCa	1770	2008	17	1
Euphrasia orthocheila subsp. *orthocheila*	U	~	3RC-	1976	1976	1	0
Gonocarpus longifolius	U	~	3RC-	1978	1978	2	0
Goodenia macbarronii	U	~	3VC-	1973	2004	4	2
Hibbertia kaputarensis	U	~	2RC-	1972	2008	13	0
Hovea apiculata	U	~	C-	1901	1961	4	1
Isotropis foliosa	U	~	3KC-	2007	2007	1	0
Leionema viridiflorum	U	~	3RCa	1965	2008	15	0
Lomandra patens	U	~	3RCa	2007	2007	1	0
Macrozamia diplomera	P13	~	C-	1788	1996	1	0

Table 2 (Cont)
Rare or Threatened Flora Previously Recorded Within the Study Locality
Page 2 of 2

Scientific Name	Status TSC Act	Status EPBC Act	ROTAP Risk Code	First Date	Last Date	No. Records (All 4 mapsheets)	No. Records (20km)
Macrozamia stenomera	P13	~	C-	1770	2008	29	0
Persoonia cuspidifera	P13	~	3KC-	1985	1985	1	0
Picris barbarorum	U	~	3R	1770	2008	2	0
Picris eichleri	U	~	3KC-	1912	1976	2	0
Pimelea ciliolaris	U	~	2RC-	1899	1899	1	0
Prostanthera cruciflora	U	~	2RC-	1770	2008	17	0
Rulingia hermanniifolia	U	~	3RCa	1967	1980	1	0
Sauropus ramosissimus	U	~	3KC-	1912	1912	1	0
Zieria odorifera	U	~	3RCi	1914	2002	3	0

Notes:
776000E 6620000N (AGD66 Grid 55) is the approximate centre of the Mine Site (Narrabri 8837, Boggabri 8936, Baan Baa 8836, Horton 8937 1:100000 map sheets)
Nomenclature follows Harden (1990-1993), Harden & Murray (2000) and subsequent updates as obtained from PlantNET.

Status (TSC): refers to the NSW *Threatened Species Conservation Act* 1995 (TSC)
- E1 Schedule 1, Part 1: Endangered Species
- V Schedule 2: Vulnerable Species
- P13 Protected under Schedule 13 of the *National Parks and Wildlife Act* 1974
- U Unprotected (not listed in Schedule 13 of the NPW Act 1974 or in the TSC Act 1995)

Status (EPBC): refers to the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC)
- E Endangered Species
- V Vulnerable Species

ROTAP Risk Code (Briggs and Leigh 1996)
- 2 Geographic range in Australia less than 100km
- 3 Geographic range in Australia greater than 100km
- E Endangered Species: at risk of disappearing from the wild within 10-20 years if present land use and other threats continue to operate
- V Vulnerable Species: not presently endangered, but possibly at risk in future due to continuing depletion or land-use change
- R Rare Species: rare in Australia, but currently without any identifiable threat
- K Poorly Known: taxon that is suspected, but not definitely known, to belong to one of the above categories. At present, accurate field information is inadequate
- C Reserved: indicates taxon has at least one population within a national park, or other proclaimed conservation reserve or in an area otherwise dedicated for the protection of flora
- a 1000 plants or more are known to occur within a conservation reserve(s)
- i less than 1000 plants are known to occur within a conservation reserve(s)
- - reserved population size is not accurately known

Please note: These records are based on information supplied by the Department of Environment and Climate Change and other sources, and may contain errors or omissions.

Lists of threatened species known or predicted to occur within the Liverpool Plains (Part B), Pilliga (Part A) and Pilliga Outwash CMA subregions were also reviewed. Predicted species are derived from Bioclimatic analysis (Busby 1991). This modelling is based on areas of suitable climate for a species, although this does not mean that its required habitat will necessarily be present within the study locality. Two additional known or predicted flora species for these subregions are listed below:

- *Thesium australe* (Austral Toadflax) – Known from Liverpool Plains (Part B) subregion
- *Tylophora linearis* – Predicted to occur in Pilliga (Part A) and Pilliga Outwash subregions

An assessment of the likelihood of each of these recorded or predicted species occurring in the study area as a result of the habitat types present is presented in **Section 4.1.1.**

2.1.1.2 Endangered Populations of Plants

No endangered populations of plants (Schedule 1, Part 2 of the TSC Act) have been recorded in the study locality or within the wider area covered by the four local 1:100 000 map sheets.

2.1.1.3 Endangered Ecological Communities and Critical Habitat

Several Endangered Ecological Communities (Schedule 1, Part 3 of the TSC Act) are known from the Brigalow Belt South and adjacent Bioregions, as listed below.

- Artesian Springs Ecological Community.
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions.
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions.
- Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions.
- Coolibah - Black Box Woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South Bioregions.
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions.
- Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions.
- Native Vegetation on Cracking Clay Soils of the Liverpool Plains.
- White Box Yellow Box Blakely's Red Gum Woodland.
- *Cadellia pentastylis* (Ooline) community in the Nandewar and Brigalow Belt South IBRA regions.
- McKies Stringybark/Blackbutt Open Forest in the Nandewar and New England Tableland Bioregions.
- Howell Shrublands in the Northern Tablelands and Nandewar Bioregions.
- Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions.

A remnant of *White Box Yellow Box Blakely's Red Gum Woodland* was recorded on the site of the Tarrawonga (previously East Boggabri) Coal Mine by Geoff Cunningham Natural Resource Consultants (2005a). This site lies approximately 30 kilometres to the south-east of the study area.

An assessment as to whether any of these ecological communities could occur within the study area will be carried out later in the report.

No critical habitat declared to date occurs within the study locality.

2.1.2 Fauna

2.1.2.1 Threatened Species

A total of 26 threatened terrestrial fauna species have previously been recorded within the study locality (listed on the Atlas of NSW Wildlife), comprising 18 bird, seven mammal and one reptile species. Of these, six species (Australian brush-turkey, black-necked stork, painted snipe, regent honeyeater, black-striped wallaby and brush-tailed rock wallaby) are currently listed as endangered on Schedule 1, Part 1 of the *TSC Act 1995* and the remainder as vulnerable on Schedule 2 of the Act. Six species are also listed in the Commonwealth EPBC Act (1999), one as endangered (regent honeyeater) and five as vulnerable (superb parrot, painted snipe, large-eared pied bat, eastern long-eared bat and brush-tailed rock-wallaby). The regent honeyeater and painted snipe are also listed as migratory species in the EPBC Act. The threatened fauna species previously recorded in the locality are listed in **Table 3.**

Table 3
Threatened Fauna Previously Recorded Within the Study Locality

Page 1 of 2

Scientific Name	Common Name	TSC Act	EPBC Act	First Date	Last Date	No. Records (20km)	No. Records (10km)
Birds							
Alectura lathami	Australian brush-turkey *Alectura lathami* Gray, 1831 in the Nandewar and Brigalow Belt South Bioregions	E2	~	2001	2004	8	2
Anseranas semipalmata	Magpie goose	V	~	1998	1998	1	0
Ephippiorhynchus asiaticus	Black-necked stork	E1		1994	1994	2	2
Hamirostra melanosternon	Black-breasted Buzzard	V	~	1983	1985	2	1
Rostratula benghalensis australis	Painted snipe (Australian subspecies)	E1	V, Mi	1992	1992	1	1
Calyptorhynchus lathami	Glossy black-cockatoo	V	~	1983	2003	7	6
Neophema pulchella	Turquoise parrot	V	~	1986	2005	10	1
Polytelis swainsonii	Superb parrot	V	V	2001	2001	1	1
Tyto novaehollandiae	Masked owl	V	~	1985	1985	1	1

Table 3 (Cont)
Threatened Fauna Previously Recorded Within the Study Locality

Scientific Name	Common Name	TSC Act	EPBC Act	First Date	Last Date	No. Records (20km)	No. Records (10km)
Birds (cont'd)							
Ninox connivens	Barking owl	V	~	1983	2007	7	5
Climacteris picumnus	Brown treecreeper	V	~	1991	2005	19	12
Climacteris picumnus victoriae	Brown treecreeper (eastern subspecies)	V	~	2007	2007	1	0
Pyrrholaemus saggitatus	Speckled warbler	V	~	1982	2004	10	9
Melithreptus gularis gularis	Black-chinned honeyeater (eastern subspecies)	V	~	2004	2004	1	0
Xanthomyza phrygia	Regent honeyeater	E1	E, Mi	2003	2003	1	1
Melanodryas cucullata	Hooded robin	V	~	2003	2004	3	2
Pomatostomus temporalis temporalis	Grey-crowned babbler (eastern subspecies)	V	~	2001	2007	5	5
Stagonopleura guttata	Diamond firetail	V	~	2003	2004	4	0
Mammals							
Phascolarctos cinereus	Koala	V	~	1967	2006	17	6
Petaurus norfolcensis	Squirrel glider	V	~	1993	2001	2	1
Macropus dorsalis	Black-striped wallaby	E1	~	2000	2000	1	0
Petrogale penicillata	Brush-tailed rock-wallaby	E1	V	2001	2005	8	0
Saccolaimus flaviventris	Yellow-bellied sheathtail-bat	V	~	2001	2005	5	3
Nyctophilus timoriensis	Eastern long-eared bat	V	V	1979	2001	3	2
Chalinolobus dwyeri	Large-eared pied bat	V	V	2001	2001	2	1
Reptiles							
Hoplocephalus bitorquatus	Pale-headed snake	V	~	2001	2001	1	0

Notes:
776000E 6620000N (AGD66 Grid 55) is the approximate centre of the Mine Site.
Status (TSC): refers to the NSW *Threatened Species Conservation Act* 1995 (TSC)
E1 Schedule 1, Part 1: Endangered species
CE Schedule 1A, Part 1: Critically endangered species
V Schedule 2: Vulnerable species
Status (EPBC): refers to the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC)
E Endangered Species
V Vulnerable Species
Mi Migratory Species
Please note: These records are based on information supplied by the Department of Environment and Climate Change and other sources, and may contain errors or omissions.

2.1.2.2 Endangered Fauna Populations

The Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions includes the study locality.

2.1.3 Preliminary and Final Determinations of Species Listings on the TSC Act

The Scientific Committee under the TSC Act may at any time alter the list of species on Schedules 1, 1A and 2 of the TSC Act. Such changes may include the addition of new species, the removal of previously listed species or changes in the schedule status of a species. During a period of consideration by the Scientific Committee the species under consideration is listed as a Preliminary Determination. If the proposed Preliminary Determination is approved the change is listed as a Final Determination.

Where a development application has been lodged for a s. 91 TSC Act licence and is awaiting approval the implications of any final determinations declared during that period depend on the schedule on which the species is to be listed. Final Determinations affecting Schedules 1 and 1A must still be considered in the assessment of significance of all applications prior to approval, even after lodgement. Final Determinations affecting Schedule 2 (vulnerable species) are not subject to impact assessment if they are declared after the date of lodgement of a development application, as long as the application is determined within 12 months of lodgement (s. 113C TSC Act).

For the purposes of this assessment and using a precautionary approach all species listed as preliminary determinations under the TSC Act are assessed as approved final determinations.

At the date of submission of this report the following preliminary determinations exist on the following species known (recorded during surveys for this project or recorded on the Atlas of NSW Wildlife) to occur in the study locality:

- Little lorikeet (*Glossopsitta pusilla*) – proposed vulnerable species listing,
- Little eagle (*Hieraaetus morphnoides*) – proposed vulnerable species listing,
- Varied sittella (*Daphoenositta chrysoptera*) – proposed vulnerable species listing.

2.1.4 EPBC Act Protected Matters Report

The EPBC Act Protected Matters Search Tool was accessed on 11th May 2009 to identify the Protected Matters under the Commonwealth EPBC Act that occur or may occur within the study locality. This review yielded a report listing the matters that could potentially be relevant under the EPBC Act for activities within the study area. The report below (**Table 4**) identifies matters that could potentially be relevant in any part of the study locality (20 km radius). The species or matters listed below may not necessarily be relevant to the study area or Mine Site itself.

Table 4
Summary of Potentially Relevant Matters Under the Commonwealth EPBC Act 1999

Page 1 of 2

Protected Matter	Potentially Relevant?	Details
Matters of National Environmental Significance		
Biodiversity		
Threatened Species - Flora	Yes	Nine species: **Species or species habitat may occur within area according to EPBC modelling.** *Diuris sheaffiana* (=*Diuris tricolor*) Tricolour diuris (**V**) **Species or species habitat likely to occur within area according to EPBC modelling.** *Bertya opponens* (**V**) *Cadellia pentastylis* Ooline (**V**) *Digitaria porrecta* Finger panic grass (**E**) *Philotheca ericifolia* (**V**) *Pterostylis cobarensis* Cobar greenhood orchid (**V**) *Rulingia procumens* (**V**) *Swainsona murrayana* Slender darling-pea (**V**) *Thesium australe* Austral toadflax (**V**) The likelihood of any of these species occurring in the study area on the basis of available habitat is assessed in **Section 4.1.1**.
Threatened Species – Fauna (Terrestrial Species only)	Yes	Twelve species: **Species or species habitat may occur within area according to EPBC modelling.** Australian painted snipe *Rostratula australis* (**V**) Booroolong frog *Litoria booroolongensis* (**E**) Brush-tailed rock-wallaby *Petrogale penicillata* (**V**) Eastern long-eared bat *Nyctophilus timoriensis* (south-eastern form) (**V**) Five-clawed worm-skink *Anomalopus mackayi* (**V**) Large-eared pied bat *Chalinolobus dwyeri* (**V**) Regent honeyeater *Xanthomyza phrygia* (**E**) Superb parrot *Polytelis swainsonii* (**V**) **Species or species habitat likely to occur within area according to EPBC modelling.** Border thick-tailed gecko *Underwoodisaurus sphyrurus* (**V**) Malleefowl *Leipoa ocellata* (**V**) Swift parrot *Lathamus discolor* (**E**) Pilliga mouse *Pseudomys pilligaensis* (**V**) (*now known as the Delicate mouse Pseudomys delicatatus*). The likelihood of any of these species occurring in the study area on the basis of available habitat is assessed in **Section 4.1.2**.

Table 4 (Cont)
Summary of Potentially Relevant Matters Under the Commonwealth EPBC Act 1999

Page 2 of 2

Protected Matter	Potentially Relevant?	Details
Matters of National Environmental Significance		
Biodiversity		
Migratory Species (Terrestrial Species Only)	Yes	Nine species : **Species or species habitat likely to occur within area according to EPBC modelling.** Malleefowl *Leipoa ocellata* (**Mi, V**) White-bellied sea eagle *Haliaeetus leucogaster* (**Mi**) **Species or species habitat may occur within area according to EPBC modelling.** White-throated needletail *Hirundapus caudacutus* (**Mi**) Rainbow bee-eater *Merops ornatus* (**Mi**) Regent honeyeater *Xanthomyza phrygia* (**Mi, E**) Wetland Species **Species or species habitat may occur within area according to EPBC modelling.** Cattle egret *Ardea ibis* (**Mi**) Great egret *Ardea alba* (**Mi**) Latham's snipe *Gallinago hardwickii* (**Mi**) Painted snipe *Rostratula benghalensis s. lat.* (**Mi**) The likelihood of any of these species occurring in the study area on the basis of available habitat is assessed in **Table 12** (**Section 4.1.2**).
Listed Marine Species	No	-
Whales and Other Cetaceans	No	-
Threatened Ecological Communities	Yes	Three: Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (**CE**), Weeping Myall Woodlands (**E**), and White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (**CE**)
Heritage		
World Heritage Properties	Yes	None
National Heritage Places	Yes (natural places only)	None
Wetlands (catchment areas for these wetlands occur within the study locality)		
Wetlands of International Significance (Ramsar sites)	Yes	None
Protected Areas		
Reserves and Conservation Areas	Yes	None
Regional Forest Agreements	Yes	None

Notes:
V Species listed as **Vulnerable** under the Commonwealth *EPBC Act*.
E Species listed as **Endangered** under the Commonwealth *EPBC Act*.
CE Species listed as **Critically Endangered** under the Commonwealth *EPBC Act*.
Mi Species listed as **Migratory** under the Commonwealth *EPBC Act*.

2.1.5 Summary of Local Threatened Species

Following the above literature review and database searches the following 40 threatened and/or migratory species have been identified within or are likely to occur within a 20 kilometre radius of the Mine Site:

- Australian brush-turkey,
- Malleefowl,
- Magpie goose,
- Black-necked stork,
- Cattle egret,
- Great egret,
- Black-breasted buzzard,
- White-bellied sea eagle,
- Little eagle,
- Painted snipe,
- Latham's snipe,
- Glossy black-cockatoo,
- Little lorikeet,
- Turquoise parrot,
- Swift parrot,
- Superb parrot,
- Masked owl,
- Barking owl,
- Brown treecreeper (eastern subspecies),
- White-throated needletail,
- Rainbow bee-eater,
- Speckled warbler,
- Black chinned-honeyeater (eastern subspecies),
- Regent honeyeater,
- Hooded robin,
- Varied sitella,
- Grey-crowned babbler (eastern subspecies),
- Diamond firetail,
- Koala,
- Squirrel glider,
- Brush-tailed rock-wallaby,
- Black striped wallaby,
- Yellow-bellied sheathtail-bat,
- Eastern long-eared bat,
- Large-eared pied bat,
- Delicate mouse (formerly known as the Pilliga mouse),
- Booroolong frog,
- Border thick-tailed gecko,
- Five-clawed worm-skink, and
- Pale-headed snake.

An assessment of each species' likelihood of occurrence on the Mine Site (**Section 4.1.2**) will be undertaken following a fauna survey across the Mine Site (**Section 3.2**) and a review of the habitat requirements of each threatened or migratory species (**Table 12**).

3 SECOND STAGE ECOLOGICAL INVESTIGATION – FIELD SURVEYS

3.1 Floral Investigations

3.1.1 Methodology

Following a general site inspection throughout the study area on 19th January 2009, full flora field surveys were undertaken within the study area from the 20th to 23rd January 2009 to document the flora and vegetation communities within the mine site component of the study area. The methodology involved the selection of 12 survey sites throughout the Mine Site with the locations chosen to ensure that representative vegetation communities were sampled. Following subsequent plans to construct a Brine Storage Area for the storage of waste brine produced by the desalination of dewatered groundwater, and a water pipeline to the Namoi River (to enable discharge of surplus fresh water raffinate produced by the desalination process and/or extraction of water from the river to supplement mine site supplies during the initial years of operations), a supplementary field survey was conducted on the 6th and 7th of August 2009 to assess the habitat, vegetation communities and any significant flora features within this extended section of the study area. Locations of the survey sites are given in **Figures 3** and **3A.** The methodology at each survey site involved the following components:

- A 'loop' or linear transect on foot ranging in length from approximately 300 m to 1 km within which all vascular flora species were recorded and the variation in the structure and condition of the vegetation generally was noted;
- One 400 m^2 (20 x 20 m or 40 x 10 m in linear sites such as riparian or roadside habitat) flora quadrat at a representative point along the transect within which vegetation structure (strata, heights and cover), soil type, topography, extent of modification, disturbance, weed invasion and condition of the vegetation generally was recorded. All vascular flora species were recorded within the quadrat. The location of the quadrat was recorded using a hand-held GPS to an accuracy of $\pm$10 m and photographs showing general views of the habitat were taken.
- A targeted search for any threatened flora species as listed in the *TSC Act* 1995 or *EPBC Act* 1999 for which potential habitat was available and which were considered to have at least a moderate likelihood of occurring and potentially detectable at the time of the survey. This mainly involved a search for *Bertya opponens* (*Bertya* sp. Cobar-Coolabah) in the area where it had previously been recorded. The search used the random meander method (Cropper 1993) which is considered to be the most efficient method of detecting threatened flora species.

Small samples of any plant species that could not be identified in the field were obtained for further examination and identification.

The survey sites were supplemented by general traverses throughout the entire study area, mainly by vehicle, with some short random meanders on foot to assess the general vegetation type and condition throughout the study area in locations other than the survey sites.

The survey methodology broadly complied with current best practice flora survey guidelines for a full impact assessment where practically possible, such as DECC's Draft Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004). **Table 5** outlines the level of

compliance with the DECC recommended level of survey effort. Note that whilst fewer traverses and quadrats were used within Community 1 than recommended, the total traverse length was far in excess of the suggested minimum length overall. This stratification unit overall was uniform throughout, therefore the strategy of allocating relatively greater survey effort to transect length than quadrat number for this unit is considered appropriate. The variation is likely to have provided more useful data for the same time allocation, particularly given the limited opportunities for access points to the area.

Table 5
Compliance with Suggested Flora Survey Effort*

Method	Suggested Minimum Effort (Community# = Stratification Unit)		As Carried Out
Transects (or Traverse)	Community 1	20 traverses of 100m each = 2000m total traverse length	6 traverses of average 800m each = 4800m total traverse length
	Community 2	3 traverses of 100m each = 300m total traverse length	3 traverses of average 800m each = 2400m total traverse length.
	Community 3	2 traverses of 100m each = 200m total traverse length	2 traverses of average 800m each = 1600m total traverse length.
	Community 4	1 traverse of 100m	1 traverse of approx. 800m
	Community 5	1 traverse of 100m	1 traverse of approx. 300m
	Community 6	1 traverse of 100m	1 traverse of entire area
Random Meander	30 minutes for each quadrat sampled within the same stratification unit as the quadrat		Done
Plot-based (Quadrat) Survey	Community 1	20 quadrats	6 quadrats, but much longer transects than suggested.
	Community 2	3 quadrats	6 quadrats
	Community 3	2 quadrats	3 quadrats
	Community 4	1 quadrat	1 quadrat
	Community 5	1 quadrat	1 quadrat
	Community 6	1 quadrat	Quadrat unnecessary – all plant species documented during the above traverse

* Adapted from Section 5 of the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, Working Draft, DECC 2004.

\# Section 3.1.3.1 provides a description of the vegetation communities identified and surveyed within the study area.

3.1.2 Survey Limitations

Owing to the size and scale of the study area (the entire Mine Site was 5210 ha in area and the largest vegetation unit alone was 2058 ha in area), only selected representative areas could be sampled. It was not possible to survey the entire area of the Mine Site. In particular, the vegetated western third of the site was rugged and had a dense shrub layer. Additionally, an extensive area in the centre lacked any tracks for vehicle access. As a consequence it is

possible that some significant flora features may have been overlooked, although the locations of survey sites were selected in such a manner as to minimise this possibility.

3.1.3 Results

3.1.3.1 Vegetation Communities

Six natural or predominantly natural vegetation community types and one artificial vegetation community type occur within the Study Area as follows:

Natural Communities

1. Sandstone Slopes Woodland: Brown Bloodwood / Pilliga Grey Box / Red Ironbark
2. Lower Flats and Floodplain Woodland: Inland Grey Box / Bimble Box / Blakely's Red Gum
3. Riparian Forest: River Oak / Belah / Inland Grey Box
4. White Cypress Forest
5. Riparian Open Forest / Woodland: River Red Gum
6. Weeping Myall Woodland

Artificial Community

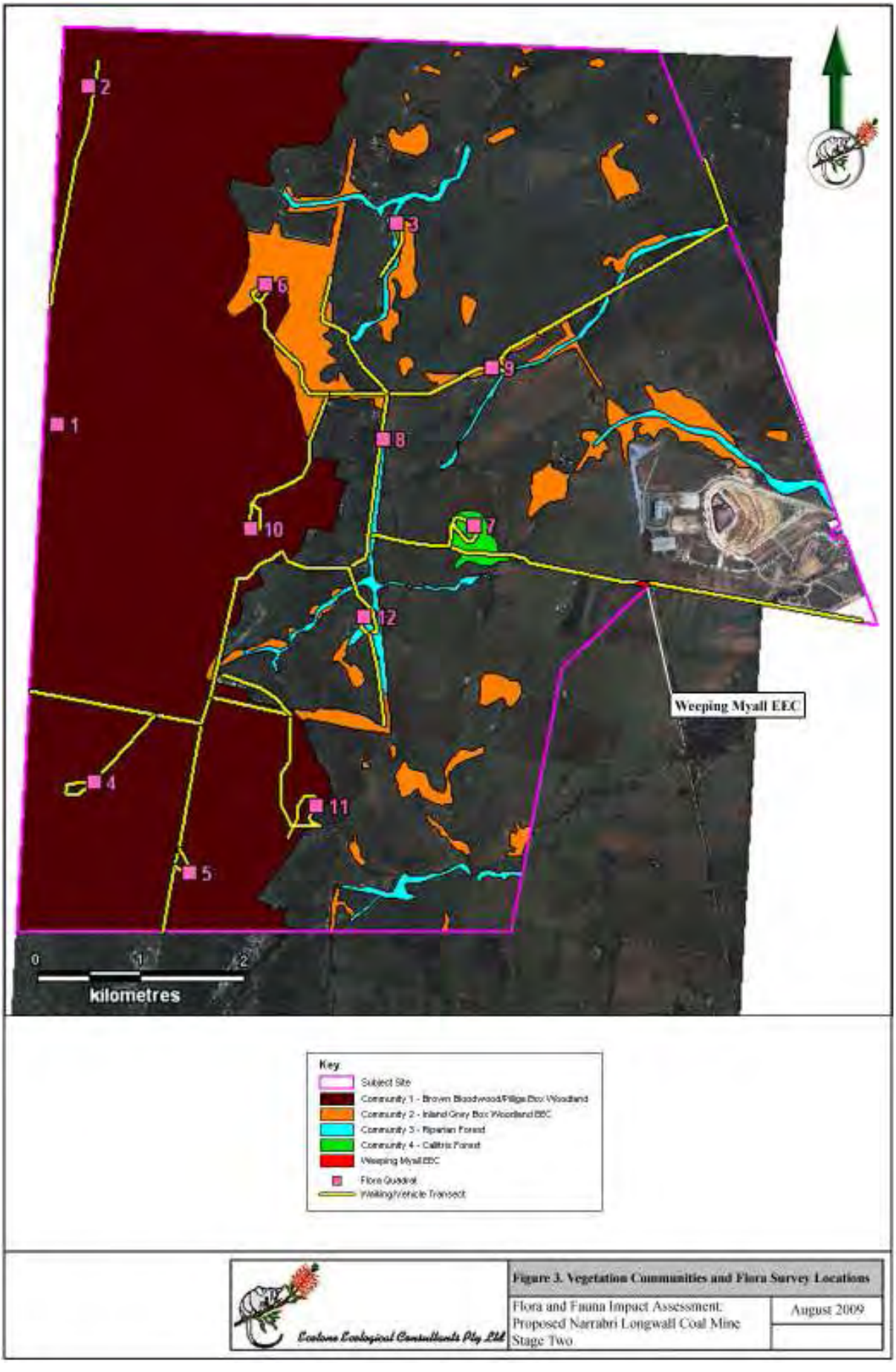
7. Cleared Open Grassland / Cropland / Weedy Areas / Cultivated Gardens

Community 1 generally occupies the western part of the Mine Site, whilst Communities 2, 3 and 4 occur in the eastern part of the Mine Site. Community 5 occurs along the Namoi River at the proposed discharge point of the water pipeline. One small patch of Community 6 was identified along a farm track on the Mine Site (to the south of the Pit Top Area) with two additional patches identified within the road reserve of the water pipeline route. Community 7 is the largest single community in area, and make up the balance of the eastern part of the Mine Site.

Distributions of the natural vegetation communities are shown in **Figures 3** & **3a** and descriptions of the structure and floristics of each community within the site are given in **Table 6**. The full systematic list of flora species recorded from the study area is given in **Appendix 1** and details of the data collected from the quadrats within each site are given in **Appendix 2**.

3.1.3.2 Comparison with Statewide and Regional Vegetation Mapping

No detailed local or regional vegetation mapping studies have been undertaken over the area within which the study area occurs. However, on a statewide and bioregional basis, **Table 7** gives the broad vegetation categories that correspond to the vegetation communities identified and described by this study. The vegetation categories comprise the formations and classes of Keith (2004) and the Vegetation Types for the Namoi Catchment Management Area (CMA) that were developed for use with the Biometric Tool under the NSW Native Vegetation Act 2003 and subsequently adopted for use by the BioBanking methodology. For the Namoi CMA, these communities are derived from the studies of Benson et al. (2006), Benson (2008) and others.


2
3
6
9
1
8
10
7
12
Weeping Myall EEC
4
11
5
0
1
2
kilometres
Key
Subject Site
Community 1 - Brown Bloodwood/Pilliga Box Woodland
Community 2 - Inland Grey Box Woodland EEC
Community 3 - Riparian Forest
Community 4 - Callitris Forest
Weeping Myall EEC
Flora Quadrat
Walking/vehicle Transect
Ecotone Ecological Consultants Pty Ltd
Figure 3. Vegetation Communities and Flora Survey Locations
Flora and Fauna Impact Assessment: Proposed Narrabri Longwall Coal Mine Stage Two
August 2009

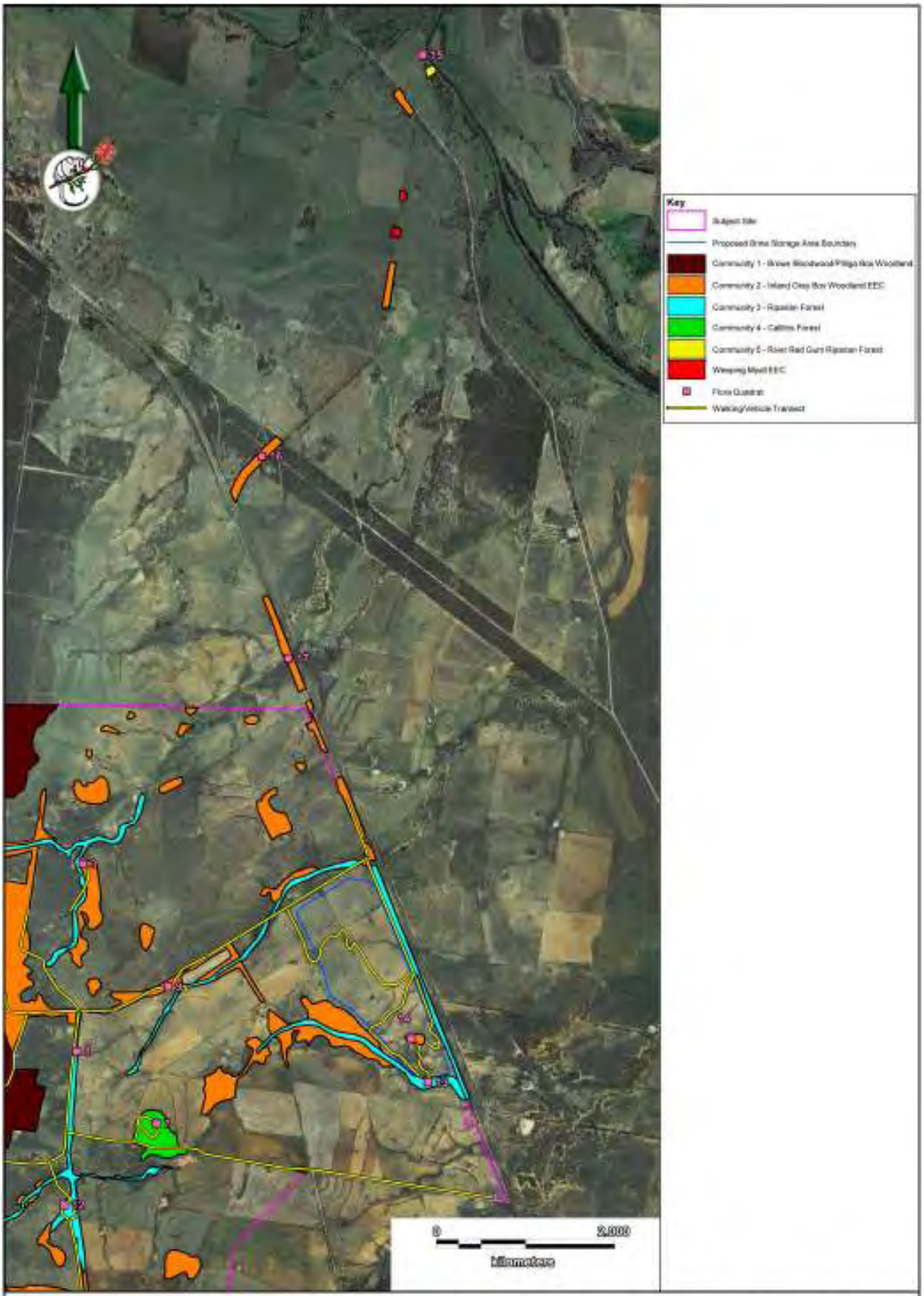

Key
Subject Site
Proposed Brine Storage Area Boundary
Community 1 - Brown Bloodwood/Pilliga Box Woodland
Community 2 - Inland Grey Box Woodland EEC
Community 3 - Riparian Forest
Community 4 - Callitris Forest
Community 5 - River Red Gum Riparian Forest
Weeping Myall EEC
Flora Quadrat
Walking/Vehicle Transect
0
2,000
Kilometers
Aerial Photo Source: Google Maps
http://maps.google.com.au
Ecotone Ecological Consultants Pty Ltd
Figure 3a. Vegetation Communities of the Proposed Pipeline Corridor
Flora and Fauna Impact Assessment:
Proposed Narrabri Longwall Coal Mine
Stage Two
August 2009

Table 6
Descriptions of the Vegetation Communities Within the Study Area

Stratum	*Height*	*Percent Cover**	*Dominant Species*	*Comments*
Community 1: SANDSTONE SLOPES WOODLAND: Brown Bloodwood / Pilliga Grey Box / Red Ironbark				
Tree layer	10 – 18m	15 – 30	*Corymbia trachyphloia* *E. pilligaensis* *E. fibrosa*	Habitat: Undulating sandstone slopes and ridgetops on sandy / sandy loam or rocky soil. Structure/Characteristics: Occurs as numerous patches of similar species composition and structure throughout. Ranges from low mallee woodland with dense shrub layer to open forest with sparse shrub layer. Tree layer mostly sparse. Often dense presence of tall wattles (yarran and brigalow). Distribution within Study Area: Occupies a large area on the elevated undulating land in the western third of the study area. Condition & Presence of Weeds: Most areas of the community are in a natural state with minimal disturbances. Weeds are mostly absent to very sparse in disturbed areas such as adjacent to tracks. Many parts of the community appear to be regrowth from past logging. Conservation Status: Scattered patches of brigalow within the community could represent a marginal EEC (see text). The community could also provide habitat for threatened flora species.
Small tree layer	8 – 10m	15 – 25	*Callitris glaucophylla* *Acacia homalophylla* *A. harpophylla*	
Shrub layer	1 – 3m	10 – 50	*Calytrix tetragona* *Phebalium squamulosum* *Acacia burrowii* *Persoonia sericea* *Homoranthus flavescens* *Allocasuarina diminuta* *Melaleuca erubescens* *Leptospermum polygalifolium* *Cassinia arcuata*	
Ground layer	To 1m	5 – 60	*Cleistochloa rigida* *Eragrostis brownii* *Perotis rara* *Microlaena stipoides* *Eragrostis brownii* *Pomax umbellata* *Melichrus urceolatus* *Dianella revoluta* *Goodenia hederacea* *Dampiera adpressa*	

*projective foliage canopy cover

Table 6 (Cont)
Descriptions of the Vegetation Communities Within the Study Area

Stratum	*Height*	*Percent Cover**	*Dominant Species*	*Comments*
Community 2: LOWER FLATS AND FLOODPLAIN WOODLAND: Inland Grey Box / Bimble Box / Blakely's Red Gum				
Tree layer	20 - 22m	15 - 25	*Eucalyptus microcarpa* *E. populnea* *E. blakelyi*	Habitat: Flat floodplain or slightly elevated gently sloping land between watercourses. Structure/Characteristics: Modified partially cleared and disturbed woodland dominated by species adapted to or tolerant of drier conditions, with occasional inundation due to flooding. The density of the shrub and ground layers is highly variable. Distribution within Study Area: Occupies relatively small patches within the matrix of cleared farmland in the eastern two-thirds of the study area. Condition & Presence of Weeds: Most patches of the community are in a modified condition, with partial clearing of the tree and shrub layers. Most patches are subject to at least occasional grazing. Nevertheless, the abundance of exotic species is mostly low. Conservation Status: The habitat of the community together with the particular assemblage of species according to the Final Determination (NSW Scientific Committee 2007) indicates that the community qualifies as the EEC 'Inland Grey Box Woodland' under the NSW TSC Act.
Small tree layer	5 – 8m	5 - 30	*Geijera parviflora* *Callitris glaucophylla* *Casuarina cristata* *Capparis mitchellii*	
Shrub layer	1 – 3 m	5 – 30	*Geijera parviflora* *Maytenus cunninghamii* *Acacia homalophylla*	
Ground layer	To 1m	40 - 70	*Aristida benthamii* *Solanum ferocissimum* *Atriplex* spp. *Abutilon* spp. *Austrostipa ramosissima* *A. verticillata* *Gonocarpus elatus* *Sporoblous caroli* *Chloris truncata* *C. ventricosa* *Solanum ferocissimum* *Chrysocephalum apiculatum* *Sclerolaena birchii* *Cheilanthes sieberi* *Rostellularia adscendens* *Calotis* spp. *Wahlenbergia* spp.	

*projective foliage canopy cover

Table 6 (Cont)
Descriptions of the Vegetation Communities Within the Study Area

Stratum	*Height*	*Percent Cover**	*Dominant Species*	*Comments*
Community 3: RIPARIAN FOREST: River Oak / Belah / Inland Grey Box				
Tree layer	20 - 35 m	10 - 40	*Casuarina cunninghamiana* *C. cristata* *Eucalyptus populnea* *E. microcarpa*	Habitat: Banks and adjacent floodplains of creeks. Structure/Characteristics: Modified partially cleared but relatively intact open forest to woodland dominated by casuarinas and species adapted to higher water availability. Shrub and ground layers variable in density. Also occurs as stands of Belah in patches near watercourses or in strips along fence lines. Distribution within Study Area: Limited to the eastern two thirds of the study area, along watercourses or adjoining floodplains. Condition & Presence of Weeds: All patches of the community have some degree of modification, including clearing and shrub layer removal. Most patches are subject to regular or intermittent grazing. Local high abundances of noxious and exotic weeds occur, but the density of weeds in most parts is generally low. Conservation Status: Not listed under any legislation. However, the community usually intergrades with and is closely associated with Community 2, which is a listed EEC. Additionally, all natural riparian communities are considered to have intrinsic conservation significance and are generally assigned a 'Vulnerable' or 'Near Threatened' threat category by Benson et al (2006) and Benson (2008).
Small tree layer	6 – 8 m	20 -30	*Eremophila mitchellii* *Myoporum montanum*	
Shrub layer	2 – 4 m	0 – 30	*Geijera parviflora* *Acacia penninervis* *Notelaea microcarpa*	
Ground layer	To 1 m	10 – 60	*Aristida benthamii* *Austrostipa aristiglumis* *A. ramosissima* *A. verticillata* *Bothriochloa decipiens* *Dichondra repens* *Glycine clandestina* *Gomphrena celosioides* *Gonocarpus elatus* *Einadia trigonos* *E. hastata* *Rhagodia spinescens* *Sporoblous caroli* *Chloris truncata* *C. ventricosa* *Cyperus gracilis* *Solanum amblymerum* *S. ferocissimum* *Crassula sieberiana* *Cheilanthes sieberi* *Rostellularia adscendens* *Calotis* spp.	

*projective foliage canopy cover

Table 6 (Cont)
Descriptions of the Vegetation Communities Within the Study Area

Stratum	*Height*	*Percent Cover**	*Dominant Species*	*Comments*
Community 4: WHITE CYPRESS FOREST				
Tree layer	18 - 20 m	50 - 60	*Callitris glaucophylla*	Habitat: Red soil with laterite on a low, flat ridge with poor drainage. Structure/Characteristics: A simplified community consisting almost entirely of tall white cypress in the tree layer with no shrub layer and a sparse, grazed ground layer. Occurs in a transition zone between the pilliga community on undulating land and the grey box community on the plain. Distribution within Study Area: Restricted to a single patch on the foothills of the slopes in the centre of the study area. Condition & Presence of Weeds: The patch is likely to have been artificially under scrubbed to provide pasture for grazing. Some noxious and environmental weeds occur, such as prickly pear, but they do not occur at high abundance. Conservation Status: No particular conservation significance.
Ground layer	To 1 m	40 – 50	*Eragrostis cilianensis* *Goodenia rotundifolia* *Aristida benthamii* *Austrodanthonia* sp. *Austrostipa aristiglumis* *Cleistochloa rigida* *Solanum amblymerum* *Tricoryne elatior* *Solanum amblymerum* *Einadia hastata* *Lolium perenne* *Sclerolaena birchii* *Cheilanthes sieberi* *Dichondra repens* *Calotis lappulacea* *Fimbrtistylis dichotoma* *Gomphrena celosioides* *Wahlenbergia* spp. *Sida cunninghammii* *Laxmannia gracilis*	
				

*projective foliage canopy cover

Table 6 (Cont)
Descriptions of the Vegetation Communities Within the Study Area

Stratum	*Height*	*Percent Cover**	*Dominant Species*	*Comments*
Community 5: RIPARIAN OPEN FOREST / WOODLAND: River Red Gum				
Tree layer	28 - 32 m	0 - 30	*Eucalyptus camaldulensis*	Habitat: Banks and floodplains of larger rivers and watercourses Structure/Characteristics: Modified partially cleared but relatively intact open forest to woodland dominated by river red gum and species adapted to wetter areas or permanently available water. Shrub and ground layers variable in density. Distribution within Study Area: Restricted to the bank and immediate floodplain of the Namoi River at the far eastern end of the study area. Condition & Presence of Weeds: All patches of the community have some degree of modification, including partial tree removal and shrub layer removal. Most patches have been subject to past grazing but the river bank has now been fenced off and a local landcare group has planted native species on the bank (acacias and casuarinas). No regenerating river red gum saplings were evident. Local high abundances of herbaceous exotic weeds occur, but the density of weeds is generally low. Conservation Status: The community is not listed under any legislation, however all natural riparian communities are generally considered to have intrinsic conservation significance. Equivalent vegetation communities in the relevant bioregions have been assigned a 'Vulnerable' or 'Near Threatened' threat category by Benson (2006, 2008).
Small tree layer	0 – 10 m	0 -10	*Acacia stenophylla*	
Ground layer	To 1 m	80 – 90	*Bothriochloa decipiens* *Lolium perenne* *Austrodanthonia* sp. *Paspalum dilatatum* *Marrubium vulgare* *Malva parviflora* *Dichondra repens* *Phragmites australis* *Verbena bonariensis* *Bidens pilosa* *Einadia nutans* *Sclerolaena birchii* *Chloris truncata* *Solanum parvifolium* *Medicago polymorpha* *Cheilanthes sieberi* *Sida rhombifolia*	

*projective foliage canopy cover

Table 6 (Cont)
Descriptions of the Vegetation Communities Within the Study Area

Community 6: Weeping Myall Woodland	
This community has a simple structure and florisitics, occurring as small patches of weeping myall (*Acacia pendula*) trees with a grassy understorey and no additional tree or shrub layer species. It occurs in two areas within the study area. Within the mine site, it is restricted to a single small patch on either side the central dirt road in the south-eastern part of the site. Two small patches also occur a few metres from the bitumen edge by the road to the Namoi River in the Pipeline Corridor. The commmunity is subject to periodic disturbance and edge effects, being at the edges of roads in both parts of the study area. The habitat of the community together with the particular assemblage of species according to the Final Determination (NSW Scientific Committee 2005) indicates that the community qualifies as the EEC 'Myall Woodland' under the NSW TSC Act.	 Image: DECC © Damon Oliver (not taken within the study area)
Community 7: Cleared Open Grassland / Cropland / Weedy areas / Cultivated Gardens	
This community occupies a the balance of the eastern two-thirds of the study area, and is almost entirely restricted to the plains section of the study area. It is composed predominantly of cleared open pasture without trees or isolated paddock trees and with ground cover generally to a height of less than 50cm. Cropped fields and artificially planted gardens around homesteads are also included in this artificial community. The community is regularly grazed and/or ploughed and cultivated. The community has no flora conservation significance.	

Table 7
BioMetric Vegetation Types That Correspond to Vegetation Communities from this Study

Vegetation Formation (Keith 2004)	Vegetation Class (Keith 2004)	BioMetric Vegetation Type for the Namoi CMA	Equivalent Vegetation Communities (this study)
Dry sclerophyll forests	Western Slopes Dry Sclerophyll Forests	Brown Bloodwood - cypress - ironbark heathy woodland in the Pilliga region of the Brigalow Belt South Bioregion	Communities 1 & 4
Grassy woodlands	Floodplain Transition Woodlands	Inland Grey Box tall grassy woodland on clay soils in the Brigalow Belt South and Nandewar Bioregions [Benson *et al.* (2006) Veg ID81]	Community 2
Forested Wetlands	Eastern Riverine Forests	River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [Benson *et al.* (2006) Veg ID84]	Community 3 (marginally)
Forested Wetlands	Inland Riverine Forests	River Red Gum open forest and woodland mainly of the Darling Riverine Plains and South West Slopes Bioregions [Benson *et al.* (2006) Veg ID36]	Community 5
Semi-arid woodlands (Grassy subformation)	Riverine Plain Woodlands	Weeping Myall open woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions [Benson *et al.* (2006) Veg ID27]	Community 6

3.1.3.3 Floral Diversity

Flora species diversity was found to be relatively high within the entire study area, with 232 flora species from 62 families being identified. This total included two ferns, one cycad, two conifers, 171 dicotyledons and 56 monocotyledons. Of the total species recorded, 32 species of introduced flora were identified, representing approximately 14% of the total species.

A list of all flora species recorded and identified from within the study area is included as **Appendix 1**.

3.1.3.4 Condition of the Vegetation and Presence of Weeds

The condition of the vegetation varied significantly within the study area. The natural vegetation at the western end of the study area was often close to pristine, with few or no exotic species, although past logging and/or clearing was evident. Overall, the condition of the vegetation was surprisingly good even in the grazed pasture areas with patches of remnant tree cover, where there was moderate to high native species diversity and a low diversity and cover of weeds. Weeds occurred almost exclusively in the cleared farmland on the plains in the eastern part of the study area (Vegetation Communities 2 – 6). Native vegetation in this area was highly modified with the tree layer absent over much of the area, with the exception of remnant patches of trees, riparian and fence line strips, and scattered paddock trees.

Eight of the species recorded in the study area are declared Noxious Weeds in the Narrabri Shire Council control area, pursuant to the *Noxious Weeds Act 1993*. These, together with their relevant control classes, are:

- African boxthorn (*Lycium ferocissimum*) – Class 4
- Bathurst burr (*Xanthium spinosum*) – Class 4
- Creeping oxalis (*Oxalis corniculata*) – Class 5
- Johnson Grass (*Sorghum halepense*) – Class 4
- Mother of millions (*Bryophyllum delagoense*) – Class 4
- Noogoora burr (*Xanthium occidentale*) – Class 4
- Prickly pear (*Opuntia stricta*) – Class 4
- Spiny burrgrass (*Cenchrus longispinus*) – Class 4

Explanations of the relevant control categories are as follows:

Class 4: Locally Controlled Weeds: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority. Local Control Plans for most Class 4 weeds in Narrabri control area can be found at:
http://www.narrabri.nsw.gov.au/index.cfm?page_id=1144

Class 5: Restricted Plants: The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with. See **Appendix 3** for further details.

Most of the noxious weeds identified had a trace presence within the Mine Site only or were present at high abundance in very restricted areas within the site.

Apart from declared noxious species, common or established environmental weed species within the study area include gomphrene weed, cobblers pegs, greater beggar's ticks, spear thistle, flatweed, fleabane, curly dock, moss verbena (Mayne's pest) and stinkgrass. Some of these weed species occurred at locally high densities, but most were generally restricted in their distribution throughout the site or occurred at low density. Control or management of any of these species is desirable.

3.1.3.5 Threatened or Significant Flora Species

No threatened flora species listed under either the NSW TSC Act or Commonwealth EPBC Act or rare species on the ROTAP database were detected in the study area during the flora surveys. One NSW Wildlife Atlas record of *Bertya opponens* (Vulnerable TSC Act) from 1999 was found to fall within the western end of the study area, but its position was only given to an accuracy of 1000 m. The existence of this record was used as the basis for the location of Flora Site 1, and this species was particularly targeted during the survey at this site. However, its presence was not detected at this or any other flora site, but due to the record (which could

actually occur just off-site) the likelihood of the species being present within the study area must be regarded as remaining high.

Two other threatened flora species considered to have potential to occur in the study area (see **Section 4.1.1**) include *Cadellia pentastylis* (ooline) and *Lepidium aschersonii* (spiny peppercress). The three likely to possible flora species will be treated as subject species for assessment in **Section 4.1.1**.

3.1.3.6 Threatened Ecological Communities

One definite Endangered Ecological Community (EEC) and two marginal or remnant EECs listed under the NSW TSC Act are considered to occur within the study area, based on the results of the field investigations.

Inland Grey Box Woodland in the Riverina, NSW Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions

The Inland Grey box community on the plains, Community 2 (including intergrade areas with Community 1 on the slopes to the west) qualifies as the NSW-listed EEC *Inland Grey Box Woodland in the Riverina, NSW Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions.* The location, soil type, habitat and species assemblage as outlined in the Final Determination (NSW Scientific Committee 2007) indicate the presence of the EEC. The most characteristic tree species, Inland Grey Box (*Eucalyptus microcarpa*) is abundant within Community 2. The commonly associated species bimbil box (*Eucalyptus populnea*), white cypress-pine (*Callitris glaucophylla*), white box (*Eucalyptus albens*) and kurrajong (*Brachychiton populneus*) are also present. Of the assemblage of 74 species that characterises the EEC according to the Final Determination, 28 (38%) are present within Community 2. The community also corresponds to Vegetation ID81 of Benson *et al.* (2006), which, amongst others, is noted by the Final Determination (NSW Scientific Committee 2007) as fitting within the definition of the EEC. The EEC was only gazetted in April 2007, and was therefore not noted as occurring within the Mine Site in the impact assessment for Stage 1 of the project (Ecotone Ecological Consultants 2006). The community is <u>not</u> the *White Box Yellow Box Blakely's Red Gum* EEC, being specifically excluded by paragraph 7 of the Final Determination for that EEC (NSW Scientific Committee 2002a). By extension, this would also exclude the Critically Endangered *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* as listed under the Commonwealth EPBC Act, but there is currently no equivalent threatened community listed by the Commonwealth.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions

Another EEC listed by the NSW TSC Act, *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions,* appears to occur marginally within the Mine Site on the basis of the species present, however it mainly occurs as isolated patches in atypical habitat. The dominant species, brigalow (*Acacia harpophylla*), was recorded within the Mine Site in addition to a number of the species listed within the assemblage characterising the community in the Final Determination for the EEC (NSW Scientific Committee 2002b). However, according to the Final Determination, the EEC is only deemed to occur where Brigalow is a dominant or

co-dominant species in the canopy, and it usually occurs on heavy clay soils. Brigalow occurred as scattered plants or small clumps of plants within the flat plains area covered by Community 2, along with other characteristic species such as belah (*Casuarina cristata*) and poplar box (*Eucalyptus populnea*). It did not form the dominant or co-dominant species in this area. Brigalow did form stands where it was the dominant canopy species in scattered parts of the pilliga community (Community 1) which is generally on sandy soil on sandstone (**Plate A**). However, the associated shrub and ground layer species (such as *Phebalium squamulosum* and *Calytrix tetragona*) are atypical of the EEC. It is concluded that the EEC occurs in marginal form only in scattered parts of the western slopes portion of the study area. This would also apply to the equivalent *Brigalow (Acacia harpophylla dominant and co-dominant)* EEC as listed by the Commonwealth EPBC Act. The indicative map for the EEC shows brigalow as occurring only west of the Newell Highway in the Narrabri area.

Plate A: A Patch of Brigalow Within the Pilliga Community in the Far West of the Site

Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions

A third EEC listed by the TSC Act, *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions* has a trace remnant presence within the Mine Site and Pipeline Corridor north-east of the Kamilaroi Highway. One short, narrow patch of weeping myalls (*Acacia pendula*) was found to occur along both sides of a dirt road on a more elevated part of the central plains area (see **Figure 3**). These remnant trees generally lacked a native understorey

and the stand was highly disturbed by farm activities. Two smaller patches of the community occurred along the western side of the road between the Kamilaroi Highway and the Namoi River, but set back 5 m or more from the edge of the road (see **Figure 3a**). Other remnant occurrence of the species could occur elsewhere within the study area.

3.1.4 Overall Significance of the Vegetation

The vegetation of the study area has significance in terms of threatened species legislation, since it contains at least one likely threatened flora species (*Bertya opponens*), one definite EEC (Inland Grey Box Woodland) one marginal EEC (Brigalow) and one very small, remnant EEC (Myall Woodland).

The sandstone woodland in the more elevated land in the western part of the Mine Site (Community 1) is contiguous with the large area of natural vegetation in Jacks Creek State Forest along the western boundary. This community is a high quality and large remnant of natural vegetation. It is in particularly good condition, practically undisturbed and free of weeds. It has high species diversity, and is a sharply contrasting vegetation type to the community on the low-lying flats and floodplains.

The natural vegetation on the low-lying flats and floodplains in the eastern part of the site (Communities 2, 3 & 4) is much more disturbed by past and current clearing and grazing, but nevertheless retains a high native species diversity, particularly in the ground layer. The species composition is almost totally different to that of Community 1. One species of tree (*Eucalyptus populnea* – bimble or poplar box) is also significant as a listed habitat tree for koalas. These communities are disturbed remnants of the once extensive floodplain communities that would have occurred widely on the flat areas that are now largely cleared for grazing and agriculture.

All the remnant natural vegetation within the site has ecological value in that it facilitates movement of fauna and exchange of genetic material between native flora species locally, from one part of the study area to another via remnant connections and riparian corridors (including scattered trees in some areas). Although loss or modification of this vegetation may not isolate any populations of flora or fauna, it could have local impacts on natural populations and compromise movements.

3.2 Faunal Investigations

3.2.1 Methodology

A habitat assessment and fauna survey were undertaken across the Mine Site from the 19th to the 23rd of January 2009. Habitat assessment and opportunistic fauna survey were undertaken across the proposed Brine Storage Area (within the Mine Site) and along the proposed Pipeline Corridor on the 6th and 7th of August 2009.

3.2.1.1 Habitat Assessment

During the fauna survey the type and condition of potential habitats for fauna species was investigated and recorded. Habitat features investigated on the Mine Site and along the proposed Pipeline Corridor (**Figures 4** and **4a**) included;

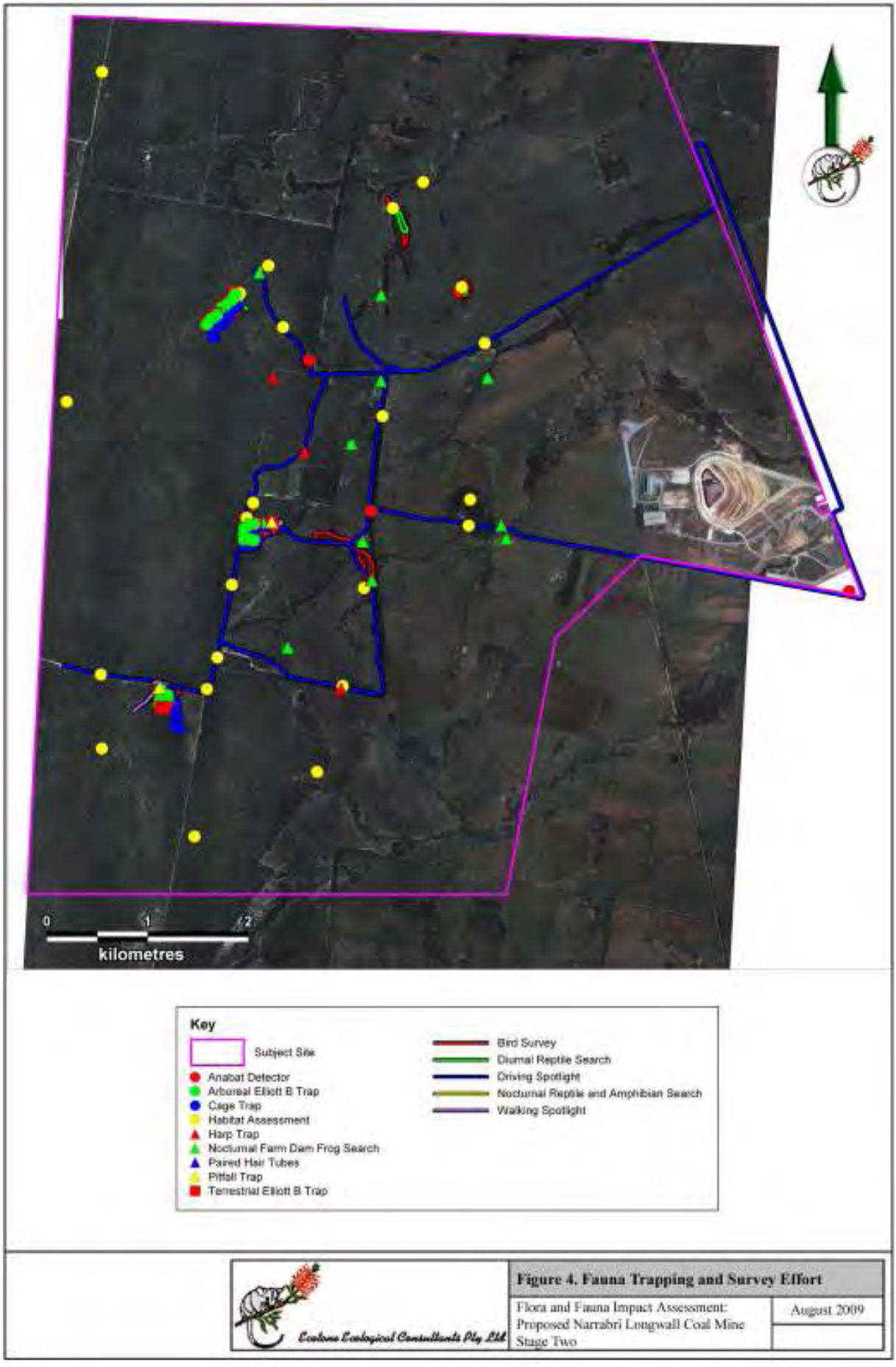
- Topographic features (such as slope, aspect & landscape position),
- Dominant vegetation community composition, structure and condition at all strata levels (i.e. from ground to canopy cover),
- Ground cover type and percentage cover,
- Form, quality and location of water sources,
- Location, type and size of tree hollows,
- The presence, number and condition of unique habitat features (such as caves, crevices, loose tree bark, rocks on rock and mistletoe), and
- The level of disturbance.

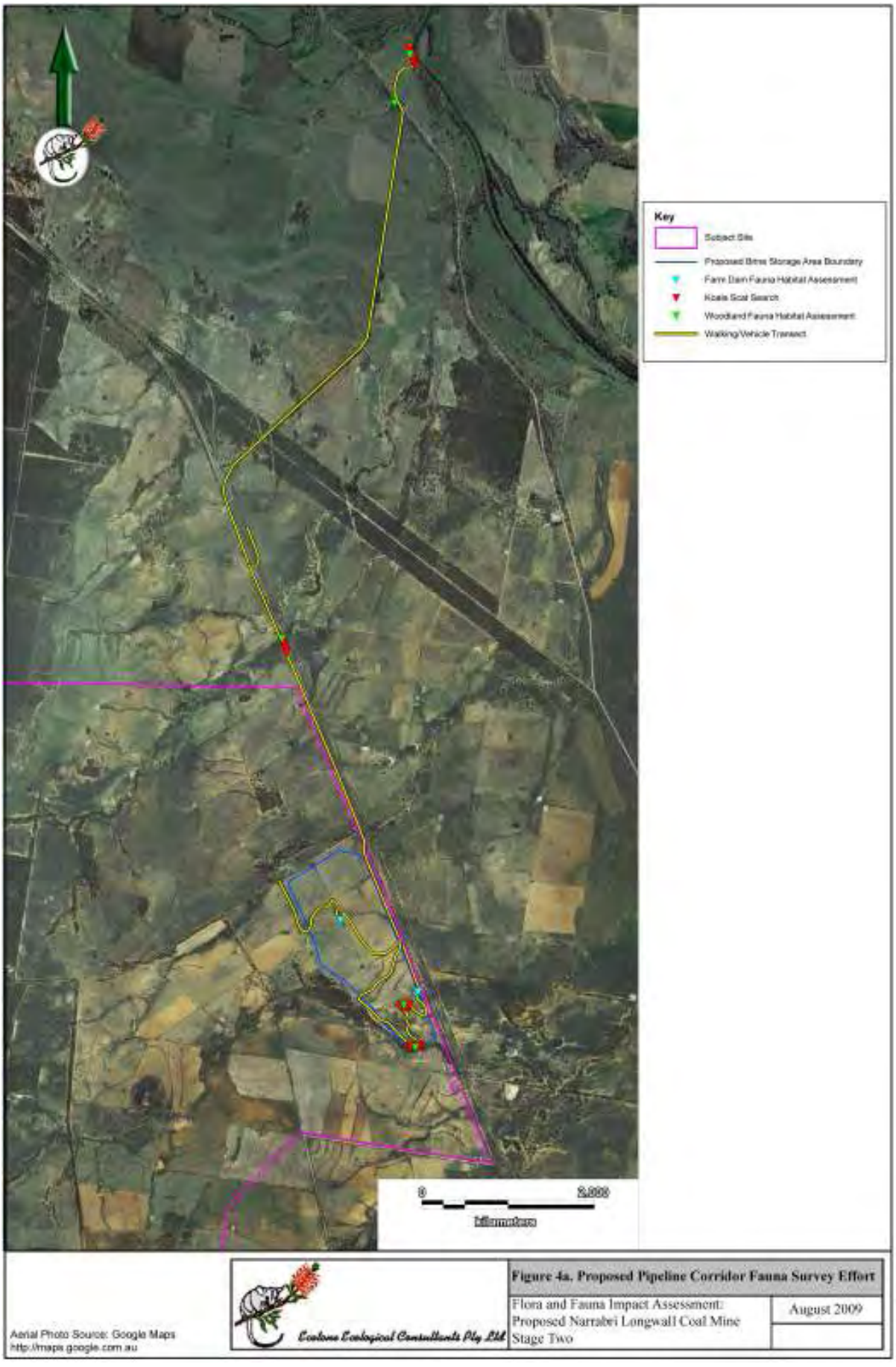
During the habitat assessment all opportunistic observations of fauna or faunal activity were recorded, including visual and auditory recognition of fauna species and identification of evidence of faunal activity (eg. nests, diggings, scratch marks, droppings).

To increase the number of sites that could be visited during the January week of survey, the flora survey team also undertook fauna habitat assessments as they moved around the site.

3.2.1.2 Fauna Survey

Targeted fauna survey was undertaken across the Mine Site from the 19th to the 23rd of January 2009. Surveys included Elliot trap lines, cage trap lines, harp trapping, pitfall trapping, bird transects, reptile searches, amphibian searches, spotlighting, nocturnal owl and mammal call playback, and Anabat micro-bat echolocation survey (**Figure 4** and **4a**). Opportunistic fauna survey was across the proposed Brine Storage Area (within the Mine Site) and the proposed Pipeline Corridor on the 6th and 7th of August 2009. Opportunistic fauna survey comprised the recording of species sighted or heard, koala scat searches at the base of trees (one metre radius), the opportunistic rolling of rocks and logs, and the identification of species presence from signs and traces such as scats and scratch marks.


0
1
2
kilometres
Key
Subject Site
Anabat Detector
Arboreal Elliott B Trap
Cage Trap
Habitat Assessment
Harp Trap
Nocturnal Farm Dam Frog Search
Paired Hair Tubes
Pitfall Trap
Terrestrial Elliott B Trap
Bird Survey
Diurnal Reptile Search
Driving Spotlight
Nocturnal Reptile and Amphibian Search
Walking Spotlight
Ecotone Ecological Consultants Pty Ltd
Figure 4. Fauna Trapping and Survey Effort
Flora and Fauna Impact Assessment: Proposed Narrabri Longwall Coal Mine Stage Two
August 2009


Key
Subject Site
Proposed Brine Storage Area Boundary
Farm Dam Fauna Habitat Assessment
Koala Scat Search
Woodland Fauna Habitat Assessment
Walking/Vehicle Transect
0
2,000
Kilometres
Aerial Photo Source: Google Maps
http://maps.google.com.au
Ecotone Ecological Consultants Pty Ltd
Figure 4a. Proposed Pipeline Corridor Fauna Survey Effort
Flora and Fauna Impact Assessment:
Proposed Narrabri Longwall Coal Mine
Stage Two
August 2009

The level of survey and methods undertaken were designed using best practice fauna survey guidelines for impact assessment, such as those endorsed the Department of Environment and Climate Change (DECC 2004). The methods employed were tailored to the habitat types and site characteristics present.

Trapping Sites

Three trapping sites were established in the woodland areas of the western half of the Mine Site. The trapping sites were selected to sample the representative woodland vegetation types present and to cover the area of the Mine Site.

Northern Trapping Site
The northern trapping site was located along a drainage line (draining in a north-easterly direction) in the northern part of the main woodland area of the Mine Site (**Figure 5**). The northern trapping site was positioned in the transition between two vegetation communities. The first community was dominated by regenerating western grey box (*Eucalyptus microcarpa*) and scattered white box trees (*E. albens*). The understorey was of moderate to high density comprising shrub species to three metres and moderately scattered regenerating belah trees (*Casuarina crista*) to approximately eight metres in height. The second community, located higher up in the drainage line, at the south-western end of the trap-line, was shorter and dominated by Pilliga grey box (*E. pilligaensis*) and a moderately open understorey.

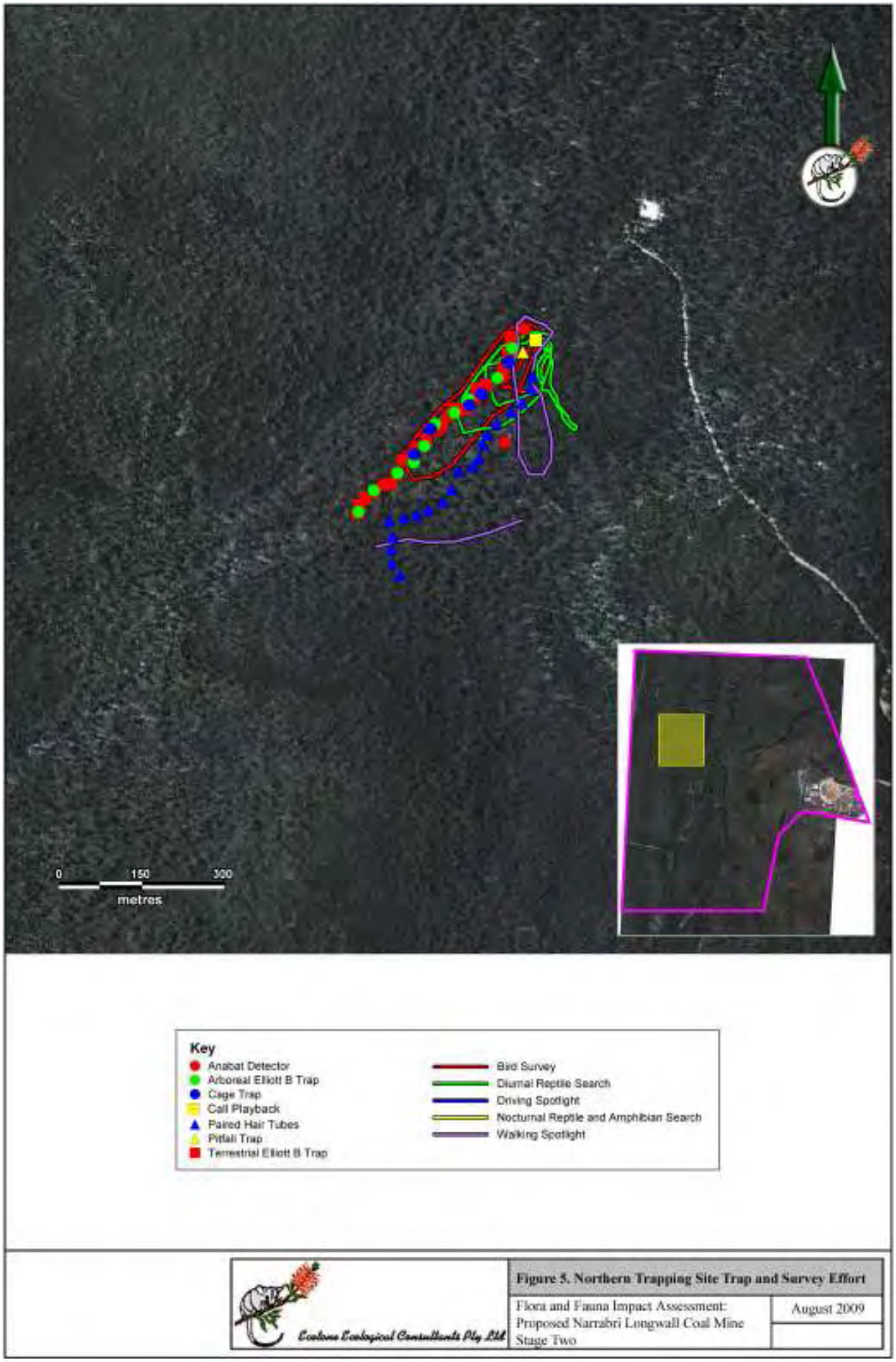
Central Trapping Site
The central trapping site was located in a vegetation community dominated by regenerating red ironbark (*E. fibrosa*) with a variable density understorey ranging from open to dense (**Figure 6**).

Southern Trapping Site
The southern trapping site, located in Pilliga East State Forest, was located in a Pilliga community dominated by Pilliga grey box and red ironbark (**Figure 7**). A dense cypress understorey occurred in most parts and reached up to four metres in height.

Trapping effort

At each of the three trapping sites the following trapping effort was undertaken.

- 25 terrestrial Elliott A traps
- 10 arboreal Elliott B traps
- Five terrestrial cage traps
- One 30 metre pitfall fence with three buckets.
- 20 terrestrial medium hair tubes
- 20 terrestrial small hair tubes
- 10 arboreal small hair tubes


0
150
300
metres
Key
Anabat Detector
Arboreal Elliott B Trap
Cage Trap
Call Playback
Paired Hair Tubes
Pitfall Trap
Terrestrial Elliott B Trap
Bird Survey
Diurnal Reptile Search
Driving Spotlight
Nocturnal Reptile and Amphibian Search
Walking Spotlight
Ecotone Ecological Consultants Pty Ltd
Figure 5. Northern Trapping Site Trap and Survey Effort
Flora and Fauna Impact Assessment: Proposed Narrabri Longwall Coal Mine Stage Two
August 2009

Key

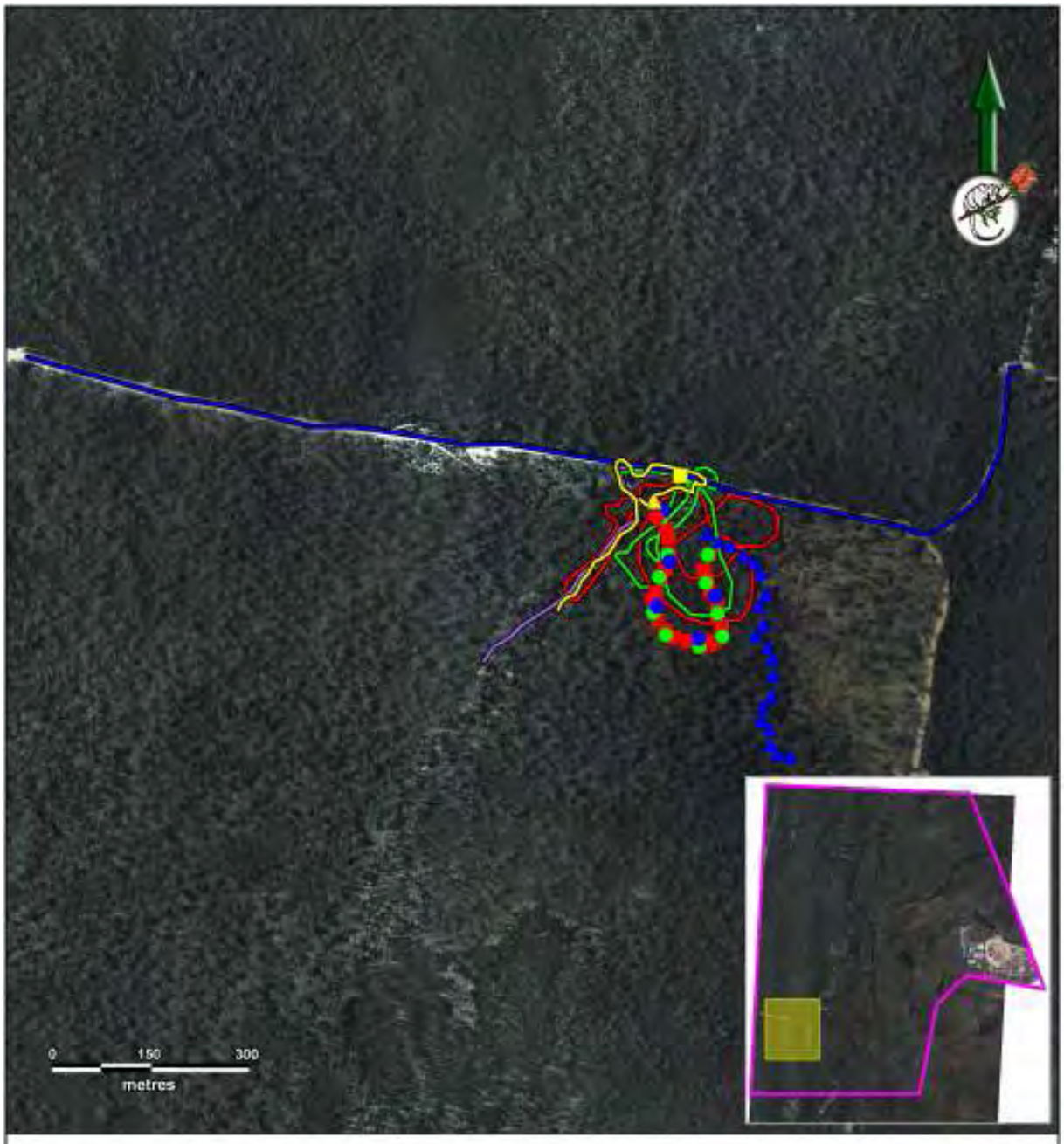
- Anabat Detector
- Arboreal Elliott B Trap
- Cage Trap
- Call Playback
- Paired Hair Tubes
- Pitfall Trap
- Terrestrial Elliott B Trap
- Bird Survey
- Diurnal Reptile Search
- Driving Spotlight
- Nocturnal Reptile and Amphibian Search
- Walking Spotlight

Ecotone Ecological Consultants Pty Ltd

Figure 6. Central Trapping Site Trap and Survey Effort

Flora and Fauna Impact Assessment: Proposed Narrabri Longwall Coal Mine Stage Two

August 2009



Key

- Anabat Detector
- Arboreal Elliott B Trap
- Cage Trap
- Call Playback
- Paired Hair Tubes
- Pitfall Trap
- Terrestrial Elliott B Trap
- Bird Survey
- Diurnal Reptile Search
- Driving Spotlight
- Nocturnal Reptile and Amphibian Search
- Walking Spotlight

Ecotone Ecological Consultants Pty Ltd

Figure 7. Southern Trapping Site Trap and Survey Effort

Flora and Fauna Impact Assessment: Proposed Narrabri Longwall Coal Mine Stage Two

August 2009

Terrestrial Elliott traps were baited with a mixture of rolled oats and peanut butter. Arboreal Elliott traps and hair tubes were baited with a mixture of rolled oats, peanut butter and honey. The entrance and adjacent trunk of arboreal Elliott traps were also sprayed with a honey and water mixture. Terrestrial hair tubes were baited with a mixture of meat and non-meat baits. The meat baits were a mixture of rolled oats, peanut butter, honey and cat food. The non-meat baits contained the same ingredients as the meat baits except for the cat food. Half the terrestrial hair tubes were baited with meat baits and the other half with non-meat baits.

All Elliott, cage and pitfall traps were set for four consecutive nights (**Table 8**). All hair tubes were collected 33 to 35 days after setting.

Table 8
Trap Night Effort Across the Three Trapping Sites

	Northern Site	Central Site	Southern Site	Totals
Terrestrial Elliott A traps	100	100	100	**300**
Arboreal Elliot B traps	40	40	40	**120**
Terrestrial cage traps	20	20	20	**60**
Pitfall buckets*	12	12	12	**36**
Medium terrestrial hair tubes	700	700	660	**2060**
Small terrestrial hair tubes	700	700	660	**2060**
Small arboreal hair tubes	350	350	330	**1030**
Totals	**1922**	**1922**	**1822**	**5666**

* One pitfall bucket per 10 metres of pitfall fence for one night equals one pitfall night.

Survey Effort

Bird Surveys

Where possible, bird surveys were undertaken during early morning or late afternoon. Each survey comprised one person hour of survey. Bird surveys were completed either by a single observer for one hour or by two observers for 30 minutes. Birds were identified using a 15-45×60mm spotting scope or 8×40 mm binoculars and from characteristic calls. Two bird surveys were completed at each of the trapping sites (**Figures 5, 6** & **7**). Three additional one-off bird surveys were completed at opportunistic habitat locations (**Figure 4** and **4a**). Bird sightings were also recorded opportunistically during all other survey activities.

Diurnal Reptile and Amphibian Searches

Where possible, diurnal reptile and amphibian searches were undertaken during early to mid morning or mid to late afternoon. Each survey comprised one person hour of survey. Diurnal reptile and amphibian searches were completed either by a single observer for one hour or by two observers for 30 minutes. Two diurnal reptile and amphibian searches were completed at each of the trapping sites (**Figures 5, 6** & **7**). Two additional one-off diurnal reptile and amphibian searches were completed at opportunistic habitat locations (**Figure 4** and **4a**). Habitat features investigated during diurnal reptile and amphibian searches included leaf litter, fallen timber, rocks, tree trunks, loose soil, water body margins and grassland areas.

Nocturnal Reptile and Amphibian Searches

Nocturnal reptile and amphibian searches were undertaken between early and mid evening. Nocturnal reptile and amphibian searches included searches of both terrestrial and aquatic habitats. Terrestrial nocturnal reptile and amphibian searches were undertaken at each of the three trapping sites (**Figures 5, 6** & **7**). Each terrestrial survey comprised one person hour of survey completed by two observers Aquatic habitats, represented by farm dams, were targeted on a single night. Approximately 15-20 minutes was spent searching for amphibian and reptile species at each farm dam. Nocturnal reptile and amphibian searches were undertaken with hand-held torches and head lamps.

Walking Spotlight Survey

Walking spotlight surveys were undertaken between dusk and 1 am. Each survey comprised a single person hour of survey (two observers). Walking spotlight surveys were undertaken with hand held Lightforce spotlights (35 Watt). Walking spotlight surveys were undertaken at each of the three trapping sites (**Figures 5, 6** & **7**).

Driving Spotlight Survey

Driving spotlight surveys were undertaken between dusk and 1 am. Each survey comprised spotlighting along a 1 km length of track while driving in first gear (less than 10 km per hour). The driver did not spotlight. Driving spotlight surveys were undertaken along vehicle tracks at each of the three trapping sites. Opportunistic driving spotlight surveys were undertaken across most of the Mine Site while travelling to and from trapping sites or farm dams (**Figure 4** and **4a**).

Nocturnal Call Playback

Call playback for owl and nocturnal mammal species was undertaken at dusk or during early evening at each of the trapping sites (**Figures 5, 6 & 7**). The nocturnal calls of the following species were played using a TOA megaphone (model ER-409, 15W rated output):

- Squirrel glider (*Petaurus norfolcensis*)
- Koala (Phascolarctos cinereus)
- Barking owl (*Ninox connivens*)
- Masked owl (*Ninox novaehollandiae*)
- Powerful owl (*Ninox strenua*)

After listening for 20 minutes during dusk, the calls of the above species were broadcast for approximately four minutes each and were separated by a listening period of four minutes. At the end of each four minute listening period a brief spotlighting scan was made of surrounding trees for owls that approached silently. The calls were broadcast in the order shown above. At the completion of the powerful owl call a listening period of ten minutes was undertaken and followed by a final scan of the surrounding trees. While the powerful owl was not identified as potentially occurring on the Mine Site its calls were broadcast out of habit.

Micro-bat Survey

Anabat detectors and recorders (hereafter referred to as 'Anabat detectors') were used to record the echolocation calls of micro-bats. Anabat detectors were placed at an approximate 45 degree angle (to the horizontal) during recording. All Anabat detectors began recording at dusk and recorded echolocation calls throughout the night, automatically switching off at sunrise. Anabat detectors were set at each of the three trapping sites for two nights plus single night opportunistic locations (**Figure 4** and **4a**).

Adequacy of survey effort

Where possible the level of survey effort complied with the current best practise level of survey effort, the DEC (2004) Draft Threatened Biodiversity Survey and Assessment: Guidelines for development and activities (**Table 9**).

Table 9
Application of Recommended Flora and Fauna Field Survey Techniques

Page 1 of 6

Field Survey Techniques Applied	Suggested Minimum Effort	Applied (✓)	Effort Achieved & Commentary
Amphibians			
Systematic day habitat search	One hour per stratification unit	✓	No water bodies were present at two of the three trapping sites. Two one person hour diurnal reptile and amphibian surveys were completed on two separate days at each trapping site. Two additional one person hour diurnal reptile and amphibian surveys were conducted at opportunistic locations.
Night habitat search of damp and watery sites	30 minutes on two separate nights per stratification unit	✓	No water bodies were present at two of the three trapping sites. Two one person hour nocturnal reptile and amphibian surveys were completed on two separate nights at each of the trapping sites.
Nocturnal call playback	At least one playback on each of two separate nights		Not undertaken due to the lack of suitable habitat at each trapping site (the dam at the northern trapping site was not suitable habitat for any threatened amphibian species).
Night watercourse search	Two hours per 200m of water body edge	✓	Farm dams were surveyed on a single night – at all except one dam the entire water body edge was searched.

Table 9 (cont'd)
Application of Recommended Flora and Fauna Field Survey Techniques

Page 2 of 6

Field Survey Techniques Applied	Suggested Minimum Effort	Applied (✓)	Effort Achieved & Commentary
Reptiles			
Habitat search	30 minute search on two separate days targeting specific habitat	✓	**Exceeded minimum effort**. Double the suggested minimum effort was achieved. Two one person hour diurnal reptile and amphibian surveys were completed on two separate days at each trapping site. Two additional one person hour diurnal reptile and amphibian surveys were conducted at opportunistic locations.
Pitfall traps	24 trap nights, preferably using six traps for a minimum of four consecutive nights		12 trap nights were achieved at each of the trapping sites. Each site contained a 30m fence with three buckets for four nights. Logistical constraints prevented more survey effort, however the additional habitat searches above increased the overall reptile survey effort.
Spotlighting	30 – Minute search on two separate nights targeting specific habitat.	✓	**Exceeded minimum effort**. Two one person hour nocturnal reptile and amphibian surveys were completed on two separate days at the southern trapping site. A single one person hour nocturnal reptile and amphibian survey was completed at the northern and central sites. The total survey time was achieved at all sites and doubled at one site, however only a single site was sampled on both nights.
Diurnal Birds			
Area search	*Species time curve approach should be utilised*	✓	Two one person hour bird surveys were completed on two separate days at each site. When combined with opportunistic sightings at each site, few new bird species were recorded by the end of the survey.
Wetland census	A one-hour census at dawn or dusk, for each identified wetland.	✓	No suitable wetland habitat was present.
Water source census	A 20 minute census at dawn or dusk, for each identified water source.	✓	Farm dams were not large enough to warrant individual surveys. Farm dam birds were surveyed opportunistically during travel around the site.

Table 9 (cont'd)
Application of Recommended Flora and Fauna Field Survey Techniques

Page 3 of 6

Field Survey Techniques Applied	Suggested Minimum Effort	Applied (✓)	Effort Achieved & Commentary
Nocturnal Birds			
Call playback	Sites should be separated by 800m to 1km and each site must have the playback session repeated as follows: • At least 5 visits per site, on different nights are required for the Powerful Owl, Barking Owl and the Grass Owl; • At least 6 visits per site for the Sooty Owl, and 8 visits per site for the Masked Owl are required. Sites for Bush Stone-curlew surveys should be 2-4km apart and conducted during the breeding season.		At total of four call playback sessions were completed in woodland habitat on two different nights. Further nocturnal sessions were not possible due to fatigue management issues. Walking and driving spotlight surveys, plus nocturnal reptile and amphibian surveys also allowed opportunistic or direct sampling for owl species – adding the level of survey effort for nocturnal birds.
Day habitat search	Search habitat for pellets and likely hollows. Flushing of Bush Stone-curlews by walking through potential habitat.	✓	Pellets were searched for opportunistically during reptile and amphibian searches. Reptile and amphibian searches and bird searches covered areas of potential habitat for the bush stone-curlew.
Stag watching	Observing potential roost hollows for 30mins prior to sunset and 60mins following sunset.	✓	No potential roost hollows were identified. Suitable sized hollows existed but none were more suitable that others. As such stag watching was not undertaken due to the extremely low chance of selecting a potential roost hollow. Spotlighting and call playback also sampled nocturnal birds.
Spotlighting	Spotlighting for Plains Wanderer and Bush Stone-curlew by foot or from a vehicle driven in first gear.	✓	**Exceeded minimum effort**. Two one person hour nocturnal walking spotlight searches were completed on two separate nights at each trapping site. Minimum 1km driving spotlight transects were also completed at each trapping site.

Table 9 (cont'd)
Application of Recommended Flora and Fauna Field Survey Techniques

Page 4 of 6

Field Survey Techniques Applied	Suggested Minimum Effort	Applied (✓)	Effort Achieved & Commentary
Mammals (excluding bats)			
Small Elliot traps (Small mammals)	100 trap nights over 3-4 consecutive nights	✓	100 trap nights was achieved at each of the trapping sites over four nights.
Large Elliot traps (Medium to large animals)	100 trap nights over 3-4 consecutive nights		Terrestrial large Elliot trapping was not undertaken. Species likely to be detected by large Elliott traps are also detectable using cage traps and hair tubes. Both methods were employed.
Arboreal Elliot traps (Arboreal animals)	24 trap nights over 3-4 consecutive nights	✓	**Exceeded minimum effort**. 40 trap nights were achieved at each of the trapping sites over four nights.
Wire cage traps (Medium to large animals)	24 trap nights over 3-4 consecutive nights	✓	20 trap nights were achieved at each of the trapping sites over four nights. Additional terrestrial hair tubes added to the sample effort for cage trap target species.
Pitfall traps with drift nets (Small mammals)	24 trap nights over 3-4 consecutive nights		12 trap nights were achieved at each of the trapping sites. Each site contained a 30m fence with three buckets for four nights. Logistical constraints prevented more survey effort, however hair tubes and Elliott A traps also targeted the same species.
Hair tubes (Small to medium animals)	10 large and 10 small tubes in pairs for at least 4 days and 4 nights	✓	**Exceeded minimum effort**. 20 large and 20 small hair tubes in pairs were set for four days and four nights at each trapping site.
Arboreal hair tubes (Arboreal animals)	3 tubes in each of 10 habitat tree up to 100 hectares of stratification unit, for at least 4 days and 4 nights	✓	A single hair tubes was placed in each of 10 trees, for four days and four nights. Additional arboreal trapping added to the level of arboreal mammal survey effort.
Spotlighting on foot (Arboreal and terrestrial mammals)	2 x 1 hour and 1km up to 200 hectares of stratification unit, walking at approximately 1km per hour on 2 separate nights	✓	Two one person hour nocturnal walking spotlight searches were completed on two separate nights at each trapping site.
Spotlighting from vehicle (Arboreal and terrestrial mammals)	2 x 1km of track at maximum speed of 5km per hour, up to 200 hectares of stratification unit, on 2 separate nights	✓	Two minimum 1km driving spotlight surveys on two separate nights were completed at each of the three trapping sites.

Table 9 (Cont)
Application of Recommended Flora and Fauna Field Survey Techniques

Page 5 of 6

Field Survey Techniques Applied	Suggested Minimum Effort	Applied (✓)	Effort Achieved & Commentary
Mammals (excluding bats)			
Sand plots (Mostly medium to large terrestrial mammals)	6 soil plots for 4 nights		Sand plots were not undertaken. Elliot A traps, cage traps, hair tubes and spotlighting surveys also sampled terrestrial mammals.
Call playback (Gliders, koalas)	2 sites per stratification unit up to 200 hectares, plus an additional site per 100 hectares above 200 hectares. Each playback site must have the session conducted twice on separate nights.	✓	At total of four call playback sessions were completed in woodland habitat (across the three trapping sites) on two different nights.
Stag-watching (Gliders and possums)	Observing potential roost hollows for 30mins prior to sunset and 60mins following sunset.		No potential den hollows were identified. Suitable sized hollows existed but none were more suitable that others. As such stag watching was not undertaken due to the extremely low chance of selecting a potential den hollow. Spotlighting and call playback also sampled arboreal mammals.
Search for scats and signs (All mammals)	30 minutes searching each relevant habitat, including trees for scratch marks.	✓	Scat searches were undertaken as part of diurnal reptile and amphibian searches. Two one person hour searches were undertaken on two separate days at each trapping site. Forty koala scat searches were completed at the base of 40 trees along the proposed pipeline corridor and within the proposed brine storage dam area.
Track search (Mostly medium to large terrestrial mammals)	1km of track search with emphasis where substrate is soft	✓	Undertaken opportunistically during all other survey activities. Elliot A traps, cage traps, hair tubes, scat searches and spotlighting surveys also sampled terrestrial mammals.
Collection of predator scats (All mammals)	Opportunistic collection of predators scats for hair analysis	✓	Undertaken opportunistically.
Bats			
Harp trapping	Four trap nights over two consecutive nights (with one trap placed outside the flyways for one night)	✓	**Exceeded minimum effort**. Six trap nights over three consecutive nights at two woodland sites. Plus an additional five trap nights over three consecutive nights at two additional sites.

Table 9 (Cont)
Application of Recommended Flora and Fauna Field Survey Techniques

Page 6 of 6

Field Survey Techniques Applied	Suggested Minimum Effort	Applied (✓)	Effort Achieved & Commentary
Bats			
Ultrasonic call recording	Two sound activated recording devices utilized for the entire night (a minimum of four hours) starting at dusk for two nights.	✓	**Exceeded minimum effort.** Two entire night Anabat surveys were completed at each trapping site. Additional entire night surveys were completed at four opportunistic locations.
Mist netting	For targeted survey: one trap set for at least two hours duration starting at dusk, for two nights.		Not undertaken due to requirement for a special licence. Harp trapping and all night Anabat surveys sampled bat species.
Trip line	For targeted survey of water bodies; at least two hours duration starting at dusk, for two nights		Not undertaken as harp trapping and entire night Anabat surveys were considered an adequate level of survey effort.
Spotlighting and transect walking	For targeted survey near likely food sources: 2 x 1 hour spotlighting on two separate nights	✓	Two one person hour nocturnal walking spotlight searches were completed on two separate nights at each trapping site.
Day habitat search	Search for bat excreta at or near potential habitats.	✓	Undertaken opportunistically.

3.2.2 Survey Limitations

The following limitations may have reduced the detect-ability of threatened or non-threatened species at the Mine Site.

3.2.2.1 Weather Conditions

The weather conditions during the surveys may have affected the detect-ability of some species (e.g. some burrowing frog species require warm thunderstorm nights before emerging from the ground). The weather during the survey was characterised by warm nights and hot days (**Table 10**).

3.2.2.2 Large Size of the Mine Site

The Mine Site is approximately 5,100 hectares in area, stretching approximately 8.5 km from north to south and 6.0 km to 7.2 km from east to west. Due to the large total area of the Mine Site, not all areas were able to be visited during the survey, particularly the centre of woodland areas in the western half of the Mine Site. However aerial photograph interpretation and survey of surrounding woodland areas suggested that it is likely that most habitat types present were sampled.

Table 10
Weather Conditions During the Fauna and Flora Survey for the Longwall Project

Date	Rain	Wind	Cloud Cover	Min. Temp.	Max. Temp
19.01.2009	No	None	0 to 50%	21	32
20.01.2009	No	None	25% to 75%	24	37
21.01.2009	Light evening rain	Light north westerly	100%	21	33
22.01.2009	Light rain during day and early evening	Light north westerly	25% to 100%	21	27
23.01.2009	No	Light north westerly	0 to 25%	20	33
06.08.2009	No	Light to moderate north westerly	0 to 25%	3	21
07.08.2009	No	Moderate to strong north westerly	0 to 25%	4	24

As a precautionary measure to counter potential survey limitations, all threatened species with potential to occur within the study area have been addressed in this report.

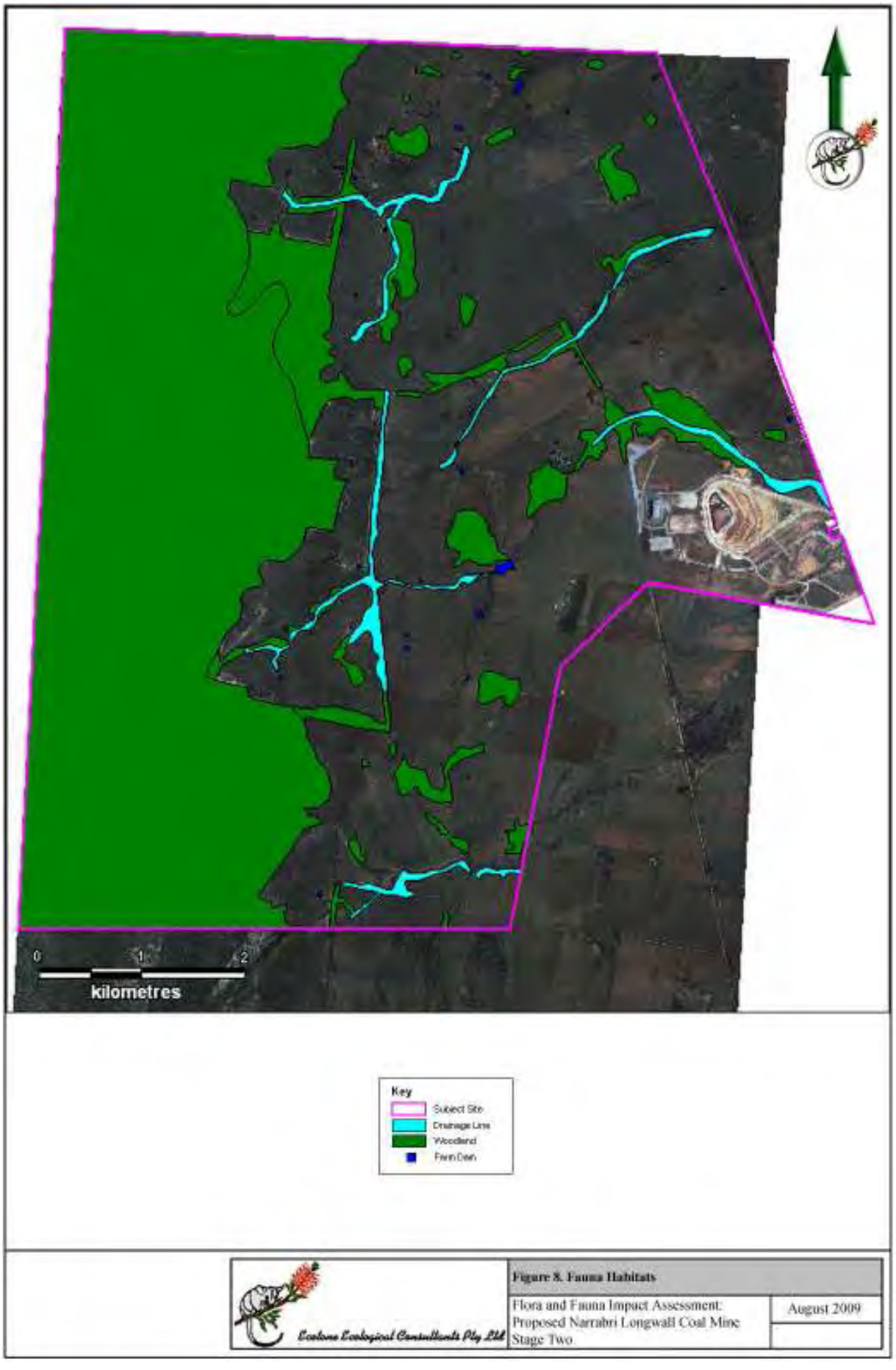
3.2.3 Fauna Survey Results

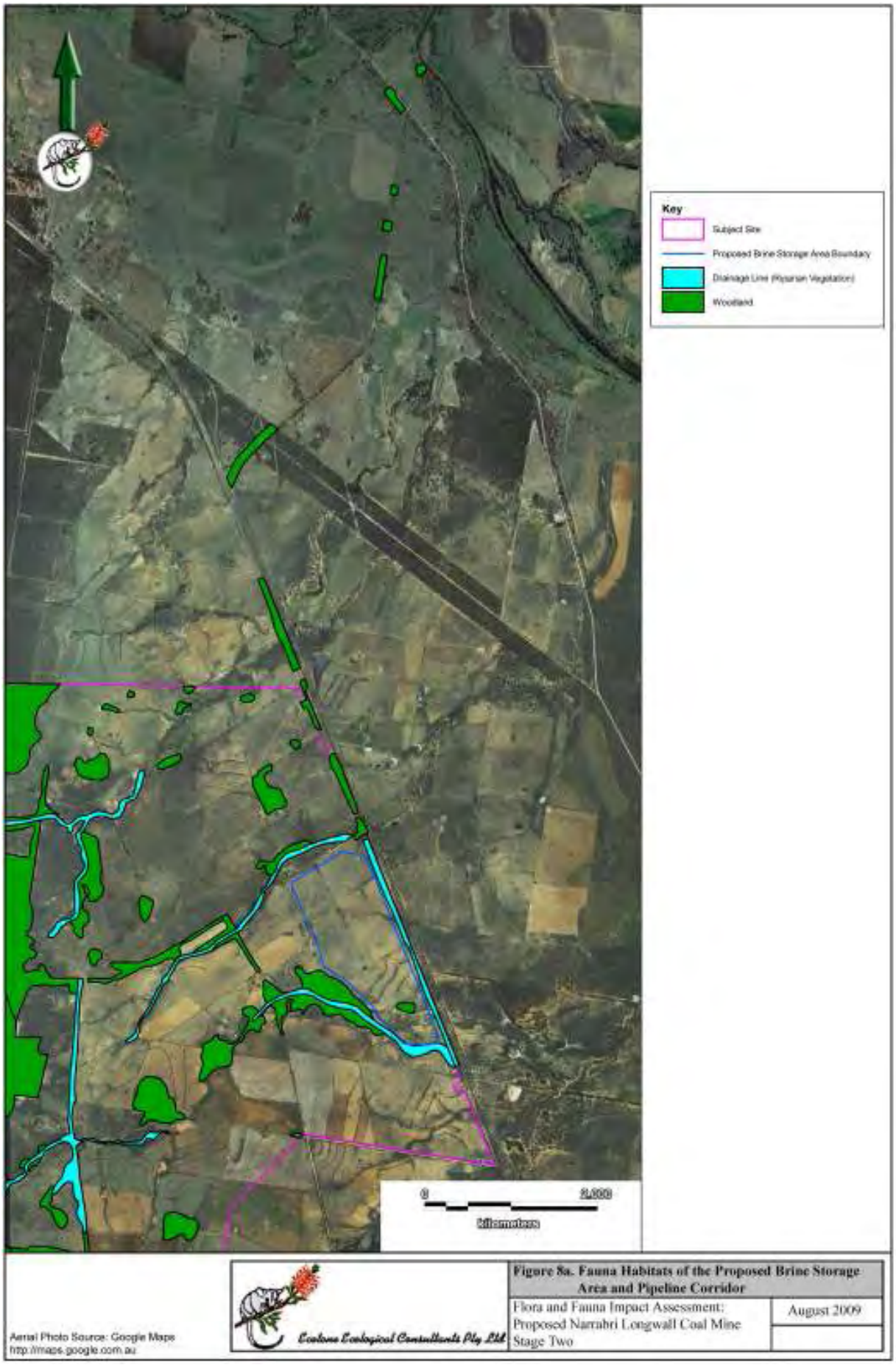
A total of 161 fauna species were recorded within the study area during the field surveys, comprising 99 birds, 37 mammals, 16 reptiles and ten frogs (**Appendix 3**). Fourteen threatened fauna species were recorded comprising five birds (superb parrot, turquoise parrot, glossy-black cockatoo, grey-crowned babbler, diamond firetail and speckled warbler), seven mammals (koala, eastern pygmy possum, black striped wallaby, yellow-bellied sheath-tail bat, little pied bat, greater long-eared bat and delicate mouse) and one reptile (pale-headed snake). Of the fourteen threatened fauna species the delicate mouse and black striped wallaby were the only endangered species (TSC Act) with the 10 remaining species listed as vulnerable on the TSC Act. No threatened amphibians were recorded. Two migratory (rainbow bee-eater and white-throated needletail) and one endangered species (delicate mouse) listed on the EPBC Act were recorded during the survey. Nine introduced species (two birds and seven mammals) were recorded.

3.2.3.1 Fauna Habitat Features

Four main types of habitat were recorded. Four within the Mine Site (**Figures 8**) and three were recorded within the proposed Pipeline Corridor (**Figure 8a**). The four habitat types were:

- Woodland areas,
- Open areas comprised of pasture and/or cropping paddocks,
- Drainage lines, and
- Farm dams.


0
1
2
kilometres
Key
Subject Site
Drainage Line
Woodland
Farm Dam
Figure 8. Fauna Habitats
Flora and Fauna Impact Assessment:
Proposed Narrabri Longwall Coal Mine
Stage Two
August 2009
Ecotone Ecological Consultants Pty Ltd


Key
Subject Site
Proposed Brine Storage Area Boundary
Drainage Line (Riparian Vegetation)
Woodland
0
2,000
Kilometers
Aerial Photo Source: Google Maps
http://maps.google.com.au
Ecotone Ecological Consultants Pty Ltd
Figure 8a. Fauna Habitats of the Proposed Brine Storage Area and Pipeline Corridor
Flora and Fauna Impact Assessment: Proposed Narrabri Longwall Coal Mine Stage Two
August 2009

Woodland areas

Mine Site

Mining Area

Woodland areas within the Mine Site were dominated by regenerating and middle-aged trees as only 54 % and 15 % of assessments contained mature and old growth trees, respectively. Maximum canopy height recorded was 28 metres. Average canopy heights were as follows: shrub layer – 3.3 metres, sapling layer – 8.6 metres, regenerating trees – 13.4 metres, middle-aged trees – 17.3 metres, mature trees – 20.8 metres, and old-growth trees – 23.5 metres. All sites recorded saplings typically forming up to 25 % cover but in some areas representing 50 to 100% cover. With the exception of three sites all sites contained a shrub layer ranging in density from less than 25 % to greater than 75 % cover. Shrub layers were typically one to five metres in height, reaching eight to 10 metres at some sites.

Ground cover in the woodland areas of the Mine Site was dominated by grass and litter cover with some areas of exposed soil, lichen and rock cover. Solid rock and rock-on-rock habitats were recorded at only two sites. No cave or crevice habitat was recorded. Log cover was common and typically comprised a moderate density of logs less than 300 in diameter. Tree hollows were recorded at a low to moderate density and small (26 to 50 mm) and medium (51 to 100 mm) hollows were the size classes most commonly recorded. Less than half of the sites recorded large hollows (101 to 300 mm) and only a single site recorded the presence of extra large tree hollows (> 300 mm). Due to the large area of woodland habitat across the Mine Site individual hollow bearing trees were not mapped.

Almost all sites had a slope of less than five degrees and an easterly or un-measurable aspect. Dieback was recorded at less than half of the sites and was only recorded at a low level of prevalence. Approximately a third of sites contained mistletoe species ranging from a slight to moderate level of infection. Forty percent of sites recorded signs of recent or past fires with half of those sites recording a moderate level of fire evidence. Most sites contained signs of grazing, typically ranging from a slight to moderate level. The most commonly recorded grazers were cattle and macropod species. A low level of sheet erosion was recorded at less than half of the sites while most sites showed no signs of soil erosion. Less than 45 % of sites contained weed species, of which prickly pear (*Opuntia stricta var. stricta*) was the most commonly recorded species. However the level of prickly pear infestation was low at all sites.

Woodland areas of the Mine Site were typically comprised of mixed stands of eucalypt, casuarina and cypress tree species, however in some areas single species stands occurred. Small patches of sapling and regenerating white cypress (*Callitris glaucophylla*) occurred at various locations throughout woodland areas and isolated patches. An approximate five kilometre long and 50 metre wide corridor stand of belah (Casuarina cristata) occurred towards the centre of the Mine Site and followed paddock fence-lines. Dense stands of regenerating belah also occurred at various locations.

Within woodland areas of the Mine Site several areas of dense shrub and regeneration occurred. These areas were comprised of very dense stands of shrubs and saplings typically forming an almost impassable barrier of dense vegetation. In some areas the shrub and regeneration layer reached eight to ten metres however in most areas it was typically three to six metres in height. Due to the dense understorey of dense shrub and regeneration areas

detailed examination of such a habitat type was not possible, such areas were only investigated where they were dissected by tracks and roads.

Brine Storage Area
A small remnant of open woodland vegetation occurred at the southern end of the proposed Brine Storage Area. The canopy was dominated by a stand of regenerating (100 – 200 mm DBH) and middle aged (201 – 400 mm DBH) trees reaching 18 metres in height. Mature (400 – 600 mm DBH) trees also occurred but at lower frequencies within the canopy. No old growth trees (600+ mm DBH) trees were recorded. Saplings (< 100 mm diameter stems) were scattered ranging between one and eight metres in height. Stags (dead standing trees) were rare. The canopies of individual trees were typically affected by slight levels of dieback during the time of the field surveys. No mistletoe infestations were recorded and the level of insect attack of canopies appeared insignificant. The dominant canopy species was bimble box accounting for over 95 percent of all trees present. Western grey box also occurred.

Tree hollows were only recorded in middle-aged and mature trees. Tiny (<25 mm), small (26 – 50 mm) and medium (51 – 100 mm) tree hollows were uncommon and no large (101 – 300 mm) or extra large (> 301 mm) tree hollows were recorded. Tree stumps (> 100 mm diameter) were common and typically hollow in nature.

A scattered shrub layer ranged between one and two metres in height and was primarily comprised of African boxthorn (*Lycium ferocissimum*). Ground cover was dominated by grass cover ranging between 50 and 300 millimetres in height. Areas of litter and soil cover also occurred. Log cover (fallen trees and branches) was moderate and dominated by small (< 100 mm diameter) and medium (101 – 300 mm diameter) logs. Log cover was predominately comprised of hollow and rotten (collapse if stepped on) logs.

No areas of rock on rock, rock overhangs, caves, litter at the base of trees, loose tree bark were recorded. Bimble box, one of the ten koala food tree species listed on Schedule Two of SEPP 44 was recorded at an individual or combined total of approximately 95 percent of the canopy cover. Koala scat searches at the bases of ten bimble box trees failed to identify any signs of koala presence. No potential food trees of the glossy-black cockatoo were recorded.

The study area was disturbed by a moderate number of cut stumps; moderate grazing pressure from kangaroos, wallabies and rabbits; slight sheet soil erosion and a moderate level of weed infestation. No evidence of a past fire history or rubbish dumping was recorded.

Proposed Pipeline Corridor

Kurrajong Creek Crossing
Where the proposed pipeline corridor crosses Kurrajong Creek the vegetation was comprised an open woodland habitat area. The canopy was dominated by a stand of middle aged trees (201 – 400 mm DBH) reaching 20 metres in height. Regenerating (100 – 200 mm DBH) and mature (400 – 600 mm DBH) trees also occurred but at lower frequencies within the canopy. No old growth trees (600+ mm DBH) trees were recorded. Saplings (< 100 mm diameter stems) were common ranging between two and five metres in height and were dominated by belah. Stags (dead standing trees) were absent. The canopies of individual trees were typically affected by slight levels of dieback, moderate levels of mistletoe infestation and slight levels of insect attack during the time of the field surveys. The dominant canopy species were bimble box (*Eucalyptus populnea* subsp. *bimbil*) and belah (*Casuarina cristata*). Other canopy species

present included western grey box (*Eucalyptus microcarpa*) and white cypress (*Callitris glaucophylla*).

Tree hollows were only recorded in mature trees. Medium (51 – 100 mm) and large (101 – 300 mm) tree hollows were uncommon and tiny (<25 mm) small (26 – 50 mm) and extra large (> 301 mm) tree hollows were not recorded. Naturally formed tree stumps (> 100 mm diameter; not cut by humans) were absent.

A moderately dense shrub layer ranged between one metre and six metres in height and was comprised of a relatively small number of species. Ground cover was dominated by grass cover. Areas of litter cover also occurred. Log cover (fallen trees and branches) was moderate and dominated by medium (101 – 300 mm diameter) and large (> 100 mm diameter) logs. Log cover was predominately comprised of solid logs (with and without bark) however some rotten (collapse if stepped on) logs were also recorded.

Species specific habitat areas of loose tree bark were recorded in parts. No areas of rock on rock, rock overhangs, caves and litter at the base of trees were recorded. Bimble box, one of the ten koala food tree species listed on Schedule Two of SEPP 44 was recorded at an individual density of greater than 15 percent of the canopy cover. Koala scat searches at the bases of ten trees failed to identify any koala scats. One potential food tree of the glossy-black cockatoo (belah) was recorded.

The study area was disturbed by moderate grazing pressure from kangaroos and wallabies and a slight level of understorey weed infestation. No evidence of a past fire history, erosion or rubbish dumping was recorded.

Along Proposed Pipeline Corridor
Where woodland was likely to be removed along the proposed pipeline corridor the vegetation was comprised open woodland habitat. The canopy was dominated by stands of mature (400 – 600 mm DBH) trees reaching 20 metres in height. Regenerating (100 – 200 mm DBH) and middle aged (201 – 400 mm DBH) trees also occurred but at lower frequencies within the canopy. No old growth trees (600+ mm DBH) trees were recorded. Saplings (< 100 mm diameter stems) were rare ranging between one and seven metres in height. Stags (dead standing trees) were absent. The canopies of individual trees were typically affected by slight levels of dieback during the time of the field surveys. Infestation by mistletoe was not recorded. The dominant canopy species were bimble box and western grey box.

Tree hollows were only recorded in mature trees. Tiny (<25 mm), small (26 – 50 mm), medium (51 – 100 mm) and large (101 – 300 mm) tree hollows were uncommon and extra large (> 301 mm) tree hollows were recorded. Naturally formed tree stumps (> 100 mm diameter; not cut by humans) were absent.

A scattered shrub layer ranged between one metre and seven metres in height and was comprised of a monoculture of Wilga (*Geijera parviflora*). Ground cover was dominated by grass cover. Areas of litter also occurred. Log cover (fallen trees and branches) was moderate and dominated by medium (101 – 300 mm diameter) logs. Log cover was predominately comprised of solid logs (without bark) however some solid (with bark) and rotten (collapse if stepped on) logs were also recorded.

No areas of rock on rock, rock overhangs, caves, litter at the base of trees, loose tree bark were recorded. Bimble box, one of the ten koala food tree species listed on Schedule Two of

SEPP 44 was recorded at an individual or combined total of 90 percent of the canopy cover. Koala scat searches at the bases of ten mature bimble box trees failed to identify any signs of koala presence. No potential food trees of the glossy-black cockatoo were recorded.

The study area was disturbed by a few cut stumps and a moderate level of weed infestation dominated by understorey weed species. No evidence of a past fire history, grazing pressure, erosion or rubbish dumping were recorded.

Namoi River Riparian Woodland
Vegetation along the southern bank of the Namoi River was dominated by old growth tall open woodland habitat. The canopy was dominated by a stand of old growth trees (600+ mm DBH) reaching 25 metres in height. Regenerating (100 – 200 mm DBH) and middle aged (201 – 400 mm DBH) trees also occurred but at lower frequencies within the canopy. No mature (400 – 600 mm DBH) trees were recorded. Saplings (< 100 mm diameter stems) were rare ranging between one and six metres in height. Stags (dead standing trees) were absent. The canopies of individual trees were typically affected by moderate levels of dieback and appeared to be free of mistletoe infestation and insect attack during the time of the field surveys. The sole canopy species present was river red gum (*Eucalyptus camaldulensis*).

Tree hollows were only recorded in old growth trees. Tiny (<25 mm), small (26 – 50 mm), medium (51 – 100 mm), large (101 – 300 mm) and extra large (> 301 mm) tree hollows were common. Naturally formed tree stumps (> 100 mm diameter; not cut by humans) were not recorded.

A highly scattered shrub layer ranged between three and six metres in height and was comprised of a single wattle species. Ground cover was dominated by grasses reaching 400 millimetres in height along the riparian corridor (fenced) and less than 50 millimetres within the adjacent farm paddocks. Log cover (fallen trees and branches) was scattered and dominated by small (< 100 mm diameter) and medium (101 – 300 mm diameter) logs.

No areas of rock on rock, rock overhangs, caves, litter at the base of trees, loose tree bark were recorded. River red gum, one of the ten koala food tree species listed on Schedule Two of SEPP 44 was the sole canopy species present. Koala scat and scratch searches of ten trees failed to identify any signs of koala presence. No potential food trees of the glossy-black cockatoo were recorded.

The adjacent farm paddocks were disturbed by moderate levels of domestic stock grazing (and past tree clearing) while the fenced riparian corridor was disturbed by slight weed infestation. No evidence of a past fire history, erosion or rubbish dumping was recorded.

Open areas

Approximately half of the Mine Site is comprised of open pasture and cropping areas. At the time of the surveys most pasture areas were less than 300 mm in height and comprised 100 percent ground cover. Pastures were grazed by domestic sheep and cattle. While some eastern grey kangaroos were recorded during the survey, they were only recorded at low density and were unlikely to exhibit any significant grazing pressure on pastures.

Large sections of the proposed pipeline corridor were comprised of roadside grassland. Grasses typically ranged between 0.3 metres and 1.0 metres in height. Grassland species

diversity ranged from low to moderate and in most parts was dominated by agricultural species.

Drainage lines

Two creek-lines and tributary's of the Namoi River drain the Mine Site to the east (Kurrajong Creek) and north east (Pine Creek). Within the Mine Site both creek-lines comprise little more than dry drainage lines lacking pools of semi-permanent or permanent water (no pools of water were encountered in the portions of drainage line sampled). No fish habitat was identified or likely to occur. Drainage line structure varied between sandy creek beds with eroded and incised steep banks between one and three metres in depth and broad grassy creek beds between two and 15 metres in width. No aquatic vegetation was recorded. In most parts drainage lines were bordered by thin strips of woodland vegetation, typically lacking a shrubby understorey.

At the northern end of the proposed pipeline corridor the Namoi River was approximately 20 to 30 metres in width. The steeply sloped three to four metre river banks were covered by a dense 0.4 to 1.0 metre mixture of grasses during the time of the field survey. The woodland habitat along the southern bank of the Namoi River has been detailed above (woodland areas – Namoi River riparian woodland). Snags (dead fallen timber completely or partially submerged in the river) were common along the edges of the river. Suitable habitat for fish species occurs within the Namoi River (no fish sampling was undertaken).

Farm dams

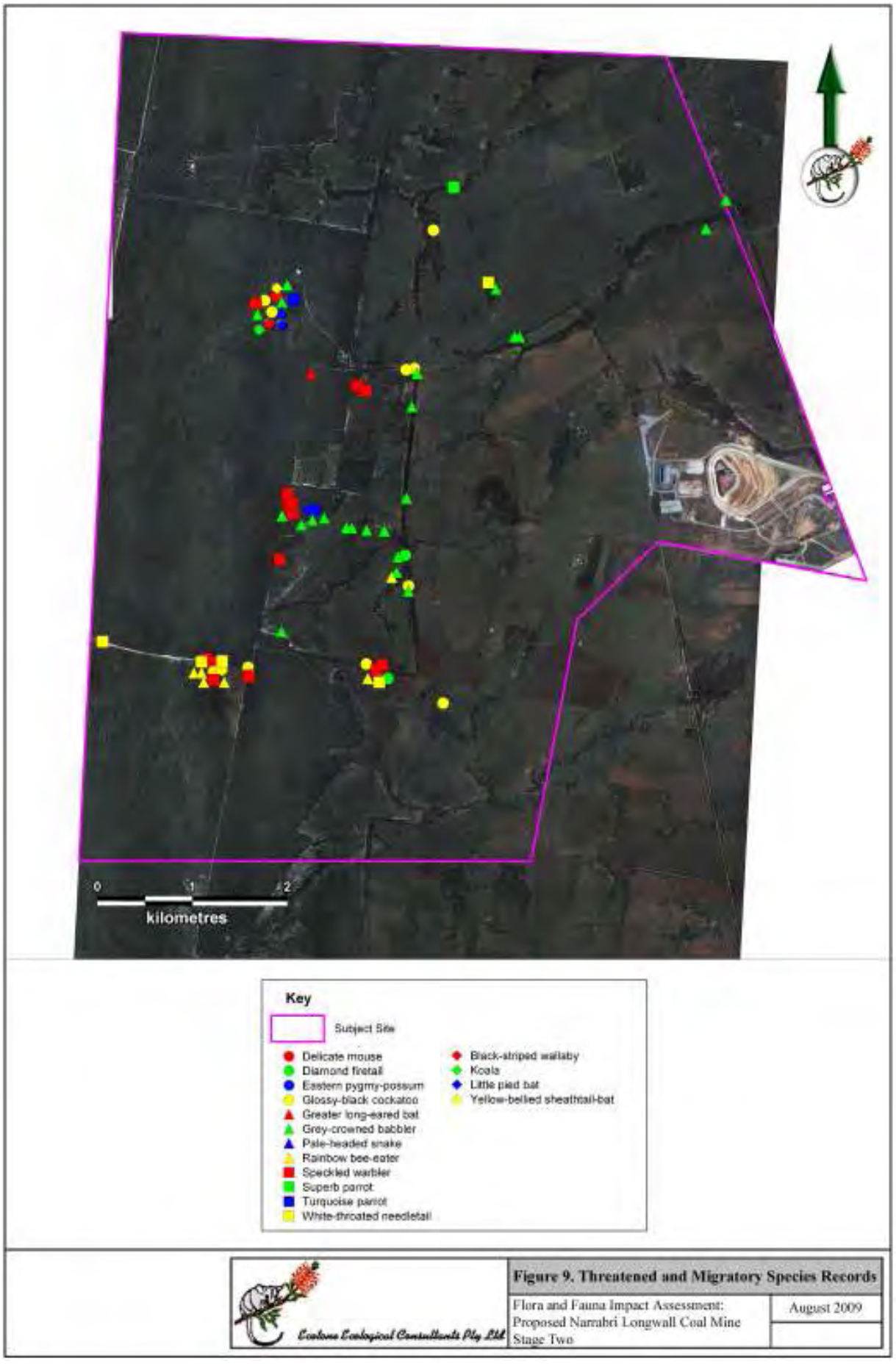
Approximately 30 farm dams occur across the Mine Site. Most farm dams were less than 50 metres in diameter, contained gently sloping grassy banks and were likely between one and three metres deep. Most farm dams contained areas of emergent and aquatic vegetation while others were bordered by a narrow strip of soil between the water and surrounding grass cover. Most farm dams visited contained relatively clear water and all contained some aquatic macro-invertebrates.

3.2.3.2 Threatened Fauna Species

Fourteen threatened fauna species were recorded during the five days of survey.

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

Grey-crowned Babblers are a species commonly encountered on the Mine Site. The grey-crowned babbler is listed as vulnerable on the TSC Act. The position of grey-crowned babbler groups was recorded on 21 occasions within the mine site and once along the proposed pipeline corridor (**Figure 9**), however a large number of groups were also heard calling in the distance during the survey (their locations were not recorded). Groups of up to nine birds were recorded. In addition to frequently recording the species on the subject site, a large number of grey-crowned babbler nests, in excess of 100, were sighted. The number of grey-crowned babbler nests encountered was well beyond the available time to record all their locations. Grey-crowned babbler nests were common anywhere belah trees occurred and were particularly common in belah trees on the western side of woodland patches. Approximately 90 percent of all grey-crowned babbler nests identified appeared to be located within belah trees.


0
1
2
kilometres
Key
Subject Site
Delicate mouse
Diamond firetail
Eastern pygmy-possum
Glossy-black cockatoo
Greater long-eared bat
Grey-crowned babbler
Pale-headed snake
Rainbow bee-eater
Speckled warbler
Superb parrot
Turquoise parrot
White-throated needletail
Black-striped wallaby
Koala
Little pied bat
Yellow-bellied sheathtail-bat
Ecotone Ecological Consultants Pty Ltd
Figure 9. Threatened and Migratory Species Records
Flora and Fauna Impact Assessment:
Proposed Narrabri Longwall Coal Mine
Stage Two
August 2009

Glossy-black cockatoo (Calyptorhynchus lathami)

The glossy-black cockatoo was recorded nine times during the survey (**Figure 9**). The glossy-black cockatoo is listed as vulnerable on the TSC Act. On all occasions a single pair of birds were recorded and it is unknown if they were different pairs of birds or the same pair recorded over several days and locations. Glossy-black cockatoos were recorded feeding in belah trees and chewed belah cones were recorded in areas where birds were not recorded.

Speckled Warbler (Chthonicola sagittata)

The speckled warbler was recorded on 14 occasions (**Figure 9**). The speckled warbler is listed as vulnerable on the TSC Act. In most cases single pairs of birds were recorded, although trios were also identified. Speckled warblers were recorded in areas of moderate to dense shrub cover within the large remnant of woodland vegetation.

Diamond Firetail (Stagonopleura guttata)

The diamond firetail was recorded on two occasions within the belah corridor (**Figure 9**). On both occasions a single bird was recorded. The diamond firetail is listed as vulnerable on the TSC Act.

Turquoise Parrot (Neophema pulchella)

A single turquoise parrot was heard calling and flying overhead during a bird survey at the northern trapping site (**Figure 9**). The turquoise parrot is listed as vulnerable on the TSC Act.

Superb Parrot (Polytelis swainsonii)

A group of four superb parrots were recorded on a single occasion (**Figure 9**). The group of four birds were recorded flying along a narrow strip of woodland drainage line vegetation. The superb parrot is listed as vulnerable on both the TSC Act and the EPBC Act.

Koala (Phascolarctos cineurus)

Three scats from a single point were identified as koala scats at the northern site (**Figure 9**). Scat identification was undertaken by Barbara Triggs, an industry recognised expert in the field of scat identification. No koala scats were identified during 40 koala scat searches at the base of trees within the Brine Storage Area and along the proposed Pipeline Corridor. The koala is listed as vulnerable on the TSC Act.

Eastern Pygmy Possum (Cercartetus nanus)

The eastern pygmy possum was recorded on two occasions at the central trapping site (**Figure 9**). The first individual was recorded in a red ash (*Alphitonia excelsa*) tree during spotlighting. The second individual, an adult male, was captured in a pitfall trap. The eastern pygmy possum is listed as endangered on the TSC Act.

Black-striped Wallaby (Macropus dorsalis)

The black-striped wallaby was identified at a “probable” level from a single hair tube sample at the northern trapping site (**Figure 9**). Hair sample identification was undertaken by Barbara Triggs, an industry recognised expert in the field of hair sample identification. The black-striped wallaby is listed as endangered on the TSC Act.

Yellow-bellied Sheath-tail Bat (Saccolaimus flaviventris)

The yellow-bellied sheath-tail bat was identified at all three trapping sites for Anabat echolocation recording analysis. The yellow-bellied sheath-tail bat was identified at the 'definite' level at all three sites. The yellow-bellied sheath-tail bat is listed as vulnerable on the TSC Act.

Greater Long-eared Bat (Nyctophilus timoriensis)

A single greater long-eared bat was captured in a harp trap (**Figure 9)**. The greater long-eared bat is listed as vulnerable on both the TSC Act and the EPBC Act.

Little Pied Bat (Chalinolobus picatus)

The little pied bat was identified at the northern trapping site following Anabat echolocation recording analysis. The little pied bat was identified at the 'probable' level of identification. The little pied bat is listed as vulnerable on the TSC Act.

Delicate Mouse (Pseudomys delicatulus)

A single delicate mouse was captured in a pitfall trap at the Northern Site (**Figure 9**). The individual, a male, weighed eight grams, had a tail length of 61 mm and a head and body length of 55 mm. The record of the delicate mouse is a significant range extension for the species which is typically found in central and southern Queensland. The delicate mouse is listed as Endangered on the TSC Act. The southern-most recorded location of the delicate mouse is Bebo State Forest near Warialda (approximately 210 km north-east), near the Queensland and New South Wales border (DEC threatened species web site). The delicate mouse is closely related to the Pilliga mouse and the New Holland mouse and there is currently some debate as to the taxonomic identity of the species (DEC threatened species web site). On the EPBC Act Protected Matters Database the Pilliga mouse is noted as "now known as the delicate mouse *Pseudomys delicatulus*". However the male captured did not exhibit the colouration or patterning of the Pilliga mouse or new Holland mouse, and its morphological measurements were well within the delicate mouse's range and smaller than the measurements of both the new Holland and Pilliga mouse.

Pale-headed Snake (Hoplocephalus bitorquatus)

A single pale-headed snake was recorded during a nocturnal spotlight search at the northern trapping site. The pale-headed snake is listed as vulnerable on the TSC Act.

3.2.3.3 Migratory Species

Two migratory species were recorded during the five day survey of the Mine Site.

Rainbow Bee-eater (Merops ornatus)

The rainbow bee-eater was recorded on five occasions (**Figure 9**). The rainbow bee-eater is listed as a migratory species on the EPBC Act. The rainbow bee-eater was recorded high above the canopy on four occasions and amongst the canopy on a single occasion.

White-throated Needletail **(Hirundapus *caudacutus*)**

The white-throated needletail was recorded on four occasions (**Figure 9**). Large groups of white-throated needletails were recorded above or high above both woodland and grassland areas. The white-throated needletail is listed as a migratory species on the EPBC Act.

4 ASSESSMENT OF THE PROPOSAL

4.1 Determination of Local Threatened Flora and Fauna as Potential Subject Species

A list of potential subject species has been compiled. Subject species are defined as those threatened species considered likely to occur or recorded within the habitats present within the study area according to the criteria for determining the list of such species given by DECC (2007). Such species could be potentially impacted by the proposal and require formal assessment of the level of potential impact unless their presence can be conclusively ruled out by appropriate field surveys.

4.1.1 Threatened Flora

An assessment of the relative likelihood of the threatened flora species previously recorded in the study locality occurring within the study area is provided below in **Table 11**. Species not recorded, but predicted to occur within the locality by Bioclim analysis or in the EPBC Act Protected Matters Report (Section 2.1.3), have also been included for consideration.

In this report, potential subject flora species are regarded as locally-occurring species listed on the TSC Act and/or EPBC Act that are rated as having at least a low to moderate likelihood of occurring in the study area in **Table 11** below. On this basis, one of the locally occurring threatened flora species (*Bertya opponens*) could be considered a potential subject species based on the available habitat and presence of previous records in the locality. Regarding species not listed by legislation, none are considered to have greater than a low to moderate likelihood of occurring in the study area.

Numerous species listed exclusively by ROTAP (Briggs and Leigh 1996) have also been recorded within the area covered by the four mapsheets (see **Table 2**), but only three have been recorded within 20 km of the Mine Site centre, none of these within the Mine Site itself. Whilst it is not considered highly likely that any ROTAP species would occur in the Mine Site, it is difficult to rule any of them out completely on the basis of the range of habitat types available. Many could have some potential to occur in the large expanse of uncleared vegetation in the western part of the Mine Site.

Table 11
Assessment of the Potential for Local Rare or Threatened Flora Species to Occur Within the Study Area

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat Available on Site?	Potential to Occur Within Study Area	Subject Species[a]
		All Map sheets	20 km				
Species likely to occur							
Bertya sp. A Cobar-Coolabah (=*Bertya opponens*) (Coolabah bertya)	2001	5	4	Grows on low rises in shallow red earth on red sandstone. Does not extend into the typical sandy gullies and flat wetter areas of the Pilliga scrub. Associated species at Jacks Creek State Forest include *Eucalyptus chloroclada, Callitris glaucophylla* and *Eucalyptus fibrosa*.	Yes	**High** (previous records within and near study area)	✓
Species that may occur							
Cadellia pentastylis (Ooline)	2008	41	9	Forms a closed or open canopy mixing with eucalypt and cypress pine species. Appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth.	Possibly	**Moderate**	✓

Table 11 (Cont)
Assessment of the Potential for Local Rare or Threatened Flora Species to Occur Within the Study Area

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat Available on Site?	Potential to Occur Within Study Area	Subject Species[a]
		All Map sheets	20 km				
Lepidium aschersonii (Spiny peppercress)	2006	28	0	Found on ridges of gilgai clays dominated by Brigalow (*Acacia harpophylla*), with *Austrodanthonia* and/or *Austrostipa* species in the understorey. Grows as a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense Brigalow, with sparse grassy understorey and occasional heavy litter. Flowers from spring to autumn.	Possibly	**Low to Moderate**	✓
Species unlikely to occur							
Boronia ruppii (Rupp's boronia)	1912	1	0	Grows in dry eucalypt woodland on soils derived from serpentinite rock.	No	**Minimal**	-
Bothriochloa biloba	1979	3	0	Woodland on poorer soils.	No – soils are probably too rich.	**Low**	-
Cyperus conicus	2006	2	0	Occurs rarely in the Pilliga area. Grows in open woodland on sandy soil. Recorded from *Callitris* forest in the Pilliga area, growing in sandy soil with *Cyperus gracilis, C. squarrosus* and *C. fulvus*. Soils are usually sandy or silty and damp to wet.	Possibly, but no local records	**Low**	-
Dichanthium setosum (Bluegrass)	1885	1	0	Associated with heavy basaltic black soils.	No	**Minimal**	-

Table 11 (Cont)
Assessment of the Potential for Local Rare or Threatened Flora Species to Occur Within the Study Area

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat Available on Site?	Potential to Occur Within Study Area	Subject Species[a]
		All Map sheets	20 km				
Digitaria porrecta (Finger panic grass)	1995	3	0	Native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire.	Possible marginal habitat, but no local records	**Low**	-
Diuris tricolor (Pine donkey orchid / Tricolour diuris)	No records. Predicted by Bioclimatic modelling only.			Grows in sclerophyll forest among grass, often with native Cypress Pine (*Callitris spp.*). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Usually recorded from disturbed habitats. Associated species include *Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta*, Ironbark and *Acacia* shrubland. The understorey is often grassy with herbaceous plants such as *Bulbine* species. Flowers from September to November or generally spring.	Possible marginal habitat, but no local records	**Low**	-
Hakea pulvinifera (Lake Keepit hakea)	2006	9	0	Confined to a single population on a hard rocky hillside below Keepit Dam (near Gunnedah).	Unlikely	**Low**	-
Haloragis exalata subsp. *velutina* (Tall velvet sea-berry)	1976	2	0	Grows in damp places near watercourses. This subspecies also occurs in woodland on the steep rocky slopes of gorges.	Unlikely	**Low**	-

Table 11 (Cont)
Assessment of the Potential for Local Rare or Threatened Flora Species to Occur Within the Study Area

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat Available on Site?	Potential to Occur Within Study Area	Subject Species[a]
		All Map sheets	20 km				
Homopholis belsonii (Belson's panic)	1994	4	0	Grows in dry woodland (eg. Belah) on poor soils. Habitat and ecology are poorly known.	Possibly, but no local records	**Low**	-
Philotheca ericifolia	1973	2	0	Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include *Melaleuca uncinata, Eucalyptus crebra, E. rossii, E. punctata, Corymbia trachyphloia, Acacia triptera, A. burrowii, Beyeria viscosa, Philotheca australis, Leucopogon muticus* and *Calytrix tetragona*. Flowering time is in the spring. Fruits are produced from November to December. Noted as being a "moisture-loving plant", with plants common on the sides of a particular spur of the Hervey Ranges where soakage from the high background provides sufficient moisture for the plants.	Possible marginal habitat, but no local records	**Low**	-

Table 11 (Cont)
Assessment of the Potential for Local Rare or Threatened Flora Species to Occur Within the Study Area

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat Available on Site?	Potential to Occur Within Study Area	Subject Species[a]
		All Map sheets	20 km				
Polygala linariifolia (Native milkwort)	2006	1	0	Sandy soils in dry eucalypt forest and woodland with a sparse understorey. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of *Eucalyptus caleyi, Eucalyptus dealbata* and *Callitris*, and in yellow podsolic soil on granite in layered open forest. Associated species include *Corymbia trachyphloia, Eucalyptus sphaerocarpa, Angophora floribunda, Angophora leiocarpa, Tristania suaveolens, Allocasuarina torulosa* and *Wahlenbergia* species in the understorey.	Unlikely	**Low**	-
Pomaderris queenslandica (Scant pomaderris)	1926	1	0	Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	Unlikely	**Low**	-
Pterostylis cobarensis (Greenhood orchid)	1989	1	0	Habitats are eucalypt woodlands, open mallee or *Callitris* shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include *Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna* spp. and *Eremophila* spp.	Possible marginal habitat, but no local records	**Low**	-

Table 11 (Cont)
Assessment of the Potential for Local Rare or Threatened Flora Species to Occur Within the Study Area

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat Available on Site?	Potential to Occur Within Study Area	Subject Species[a]
		All Map sheets	20 km				
Rulingia procumbens	1999	3	0	Grows in sandy sites, often along roadsides. Recorded in *Eucalyptus dealbata* and *Eucalyptus sideroxylon* communities, *Melaleuca uncinata* scrub, under mallee eucalypts with a *Calytrix tetragona* understorey, and in a recently burnt Ironbark and *Callitris* area. Also in *Eucalyptus fibrosa* subsp. *nubila, Eucalyptus dealbata, Eucalyptus albens* and *Callitris glaucophylla* woodlands north of Dubbo.	Possible marginal habitat, but no local records	**Low**	-
Swainsona murrayana (Slender darling pea)	1886	1	0	The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. Plants produce winter-spring growth, flower in spring to early summer and then die back after flowering. They re-shoot readily and often carpet the landscape after good cool-season rains. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated.	Unlikely	**Minimal**	-

Table 11 (Cont)
Assessment of the Potential for Local Rare or Threatened Flora Species to Occur Within the Study Area

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat Available on Site?	Potential to Occur Within Study Area	Subject Species[a]
		All Map sheets	20 km				
Thesium australe	No records. Known from Liverpool Plains (Part B) CMA subregion			Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Possible limited habitat, but no local records.	**Low**	-
Tylophora linearis	No records. Predicted by Bioclimatic modelling only.			Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides, Acacia lineata, Myoporum* species and *Casuarina* species.	Possible marginal habitat, but no local records.	**Low**	-

Notes
*compiled primarily from Harden (1990-2002), Harden & Murray (2000) and DECC threatened species profiles http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx
[a]Note - Species rated as having a low to moderate or better likelihood of occurring are regarded as potential subject species.

4.1.2 Threatened Fauna

Section 2.1.5 (above) identified the 40 threatened and/or migratory fauna species that have previously been recorded (TSC Act 1995 – **Table 3**) or are predicted to occur (EPBC Act 1999 – **Table 4**) within a 20 km radius of the Mine Site. Following is an assessment of the likelihood of occurrence of those 40 threatened and migratory fauna species on the Mine Site (**Table 12**), plus an additional three species, two identified during the survey for this report (eastern pygmy possum and little pied bat), and one not identified in **Section 2.1.2** of this report (spotted-tailed quoll) for which suitable habitat was identified during the habitat assessment and field survey.

Table 12
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Species known to occur							
Pale-headed snake (*Hoplocephalus bitorquatus*)	2001	1	1	Nocturnal and partly arboreal snake inhabiting a range of habitats from rainforest and wet sclerophyll forest to drier eucalypt forest. Preferred habitat includes dry hardwood forests and woodlands, particularly in the vicinity of a watercourse. The pale-headed snake appears to require vegetation with old-growth features and is not known to occur in greatly disturbed environments or recently regenerating vegetation. Shelters during the day under loose bark and in the hollow trunks and limbs of dead trees. Predominantly preys on tree frogs, though also takes lizards and small mammals. Recorded during surveys for this report.	Y	Y	Y
Glossy black-cockatoo (*Calyptorhynchus lathami*)	2003	7	0	Coastal woodlands and dry eucalypt forests to open inland woodlands and forested watercourses. Requires particular food trees (she-oaks, particularly *Allocasuarina torulosa*) and large tree hollows for nesting. Recorded during surveys for this report.	Y	Y	Y
Turquoise parrot (*Neophema pulchella*)	2005	10	1	Open eucalypt woodland or forest with a grassy or sparsely shrubby understorey. Favours grasslands on the edge of these habitat types, particularly timbered grassland on mountain slopes and ridges. Feeds on seeds of native and introduced grasses and other herbs. Requires suitable hollows in tree limbs, logs or fence posts for breeding. Usually seen in pairs or small, possibly family groups and have also been reported in flocks of up to thirty individuals. Recorded during surveys for this report.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Superb parrot (*Polytelis swainsonii*)	2001	1	1	Inhabit box gum, box cypress-pine and boree woodlands and river red gum forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian river red gum forest or woodland. On the south west slopes nest trees can be in open box gum woodland or isolated paddock trees. Species known to be used are Blakely's red gum, yellow box, apple box and red box. Nest in small colonies, often with more than one nest in a single tree. Breed between September and January. May forage up to ten kilometres from nesting sites, primarily in grassy box woodland. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. Also eaten are fruits, berries, nectar, buds, flowers, insects and grain. Recorded during surveys for this report.	Y	Y	Y
White-throated needletail (*Hirundapus caudacutus*)	EPBC modelling – likely to occur. Migratory Species			High open spaces of sky above all habitat types. Recorded during surveys for this report.	N	Y	Y
Rainbow bee-eater (*Meraps ornatus*)	EPBC modelling – likely to occur. Migratory Species			Migrate throughout mainland from northern Australia in September to April. Occurring in woodland, open forest, semi-arid scrub, grasslands and timbered plains, avoiding dense forest. Pursue flying insects. Nest in ground tunnels. Recorded during surveys for this report.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Speckled warbler (*Pyrrholaemus sagittatus*)	2008	10	10	The speckled warbler lives in a wide range of *Eucalyptus* dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. Recorded during surveys for this report.	Y	Y	Y
Grey-crowned babbler (*Pomatostomus temporalis temporalis*)	2007	5	2	Open eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. May also be observed along streams in cleared areas and grassy road verges. Raucous groups of 2-13 individuals foraging for insects in all substrates. Groups build several dome shaped and football sized stick nests which are used year round for roosting and during the breeding season for nesting. Nests are typically located in shrubs or regenerating eucalypts, or less frequently in the outer lower branches of large eucalypt trees. Breeding generally occurs between July and February. Territories range from one to 50 hectares, averaging 10 ha, and are defended year-round. Recorded during surveys for this report.	Y	Y	Y
Varied sittella (*Daphoenositta chrysoptera*) Preliminary determination	--	-	-	Eucalypt forest and woodland, mallee, farm trees, shelter belts, roadside trees, and parks and gardens. Recorded during surveys for this report.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Diamond firetail (*Stagonopleura guttata*)	2004	4	0	Found in grassy woodlands, open forest with a grassy groundcover, woodland, mallee, acacia scrub lands and timber belts along watercourses and roadsides. Often found in riparian area and sometimes in lightly wooded farmland. Feeds entirely on the ground, eating grass and herb seeds, green leaves and insects. Small globular nests are built in dense understorey or high in the canopy, often under raven and hawk nests. Breeding occurs between August and January. Roost in dense shrubs or small roost nests. Recorded during surveys for this report.	Y	Y	Y
Koala (*Phascolarctos cinereus*)	2004	17	6	Forest and woodland habitats that contain suitable regional eucalypt feed trees. Known to feed on more than 70 eucalypt and 30 non-eucalypt species. Home range size depends on habitat quality and ranges from a single hectare to several hundred hectares. Spend most of their time in trees but will descend to the ground to move across open ground between trees. Recorded during surveys for this report.	Y	Y	Y
Eastern pygmy-possum (*Cercartetus nanus*)	No local records on the DEC Wildata database.			Rainforest through sclerophyll forest to tree heath. Favours banksias and myrtaceous shrubs and trees for food sources and nesting sites. The eastern pygmy-possum is a nocturnal species that lives mainly solitary and spends some time in torpor during winter. Although the eastern pygmy-possum is an agile climber, they spend a proportion of time on the ground. Nests are created in tree hollows or spherical nests are wedged under bark of eucalypts, abandoned bird nests or in branch forks. Recorded during surveys for this report.	Y	Y	Y
Black-striped wallaby (*Macropus dorsalis*)	2000	1	0	In northern NSW the black-striped wallaby is found on the north western slopes in Brigalow remnants south of Narrabri. Also found in dense ironbark and bull-oak regeneration areas. Preferred vegetation is woodland with a dense understorey to three metres. Preferred vegetation must be located adjacent to open grassland foraging areas. Recorded during surveys for this report.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)	2005	5	5	Wide range of habitats, including open forest. Forages above the canopy in wooded areas and lower down in more open areas or along creeklines. Reliant on suitable trees with hollows for roosting. Breeds from mid-December to March. Recorded during surveys for this report.	Y	Y	Y
Little pied bat (*Chalinolobus picatus*)	--	-	-	Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Recorded during surveys for this report.	Y	Y	Y
Eastern long-eared bat (*Nytophilus timoriensis*)	2001	3	1	Eastern long-eared bats roost in tree hollows and fissures. On the mainland, this species is known from tall eucalypt forest as well as mallee, open savannah and black box woodland. Appear to have a preference for semi-arid areas. Recorded during surveys for this report.	Y	Y	Y
Delicate mouse (*Pseudomys delicatulus*)	No local records on the DEC Wildata database			Only known from Bebo State Forest on the Queensland and New South Wales border. Feeds on native grass seeds. Found in grassy habitats were it digs burrows up to 40 cm in depth. Recorded during surveys for this report.	Y	Y	Y
Species likely to occur							
Great egret (*Ardea alba*)	EPBC modelling - may occur – migratory species			Wetlands, flooded pastures, estuarine mudflats, dams, mangroves and reefs. Approximately 30 farm dams occur on the Mine Site. As a highly mobile and migratory species the great egret is likely to forage on some or all of the farm dams from time to time.	N	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Squirrel glider (*Petaurus norfolcensis*)	2001	2	2	Usually inhabits dry open sclerophyll forest and woodlands, but has also been observed in moist regenerating forest and moist gullies. Forages on acacia gum, eucalypt sap, nectar, honeydew and manna, invertebrates and pollen, utilising areas with an abundance of flowering eucalypts and tall shrubs (eg. banksias). Acacia species are the preferred sap feeding trees. This species requires an abundance of suitably sized hollow-bearing trees for den sites. Known to be associated with Dry Sclerophyll Forests (brown bloodwood - cypress - ironbark heathy woodland) in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). Two records occur within a 10 km radius of the centre of the Mine Site. Due to the large contiguous area of remnant habitat vegetation on the Mine Site (extending to the west and south west), the presence of local records and the presence of suitable hollows for the species it is likely that the squirrel glider occurs within the Mine Site.	Y	Y	Y
Species that may occur							
Australian brush-turkey (*Alectura lathami*)	2004	8	6	With the exception of the population in the Nandewar and Brigalow Belt South Bioregions, the Australian brush-turkey has a coastal distribution from Cape York to the Illawara. The population is believed to extend from north-east of Warialda to Narrabri. Most records are known from Mount Kaputar National Park and nearby Deriah State Forest. Six records are known to occur within a 10 kilometre radius of the Mine Site however no mounds were encountered during field surveys. Mount Kaputar National Park is approximately 25 km to the north-east of the Mine Site and it is possible that while the resident birds may not occur across the Mine Site (indicated by the presence of breeding mounds) dispersing individuals may do so.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Magpie goose (*Anseranas semipalmata*)	1998	1	0	Tropical wetlands, floodplains, dams, irrigated crops. Grazes in shallow water, usually in large flocks. Also grazes in pasture and crops. Create a large floating nest on the water amongst emerging rushes or grasses. Only vagrants occur in the south. Known to be associated with the Miscellaneous Ecosystems (highly disturbed area with little or no vegetation, and water bodies, rivers, lakes and streams) in the Namoi CMA (DECC threatened species website). Farm dams scattered across the Mine Site may form occasional and limited habitat for the magpie goose, as may the pastures and cropping areas. Only a single record is known within a 20 km radius of the centre of the Mine Site. The magpie goose may temporarily utilise some habitats on the Mine Site. Preferred breeding habitat is not present on the Mine Site.	N	Y	Y
Black-necked stork (*Ephippiorhynchus asiaticus*)	1994	2	2	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water on a variety of prey including fish, frogs, eels, turtles, crabs and snakes. Breeds in late summer in the north, and early summer further south. A large nest, up to 2 m in diameter, is made in a live or dead tree, in or near a freshwater swamp. Known to be associated with Miscellaneous Ecosystems (water bodies, rivers, lakes and streams) within the Namoi CMA (DECC threatened species website). Farm dams on the Mine Site may provide occasional habitat for this highly mobile species.	N	Y	Y
Cattle egret (*Ardea ibis*)	EPBC modelling - may occur – migratory species			Shallow open wetlands and mudflats. Moist pastures with tall grass. Often associated with grazing cattle. Farm dams and pastures with cattle may provide habitat for the cattle egret within the Mine Site.	N	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Black-breasted buzzard (*Hamirostra melanosternon*)	1985	2	0	Found in a range of inland habitats, including open woodlands and savannas. Will also hunt over grasslands and sparsely timbered woodlands. Timbered watercourses are the preferred breeding habitat. Known to be associated with Miscellaneous Ecosystems (water bodies, rivers, lakes and streams) within the Namoi CMA (DECC threatened species website). Two records of this species occur within a 20 km radius of the Mine Site. Due to the wide range of habitats across which the species may be found (ranging from woodland to timbered watercourses) the black-breasted buzzard may occur on the Mine Site on an occasional or rare basis.	N	Y	Y
Little eagle (*Hieraaetus morphnoides)*	2001	1	0	Forests, woodlands, open shrublands, tree-lined watercourses of interior. Most abundant where open country intermixes with wooded or forested hills (as in farmland/irrigated land). Avoids dense forest, but will use clearings and margins on dense eucalypt and rainforest. Woodland across the Mine Site may provide habitat for the little eagle within the Mine Site.	Y	Y	Y
Latham's snipe (*Gallinago hardwickii*)	EPBC modelling - may occur – migratory species			Wetlands with low vegetation in shallows. Farm dams scattered across the site may provide small areas of habitat for Latham's snipe. Due to the small size and scattered distribution of farm dams the Mine Site is likely to only provide occasional habitat for Latham's snipe. Latham's snipe may occur on the Mine Site.	N	Y	Y
Swift parrot (*Lathamus discolor*)	EPBC modelling - Species or habitat may occur			The migratory nature of this species makes them difficult to assess. Known to frequent sclerophyll forest and woodlands with winter flowering trees (eg. spotted gum, red ironbark, *Eucalyptus crebra*, *E. siderophloia*, forest red gum and swamp mahogany) on an opportunistic basis along the coast and ranges of NSW. Known to be associated with Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). The swift parrot may occur opportunistically during winter periods, feeding on winter flowering eucalypts.	N	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Little lorikeet (*Glossopsitta pusilla*) - Preliminary Determination	2005	3	1	Dry open eucalypt forests and woodlands form the coast to the western slopes of the Great Dividing Range. Generally considered nomadic, presumably related to food availability. Feed primarily of nectar and pollen. Require tree hollows for breeding, using hollows with very small openings. Most breeding records come from the western slopes. Suitable habitat exists within the Mine Site for the little lorikeet.	Y	Y	Y
Masked owl (*Tyto novaehollandiae*)	1985	1	1	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Known or predicted to be associated with Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). Potentially suitable habitat exists on the Mine Site for the masked owl. The masked owl may occur on the Mine Site.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Barking owl (*Ninox connivens*)	2007	7	6	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Dense vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as acacia and casuarina species, or the dense clumps of canopy leaves in large eucalypts. Feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. Live alone or in pairs. Territories range from 30 to 200 hectares and birds are present all year. Three eggs are laid in nests in hollows of large, old eucalypts. Known to be associated with Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). Six records of the barking owl occur within a 10 km radius of the centre of the Mine Site. The barking owl may occur in the woodland areas of the Mine Site.	Y	Y	Y
Black-chinned honeyeater (*Melithreptus gularis gularis*)	2004	1	1	Dry eucalypt savannah woodland and forest with an annual rainfall range of 400-700mm, particularly with box-ironbark associations and river red gums. Considered to be locally nomadic requiring remnants of greater than 200ha in area. Forages within foliage and bark of eucalypt trees on spiders, insects, lerp and nectar. Known to be associated with Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). The black-chinned honeyeaters preference for large remnants within a landscape suggests that it may occur on the Mine Site.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Regent honeyeater (*Xanthomyza phrygia*)	2003	1	0	Inhabits dry open forest and woodland, particularly box-ironbark woodlands, and riparian forests of river-sheoak. Feeds on nectar from a wide range of eucalypts and mistletoe. When nectar is scarce feeds on lerp, honeydew and insects. Regent honeyeaters undertake large-scale nomadic movements most likely in search of flowering areas, or other unknown resource requirements. Every few years regent honeyeaters are found foraging coastal swamp mahogany and spotted gum forests, particularly on the Central Coast of NSW. The nomadic nature of this species makes it difficult to assess. Known to frequent areas with densely blossoming winter-flowering trees on an opportunistic basis along the coast and ranges of NSW. Known or predicted to be associated with Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). As a nomadic species that may appear in any area of eastern NSW with winter flowering eucalypts, the regent honeyeater may find occasional foraging habitat on the Mine Site. The regent honeyeater may on rare occasions forage on winter flowering eucalypts on the Mine Site.	Y	Y	Y
Hooded robin (*Melanodryas cucullata cucullata*)	2004	3	2	Prefers open areas adjacent to large blocks of woodland, particularly with areas of dead timber and sparse shrub cover. Also recorded in open forests and acacia shrublands. Home range areas range from 10 ha during the breeding season to 30 ha during the non-breeding season. Prefers structurally diverse habitats comprising mature trees, regenerating trees, shrubs and tall grasses. Known to be associated with Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). Two records of the hooded robin occur within a 10 km radius of the Mine Site. The hooded robin may occur on the Mine Site.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Spotted-tailed quoll (*Dasyurus maculatus*)	-	-	-	Inhabits a variety of habitat types from moist and wet sclerophyll through to dry forests and woodlands on the edge of open grasslands. Individuals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky cliff faces as den sites. Use latrine sites, often on rocks or boulders. Feed on a wide variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, insects, domestic fowls. Also eats carrion. Female home ranges range up to 750 ha, males 3500 ha. Predicted to be associated with Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). Suitable habitat exists within the remnant woodland and fringing grassland for the spotted-tailed quoll.	Y	Y	Y
Large-eared pied bat (*Chalinolobus dwyeri*)	2001	2	0	Range of well-wooded habitats, including dry sclerophyll forests and woodlands of coastal and semi-arid areas. Occasionally in sub-alpine woodlands and at the edge of rainforest and semi-arid areas. Reliant on suitable roosting habitat including caves and mine tunnels (though may use other structures, eg. abandoned fairy martin nests). Known or predicted to be associated with Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). The lack of caves or tunnels indicates that the Mine Site is unsuitable breeding or shelter habitat. Woodland areas across the Mine Site may provide suitable foraging habitat for the large-eared pied bat.	N	N	Y
Border thick-tailed gecko (*Underwoodisaurus sphyrurus*)	EPBC modelling – likely to occur			Found only on the tablelands and slopes of northern NSW (south to Tamworth and west to Moree) and southern Qld. Most common in granite country of the New England tablelands. Occurs on rocky hills with dry open eucalypt forest and woodland. Favours areas with rock slabs, boulders, fallen timber and deep leaf litter. Some small low rocky ridgelines occur in the western part of the Mine Site. Those small low rocky ridgelines may provide habitat for the border thick-tailed gecko.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Five-clawed worm-skink (*Anomalopus mackayi*)	EPBC modelling – likely to occur			Patchy distribution on the north west slopes and plains of northern NSW. Inhabits lower slopes of slight rises in grassy white box woodland on black soils, and river red-gum/coolibah/bimble box woodland on deep cracking loose clay soils. May also occur in open grasslands and grasslands with scattered tree cover. Live in deep tunnel-like burrows and deep soil cracks. Known or predicted to be associated with grassy woodlands in the Pilliga outwash CMA sub-region of the Brigalow Belt South Bioregion (DECC threatened species website). Scattered areas of grassy box woodland and scattered trees along the creek lines may provide suitable habitat for the five-clawed worm-skink.	Y	Y	Y
Species unlikely to occur							
Malleefowl (*Leipoa ocellata*)	EPBC modelling - species or habitat likely to occur.			Known from mallee woodland, with abundant litter and low scrub in southern mainland (habitat needs to be unburnt for more than twenty years). Create a large mound of sand, leaves, bark and twigs 4m wide and 75cm high to lay eggs. The adults look after their nest daily, but the chicks are independent upon hatching. Feed amongst leaf litter. Known to be associated with the Western Slopes Dry Sclerophyll Forests in the Pilliga region of the Brigalow Belt South Bioregion (DECC threatened species website). No records are known to occur within a 20 km radius of the centre of the Mine Site. Two records are known to occur across the four 1:100 000 map sheets that dissect the Mine Site. No mounds were identified during field surveys. While suitable habitat is present for the species within the Mine Site, the lack of local records and the lack of mounds on the Mine Site suggests that the malleefowl is unlikely to occur.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Painted snipe (*Rostratula benghalensis*) NB. probably the Australian Painted Snipe in Australia now	1992	1	0	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions; generally occurs from September to December. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter. Farm dams across the Mine Site map provide infrequent poor quality habitat areas for the painted snipe. The painted snipe is unlikely to occur on the Mine Site.	N	N	Y
White-bellied sea-eagle (*Haliaeetus leucogaster*)	EPBC modelling – species or habitat likely to occur			Inhabit areas near large bodies of water. Hunts for fish at the water's surface. No suitable habitat exists for the white-bellied sea eagle. No large water-bodies exist nearby.	N	Y	N
Brown treecreeper (*Climacteris picumnus victoriae*)	2001	1	1	Eucalypt forests, woodlands and scrubs of the drier areas, river-edge trees, timbered paddocks. Occasionally coastal plains and ranges, though predominantly found on inland plains and inland slopes of the Great Dividing Range. Hollows in dead standing timber (trees/stumps) and live trees are essential for breeding. Sedentary, occurring in groups at sites in all seasons and year-round. Average home range size is 4.4 ha, ranging up to 10.7 ha. Known to occur within dry sclerophyll forest formations within the Pilliga sub-region of the Brigalow Belt South region (DECC threatened species website). Open understoreys preferred by the brown treecreeper were uncommon within the Mine Site, principally only occurring in remnant patches within farmland. The brown-treecreeper is a highly conspicuous species in the field due to the open understorey it inhabits and the frequency and volume of its alarm and contact calls. The brown treecreeper is unlikely to occur within the Mine Site.	Y	Y	Y

Table 12 (Cont)
An Assessment of the Likelihood of 43 Threatened and/or Migratory Fauna Species Occurring Within the Mine Site

Common Name	Most Recent Record	Record Within		Preferred Habitat* and Comments	Habitat available on site		
		20 km	10 km		Breeding	Shelter	Foraging
Brush-tailed rock-wallaby (*Petrogale penicillata*)	2008	8	1	Occupy rocky cliffs, escarpments and outcrops, with a preference for complex structures with fissures, caves and ledges facing north. Eat grasses and forbs, as well as fruit and foliage of shrubs and trees. Home range areas average 15 ha and family groups, typically of 2 to 5, are highly territorial. Breeding is likely to be year-round. No suitable habitat exists on the Mine Site for the brush-tailed rock wallaby	N	N	N
Booroolong frog (*Litoria booroolongensis*)				Permanent flowing rocky streams with fringing vegetation or groundcover. Forage up to 100 metres from streams and creeks. Detectable September – December. No suitable habitat exists on the Mine Site for the booroolong frog.	N	N	N

*Compiled from: Australian Museum Fact Sheets; Barrett et al. 2003; Churchill, 1998; Cogger, 1995; DECC threatened species information (website); Garnett & Crowley, 2000; Morcombe, 2004;Strahan, 2002.

Of the 43 threatened and/or migratory fauna species assessed in the above table, 37 have the potential to occur on the Mine Site, including 17 known to occur and two likely to occur. The 37 threatened and/or migratory fauna species are listed in **Section 4.1.3.2** below.

4.1.3 Potential Threatened Species, Endangered Populations and Endangered Ecological Communities to be assessed

The following statutory-listed species and ecological communities that were considered to have at least a low to moderate likelihood of occurrence in **Sections 4.1.1** and **4.1.2** above are considered to have potential to occur within the study area and are considered to be potential subject species in this assessment.

4.1.3.1 Flora

The following threatened flora species have potential to occur within the study area;

- *Bertya opponens* – coolabah bertya (Vulnerable – TSC Act)
- *Cadellia pentastylis* – ooline (Vulnerable – TSC Act and EPBC Act)
- *Lepidium aschersonii* – spiny peppercress (Vulnerable – TSC Act and EPBC Act)

4.1.3.2 Fauna

The following 37 threatened and/or migratory fauna species have some level of potential to at least forage within the study area;

- Australian brush-turkey (*Alectura lathami*) (TSC Act – endangered population)
- Magpie goose (*Anseranas semipalmata*) (TSC Act –vulnerable species)
- Black-necked stork (*Ephippiorhynchus asiaticus*) (TSC Act – endangered species)
- Cattle egret (*Ardea ibis*) (EPBC Act – migratory species)
- Great egret (*Ardea alba*) (EPBC Act – migratory species)
- Black-breasted buzzard (*Hamirostra melanosternon*) (TSC Act – vulnerable species)
- Little eagle (*Hieraaetus morphnoides*) (TSC Act – vulnerable species preliminary listing
- Latham's snipe (*Gallinago hardwickii*) (EPBC Act – migratory species)
- Glossy black-cockatoo (*Calyptorhynchus lathami*) (TSC Act – vulnerable species)
- Little lorikeet (*Glossopsitta pusilla*) (TSC Act – vulnerable species preliminary listing)
- Turquoise parrot (*Neophema pulchella*) (TSC Act – vulnerable species)
- Swift parrot (*Lathamus discolor*) (TSC and EPBC Acts – endangered species)
- Superb parrot (*Polytelis swainsonii*) (TSC and EPBC Acts – vulnerable species)
- Masked owl (*Tyto novaehollandiae*) (TSC Act – vulnerable species)
- Barking owl (*Ninox connivens*) (TSC Act – vulnerable species)
- White-throated needletail (*Hirundapus caudacutus*) (EPBC Act – migratory species)
- Rainbow bee-eater (*Meraps ornatus*) (EPBC Act – migratory species)
- Speckled warbler (*Pyrrholaemus sagittatus*) (TSC Act – vulnerable species)
- Black-chinned honeyeater (*Melithreptus gularis gularis*) (TSC Act – vulnerable species)
- Regent honeyeater (*Xanthomyza phrygia*) (TSC and EPBC Acts – endangered species; EPBC Act – migratory species)
- Hooded robin (*Melanodryas cucullata cucullata*) (TSC Act – vulnerable species)
- Grey-crowned babbler (*Pomatostomus temporalis temporalis*) (TSC Act – vulnerable species)
- Varied sittella (*Dapheonsitta chrysoptera*) (TSC Act – vulnerable species preliminary determination)

- Diamond firetail (*Stagonopleura guttata*) (TSC Act – vulnerable species)
- Spotted-tailed quoll (*Dasyurus maculates*) (TSC Act – vulnerable species)
- Koala (*Phascolarctos cinereus*) (TSC Act – vulnerable species)
- Eastern pygmy-possum (*Cercartetus nanus*) (TSC Act – endangered species)
- Squirrel glider (*Petaurus norfolcensis*) – (vulnerable – TSC Act)
- Black-striped wallaby (*Macropus dorsalis*) (TSC Act – endangered species)
- Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) – (vulnerable – TSC Act)
- Little pied bat (*Chalinolobus picatus*) (TSC Act – vulnerable species)
- Eastern long-eared bat (*Nytophilus timoriensis*) (TSC and EPBC Acts – vulnerable species)
- Large-eared pied bat (*Chalinolobus dwyeri*) (TSC and EPBC Acts – vulnerable species)
- Delicate mouse (*Pseudomys delicatulus*) (TSC Act – endangered species; EPBC Act – Vulnerable species)
- Border thick-tailed gecko (*Underwoodisaurus sphyrurus*) (EPBC Act – vulnerable species)
- Five-clawed worm-skink (*Anomalopus mackayi*) (EPBC Act – vulnerable species)
- Pale-headed snake (*Hoplocephalus bitorquatus*) (TSC Act – vulnerable species)

4.1.3.3 Threatened Ecological Communities

The following threatened ecological communities are considered to occur in the study area, at least in marginal form or as small remnants:

- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (TSC Act – Endangered)
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions (TSC Act – Endangered) / Weeping Myall Woodlands (EPBC Act – Endangered)
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (TSC Act – Endangered) / Brigalow (*Acacia harpophylla* dominant and co-dominant) (EPBC Act – Endangered).

The potential impacts on these subject species and communities as a result of the proposal are formally assessed below in **Section 4.3.1.1** of this report.

4.2 Overview of Potential Impacts Associated with the Proposal

The potential impacts of Stage 2 of the Narrabri Longwall Coal Mine will predominantly be related to the clearing of vegetation for mine infrastructure and land subsidence as the long walls are allowed to collapse as the mine progresses. The 26 longwall panels will be mined in an anti-clockwise direction and each long wall is expected to take approximately one year to mine. Following the beginning of a subsequent longwall, the previous longwall will be collapsed and any surface facilities associated with the collapsed longwall will be removed and rehabilitated. The 26 longwall panels are expected to be mined over an approximate 30 year period.

Our understanding of the impacts of such activities is as follows.

4.2.1 Clearing of Vegetation for Mine Site Infrastructure

The clearing of vegetation for mine infrastructure will result in a reduction of habitat areas for species, increased fragmentation and isolation of habitat and a reduced corridor function of the remaining woodland.

4.2.1.1 Habitat Loss

The activities resulting in habitat loss were described in Section 1.2.

In areas such as the power-line easement, ventilation shaft areas, pre-drainage and goaf gas drainage sites, Pit Top Area, brine storage area and reject emplacement area the majority of existing vegetation would be removed and is estimated to total 210.5 ha of vegetation communities 1 to 5 (**Figure 3**). The location of access roads would be flexible, allowing the avoidance of important habitat features such mature trees with hollows or trees containing the nests of threatened species. The location of the proposed Pipeline Corridor would have a small level of flexibility along the various road easements and as such the area of woodland vegetation to be removed for the pipeline is not a component of the 210.5 ha of vegetation to be removed.

Based on the anticipated location of the surface disturbing activities, 178.9 ha of Community 1 (brown bloodwood/Pilliga box woodland), 24.8 ha of Community 2 (inland grey box woodland), 4.1 ha of Community 3 (riparian forest) and 2.7 ha of Community 4 (callitris forest) would be disturbed. The remainder of the disturbance would occur within agricultural land of the Mine Site.

4.2.1.2 Habitat Fragmentation

The proposed longwall mine will see an increased level of habitat fragmentation across the mining area. Currently the woodland area in the western half of the mining area is a large contiguous patch of woodland only dissected by Scratch Road in the southern third and the far north-western corner. Scratch road comprises approximately a 10 metre wide road surface with two to five metre wide road edges of bare soil and/or regenerating shrub species.

The northern power line corridor would split the western woodland area (Community 1) in half and may create a barrier to movement for species wary of open areas. Further fragmentation would occur as a result of the development of access tracks to service the gas drainage and mine ventilation infrastructure. These tracks are expected to be minor tracks (removal of some trees and shrubs, and the ground cover driven over) and in woodland areas where the tracks pass around large trees, are not expected to result in significant fragmentation of the habitat. However where these tracks pass through low dense stands of regenerating shrubs and/or trees they will create openings that fragment habitat areas on either side of the tracks. As these tracks are expected to be less than two vehicles in width it is unlikely that they will create significant barriers to the movement for many species.

In addition to reducing the movements of some species between fragmented woodland areas the creation of tracks will dramatically increase the area of edge habitat within the mining area. Edge effects such as increased levels of light, solar radiation and wind penetration will alter the suitability of the environment for many species. Edges are also more likely to be colonized by weed species which may then spread further into woodland areas.

Where the proposed pipeline corridor requires the removal of trees along road easements, particularly along the dirt road running north-south along the western side of the railway line (were the road easement and stand of woodland vegetation is less than five metres wide), the level of woodland fragmentation will be increased as small linear fragments of woodland vegetation are likely to be removed.

4.2.1.3 Habitat Isolation

While the level of fragmentation of the woodland habitat within the Mine Site will increase due to the dissection of the western woodland area by numerous access tracks, the level of habitat isolation will increase only slightly across most of the western woodland area. The 30 metre wide northern power line corridor would isolate the northern half from the southern half and may prevent the movement of some species between the two halves. The presumed narrow width of access tracks running between the goaf boreholes (less than 10 metres) would mean that for many mobile species the habitat areas will remain practically intact. However, as the responses of most species to habitat isolation are unknown, some species may be affected by the increased level of habitat isolation.

Where the proposed pipeline corridor requires the removal of trees along road easements, particularly along the dirt road running north-south along the western side of the railway line (were the road easement and stand of woodland vegetation is less than five metres wide), the level of woodland isolation will be increased as small linear fragments of woodland vegetation are likely to be removed.

4.2.1.4 Corridor Function

Areas of woodland with corridor function occur along the creek lines and some fence lines on the Mine Site. The two creek lines in the northern half and the creek line at the southern end of the Mine Site are each fringed by a 20 to 50 metre wide corridor of woodland/riparian tree species (Community 3). These creek line corridors provide a linkage between the western woodland area and the riparian habitat along the Namoi River, approximately five kilometres to the east of the Mine Site.

Within the Mine Site trees retained along some fence lines provide a corridor function within the site linking woodland, riparian and other fence line corridor areas. Creek and fence line corridors are likely to be relatively unaffected by the proposed mining activities, except where goaf gas drainage sites occur within the boundaries of the corridors.

The large woodland remnant in the western half of the Mine Site also provides a corridor function. The remnant provides a north-south and east-west linkage for species within the remnant, and an east-west linkage for species moving from or to the remnant from the creek line and fence line corridors to the east. The east-west power-line easement through the centre of the woodland remnant will reduce the corridor function of the remnant for some species (small terrestrial species and some arboreal species). Access tracks for goaf boreholes will also reduce the east-west corridor function of the remnant, however the level of reduction is likely to be minor for all species due to the minimal width and minimal level of understorey disturbance. While the access tracks for the goaf boreholes are unlikely to significantly affect the corridor function of the remnant, they will increase the potential for edge effects (e.g. increased radiation and increased possibility of weed invasion) to reduce to nearby habitat quality for flora and fauna species.

Where the proposed pipeline corridor requires the removal of trees along road easements, particularly along the dirt road running north-south along the western side of the railway line (were the road easement and stand of woodland vegetation is less than five metres wide), the likely removal of all woodland trees within such areas would result in a loss of corridor areas within the local landscape.

4.2.1.5 Rehabilitation of Cleared Vegetation

Goaf boreholes and their associated access tracks will be rehabilitated progressively within 3 months of removal of goaf gas infrastructure and the completion of surface crack repairs above each longwall panel. The east-west power-line easement will be rehabilitated at the end of the mine's life.

4.2.2 Proposed Pipeline Installation

The proposed pipeline corridor will follow the following alignment (**see Figure 2a**):

- The pipeline would be aligned from Dam C or D (not shown on Figure 2A) within the rail loop, cross Kurrajong Creek Tributary Creek (underground) before being aligned along the eastern boundary of the Mine Site property. Within the mine site the pipeline would be positioned along the eastern edge of the proposed Brine Storage Area and clear of the narrow strip of woodland vegetation along the eastern fence line of the mine site (and along the adjacent road easement). No mature trees would be removed for the proposed pipeline within the mine site.
- At the "Greylands" property, the pipeline would be moved into the road easement between the freehold land and the railway line, and remain within this easement until the intersection of the Kamilaroi Highway with "Narrabri Road". Within this easement, the Proponent proposes to run the pipeline on the western side of the existing road. The western side of the road easement within this area ranges between five and 10 metres in width, and in many parts is heavily vegetated.

- The pipeline would run under the railway line and Kamilaroi Highway at Turrawan and follow the road easement to the north east until it reaches the "Broadwater" property. The pipeline would be located on the northern side of the road easement.
- At the "Broadwater" property, the pipeline would travel under the road and onto the property in line with the road sign on the eastern side of the road. The pipeline would travel in a straight line (approximately due north) to the river adjacent to a shed on the property.

Within the pipeline corridor two pipelines of 300mm in diameter would be laid within a trench of between one and 1.5 metres deep. Beneath the roads and railway line traversed by the pipeline corridor, the pipelines would be laid within a culvert or tunnel. Each pipeline would be installed with leak detection equipment, such as flow meters placed at regular intervals along the length of the pipeline.

An excavator would be used to dig and fill in the trench and a drill used to bore a tunnel beneath the roads and railway line the pipeline corridor traverses. Where possible mature vegetation along the route will be avoided, however, this would be unavoidable over parts of the corridor (especially along the road easement which runs parallel to the Mine Site which is narrow and heavily vegetated in parts). The in-filled trench would be allowed to revegetate naturally as the soil excavated would be replaced immediately.

4.2.3 Land Subsidence

The NSW Scientific Committee in its Final Determination of 'Alteration of habitat following subsidence due to longwall mining – key threatening process listing' found the following characteristics of longwall mining.

"...Longwall mining involves removing a panel of coal by working a face of up to 300 m in width and up to two km long. Longwall panels are laid side by side with coal pillars, referred to as "chain pillars" separating the adjacent panels. Chain pillars generally vary in width from 20-50 m wide (Holla and Barclay 2000). The roof of the working face is temporarily held up by supports that are repositioned as the mine face advances (Karaman *et al.* 2001). The roof immediately above the coal seam then collapses into the void (also known as the goaf) and a collapse zone is formed above the extracted area. This zone is highly fractured and permeable and normally extends above the seam to a height of five times the extracted seam thickness (typical extracted seam thickness is approximately 2-3.5 m) (ACARP 2002). Above the collapse zone is a fractured zone where the permeability is increased to a lesser extent than in the collapse zone. The fractured zone extends to a height above the seam of approximately 20 times the seam thickness, though in weaker strata this can be as high as 30 times the seam thickness (ACARP 2002). Above this level, the surface strata will crack as a result of bending strains, with the cracks varying in size according to the level of strain, thickness of the overlying rock stratum and frequency of natural joints or planes of weakness in the strata (Holla and Barclay 2000)." (NSW Scientific Committee 2005).

"The principal surface impact of underground coal mining is subsidence (lowering of the surface above areas that are mined) (Booth *et al.* 1998, Holla and Barclay 2000). The total subsidence of a surface point consists of two components, active and residual. Active subsidence, which forms 90 to 95% of the total subsidence in most cases, follows the advance of the working face and usually occurs immediately. Residual subsidence is time-dependent

and is due to readjustment and compaction within the goaf (Holla and Barclay 2000). Trough-shaped subsidence profiles associated with longwall mining develop tilt between adjacent points that have subsided different amounts. Maximum ground tilts are developed above the edges of the area of extraction and may be cumulative if more than one seam is worked up to a common boundary. The surface area affected by ground movement is greater than the area worked in the seam (Bell *et al.* 2000). In the NSW Southern Coalfield, horizontal displacements can extend for more than one kilometre from mine workings (and in extreme cases in excess of three km) (ACARP 2002, 2003), although at these distances, the horizontal movements have little associated tilt or strain. Subsidence at a surface point is due not only to mining in the panel directly below the point, but also to mining in the adjacent panels. It is not uncommon for mining in each panel to take a year or so and therefore a point on the surface may continue to experience residual subsidence for several years (Holla and Barclay 2000)." (NSW Scientific Committee 2005).

"The degree of subsidence resulting from a particular mining activity depends on a number of site specific factors. Factors that affect subsidence include the design of the mine, the thickness of the coal seam being extracted, the width of the chain pillars, the ratio of the depth of overburden to the longwall panel width and the nature of the overlying strata; sandstones are known to subside less than other substrates such as shales. Subsidence is also dependent on topography, being more evident in hilly terrain than in flat or gently undulating areas (Elsworth and Liu 1995, Holla 1997, Holla and Barclay 2000, ACARP 2001). The extent and width of surface cracking over and within the vicinity of the mined goaf will also decrease with an increased depth of mining (Elsworth and Liu 1995)." (NSW Scientific Committee 2005).

"...Mining subsidence is frequently associated with cracking of valley floors and creeklines and with subsequent effects on surface and groundwater hydrology (Booth *et al.* 1998, Holla and Barclay 2000, ACARP 2001, 2002, 2003). Subsidence-induced cracks occurring beneath a stream or other surface water body may result in the loss of water to near-surface groundwater flows. If the water body is located in an area where the coal seam is less than approximately 100-120 m below the surface, longwall mining can cause the water body to lose flow permanently. If the coal seam is deeper than approximately 150 m, the water loss may be temporary unless the area is affected by severe geological disturbances such as strong faulting. In the majority of cases, surface waters lost to the sub-surface re-emerge downstream. The ability of the water body to recover is dependent on the width of the crack, the surface gradient, the substrate composition and the presence of organic matter. An already-reduced flow rate due to drought conditions or an upstream dam or weir will increase the impact of water loss through cracking. The potential for closure of surface cracks is improved at sites with a low surface gradient although even temporary cracking, leading to loss of flow, may have long-term effects on ecological function in localised areas. The steeper the gradient, the more likely that any solids transported by water flow will be moved downstream allowing the void to remain open and the potential loss of flows to the subsurface to continue. A lack of thick alluvium in the streambed may also prolong stream dewatering (by at least 13 years, in one case study in West Virginia, Gill 2000). Impacts on the flows of ephemeral creeks are likely to be greater than those on permanent creeks (Holla and Barclay 2000). Cracking and subsequent water loss can result in permanent changes to riparian community structure and composition." (NSW Scientific Committee 2005).

"Subsidence can also cause decreased stability of slopes and escarpments, contamination of groundwater by acid drainage, increased sedimentation, bank instability and loss, creation or alteration of riffle and pool sequences, changes to flood behaviour, increased rates of erosion with associated turbidity impacts, and deterioration of water quality due to a reduction in

dissolved oxygen and to increased salinity, iron oxides, manganese, and electrical conductivity (Booth *et al.* 1998, Booth and Bertsch 1999, Sidle *et al.* 2000, DLWC 2001, Gill 2000, Stout 2003). Displacement of flows may occur where water from mine workings is discharged at a point or seepage zone remote from the stream, and in some cases, into a completely different catchment. Where subsidence cracks allow surface water to mix with subsurface water, the resulting mixture may have altered chemical properties. The occurrence of iron precipitate and iron-oxidising bacteria is particularly evident in rivers where surface cracking has occurred. These bacteria commonly occur in Hawkesbury Sandstone areas, where seepage through the rock is often rich in iron compounds (Jones and Clark 1991) and are able to grow in water lacking dissolved oxygen. Where the bacteria grow as thick mats they reduce interstitial habitat, clog streams and reduce available food (DIPNR 2003). Loss of native plants and animals may occur directly via iron toxicity, or indirectly via smothering. Long-term studies in the United States indicate that reductions in diversity and abundance of aquatic invertebrates occur in streams in the vicinity of longwall mining and these effects may still be evident 12 years after mining (Stout 2003, 2004)." (NSW Scientific Committee 2005).

"The extraction of coal and the subsequent cracking of strata surrounding the goaf may liberate methane, carbon dioxide and other gases. Most of the gas is removed by the ventilation system of the mine but some gas remains within the goaf areas. Gases tend to diffuse upwards through any cracks occurring in the strata and be emitted from the surface (ACARP 2001). Gas emissions can result in localised plant death as anaerobic conditions are created within the soil (Everett *et al.* 1998)." (NSW Scientific Committee 2005).

"...Damage to some creek systems in the Hunter Valley has been associated with subsidence due to longwall mining....Damage has occurred as a result of loss of stability, with consequent release of sediment into the downstream environment, loss of stream flow, death of fringing vegetation, and release of iron rich and occasionally highly acidic leachate. In the Southern Coalfields substantial surface cracking has occurred in watercourses...The usual sequence of events has been subsidence-induced cracking within the streambed, followed by significant dewatering of permanent pools and in some cases complete absence of surface flow..." (NSW Scientific Committee 2005).

Our assessment of the potential impacts of the longwall mining at Narrabri Coal Mine on flora and fauna species are based on the predicted impacts of subsidence:

- contained within the Mine Subsidence Predictions and Impact Assessment Report prepared by Ditton Geotechnical Services Pty Ltd (2009),

The potential impacts include:

- Subsidence of up to a maximum of 2.17 m in the east and up to a maximum of 2.44 m in the west of the Mine Site,
- Surface cracks ranging in width from 20 mm (in the west) to 190 mm (in the east) will occur. Strain concentrations in near surface rock, could double the above crack widths to 40 mm and 380 mm respectively. Cracks will probably extend to depths ranging from 5 m to 15 m, and possibly deeper in near surface rock exposures and ridges (may double to between 20 and 380mm).
- Surface cracks repair works may be required, in particular along access tracks and roads and along watercourses where cracks do not infill naturally with sediment.

- At cover depths less than 215 m, creek flows (surface waters) could be re-routed to below-surface pathways and re-surface down-stream of the mining extraction limits. Groundwater dependent vegetation is likely to be affected by increases in vertical permeability and may result in the death of such vegetation.
- At cover depths greater than 215 m surface water impacts are likely to be minimal.
- Sub-surface aquifers could be affected by subsidence and cause long-term increases to vertical permeability.
- It is very unlikely that a large-scale instability or landslip would occur in the long-term due to mining effects.
- Changes in surface tilts are very unlikely to cause localized surface slope instability unless mining-induced cracking and increased erosion rates also affect them. This particularly applies to the steeply eroded banks present within the creeks, which are likely to slump or topple if cracks develop through them.
- In areas with exposed dispersive/reactive soils and slopes greater than 10 degrees, increases in tilt by 1 or 2 degrees are expected to significantly increase the rate of soil erosion.
- In areas with slopes less than 10 degrees, increases in tilt by 1 or 2 degrees are expected to cause low erosion rate increases, except for creek channels, which would be expected to re-adjust to any changes in gradient.
- Head cuts are expected to develop above chain pillars between the panels and on the side where gradients increase. Sediments would be expected to accumulate where gradients decrease.
- Upsidence is unlikely to occur due to the broad nature of the valleys across the mining lease and the lack of thick, massive beds of conglomerate and/or sandstone units along the creeks/valleys. However if upsidence does occur, it may cause some minor, localized deviation of surface flows along ephemeral creek beds into sub-surface routes above the longwall panels. Re-routed surface flows would be expected to re-surface downstream of the damaged area.
- Surface slopes in the elevated areas of the mining area range between 10 degrees and 20 degrees and are unlikely to be affected by ponding. The net fall across the area will therefore be sufficient to allow surface drainage to continue un-impeded after mining is completed. However some of the longwall panels and watercourses present within the mining area could be susceptible to potential ponding depths of between 0.5 m and 1.5 m. Ponding may extend beyond the banks of drainage lines and result in the drowning of riparian and surrounding vegetation. The actual ponding depths will depend upon several factors, such as rain duration, surface cracking and effective percolation rates of the surface soils and fractured rock bars/outcrops along the creeks.
- Subsidence may result in the breaching of farm dam walls or water losses through the floor of the dam storage area. Loss or increases in storage area may also occur due to the predicted tilting.
- Surface cracking will be rehabilitated by filling the cracks with material excavated during the construction of mine infrastructure.

In order to minimise the potential impacts of longwall mining, the Proponent would undertake the following mitigation measures:

- Surface cracks will be filled as they are identified.
  - Small cracks will be filled in by the action of wind, water and natural soil movement,
  - Large cracks will be filled in by a bulldozer or grader,
  - Wider than expected cracks or those through drainage lines will be filled with subsoil material.
- Changes to surface drainage will be monitored and any stream re-direction or modification works will be undertaken after consultation with an appropriately qualified hydrological professional and/or the DWE.
- To minimise the potential impacts of erosion and steeply eroded creek banks toppling the Proponent would:
  - Monitor surface slope displacement along subsidence cross lines
  - Infill cracks as they appear,
  - Regrade or revegetate areas significantly affected by erosion, and
  - Regularly review and appraise any significant changes to surface slopes after each longwall is extracted.
- Treed areas to be cleared will be inspected by an ecologist for roosting or nesting fauna prior to clearing, and will relocate any identified fauna.
- The location of access tracks will be influenced by an ecologist after inspecting each proposed route and determining the path with least impact on environmental values.

Prediction of impacts on biological systems is always difficult, and this is particularly true when the linkages between and within the habitats, populations, species and communities are not obvious or are poorly studied (NSW DoP 2008).

4.2.4 Discharge of Fresh "Raffinate" to the Namoi River

We understand that while some extraction of water from the Namoi River may be required in the early years of operation of the longwall mining project, for most of its period of operation the mine will have good quality treated water excess to requirements (raffinate) that the mine proposes to discharge directly to the Namoi River via a pipeline.

The water volume will peak at around year 20 with 3.4ML/day proposed for discharge and the Namoi River typically carries a flow of 100ML/day. The water quality will be in accordance with current standards and will be of lower salinity (TDS ≤ 500mg/L) than the typical levels within the Namoi River (see Surface Water Assessment report [WRM, 2009]). This discharge into the Namoi River is expected to contribute to improved health of aquatic and riparian habitats by increasing environmental flows. Some level of seasonal variation in discharge volume may be appropriate if such seasonal flow variations occur naturally in the Namoi river system.

Seasonal flow variations are known to initiate breeding in some inland fish species and may be important for other aquatic and riparian biota.

4.2.5 Proposed Biodiversity Offset Strategy

The Proponent would implement an offset strategy to compensate for the loss of woodland communities across the Mine Site. While the exact component areas and activities of the offset strategy have yet to be finalised, the Proponent is committed to implementing these within three years of commencement of the Longwall project, or prior to surface disturbing activities above longwall panel 4, whichever occurs first. This approach to establishing and implementing the offset strategy will allow the Proponent to more accurately determine the exact areas of vegetation that will be disturbed (the Proponent notes that it is likely that gas pre-drainage activities will revert to conventional in-seam underground methods once the initial longwall panels are established), as well as obtaining more detailed information on the impact of subsidence on the local landform. In the interim, the Proponent has identified two parcels of land, namely Lots 64 and 65, DP757114, in the northwestern section of the Mine Site (**Figure 10**) that are to be protected under a covenant under Section 88B of the *Conveyancing Act 1919* or similar. **Table 13** details the area of each vegetation community that would be removed for mining activities (across the entire Mine Site), the area of each community in the proposed Biodiversity Offset Area, and the resulting offset ratio.

Table 13
Areas of Disturbance, Areas of the Interim Offset and Interim Offset Ratios

Community	Area to be Disturbed (ha)	Area to be Offset (ha)	Offset Ratio
1 – Brown bloodwood / Pilliga box woodland	178.9	465.7	2.6 : 1
2 – Inland grey box woodland	24.8	78.7	3.2 : 1
3 – Riparian forest	4.1	2.9	0.7 : 1
4 – Callitris forest	2.7	0	--
5 – River red gum	0	0	--
6 – Weeping myall	0	0	--

An offset selection priority criteria was used to identify potential offset areas across the available properties (owned by the Proponent) within the Mine Site. The proposed interim offset strategy (referred to hereafter as the proposed Biodiversity Offset Area) would see both community 1 and community 2 conserved at an offset ratio greater than 2.5:1. Community 3 (riparian forest) would be conserved at an offset ratio of 0.7:1 However the area of riparian forest within the proposed Biodiversity Offset Area is likely to increase due to the encouragement of natural regeneration within the area. Additionally areas of riparian forest have been fenced and are managed for conservation as part of the Narrabri Coal Mine Stage 1. None of the identified Weeping Myall EEC is included in the proposed offset area as the extremely small areas of this community within the Mine Site (0.3ha) and Pipeline Corridor should not be impacted by mining or pipeline construction activities.


Figure 10, Proposed Offset Strategy
Flora and Fauna Impact Assessment
Proposed Narrabri Longwall Coal Mine
Stage Two
August 2009
Ecotone Ecological Consultants Pty Ltd
BIODIVERSITY OFFSET AREA
SCALE 1:20 000
N

4.2.5.1 Offset Selection Priority Criteria

The selection priority criteria used to identify the potential biodiversity offset areas within the Mine Site is detailed below. Each priority criteria is followed by a brief discussion on the applicability of the proposed Biodiversity Offset Area to the priority criteria.

Priority 1. Areas should be selected on a like-for-like basis.

a. Areas should be selected that contain the same vegetation communities as those areas to be impacted;
b. Areas should be selected that contain, as much as possible, the same fauna species that are present in the areas are to be impacted.

The proposed Biodiversity Offset Area is comprised of the three largest woodland vegetation communities distributed across the Mine Site (Communities 1 to 3). Only the two smallest woodland vegetation communities are not included in the proposed Biodiversity Offset Area (Community 4 – 20ha, Weeping Myall community – 0.3ha). As the proposed Biodiversity Offset Area also physically comprises the vegetation communities of the Mine Site, the proposed offset area contains the same fauna species as the areas to be impacted.

Priority 2. Areas should be selected that contain known locations of threatened species, populations and/or ecological communities;

a. Where possible an appropriate radius (generally 100m or more) around each known location of a threatened species should be included in the Biodiversity Offset Area.
b. Where possible the entire area of a threatened population or ecological community should be included in the offset area.

The proposed Biodiversity Offset Area contains known records of 10 of the 16 threatened fauna species recorded across the Mine Site (see **Figure 9**). All 16 threatened fauna species were recorded in one or more of the three vegetation communities in the proposed Biodiversity Offset Area. The proposed offset area includes communities containing two to the three EECs identified on the Mine Site and offsets both communities containing the EECs at ratios greater than 2.5:1 (**Table 13**). The 0.3ha area of Weeping Myall EEC in the mine site and the small patches in the Pipeline Corridor would not be impacted by mining or pipeline construction activities.

Priority 3. Areas should be selected to protect threatened species, populations or ecological communities that may be impacted by the proposal.

See Priority 2 above.

Priority 4. Areas should be selected that minimize the level of landscape fragmentation of the vegetation community.

a. Areas within large existing patches should be selected over isolated small patches.

The proposed Biodiversity Offset Area is part of a well connected area of woodland forming part of the regional Pilliga forest area. The proposed Biodiversity Offset Area is connected to Jack's Creek State Forest to the west and Pilliga East State Forest to the south.

Priority 5. Areas should be selected that minimize the level of landscape isolation of the vegetation community.

a. Areas within existing patches or nearby existing patches should be selected in preference to patches distant from other patches.

The proposed Biodiversity Offset Area is part of a well connected area of woodland forming part of the regional Pilliga forest area. The proposed Biodiversity Offset Area is connected to Jack's Creek State Forest to the west and Pilliga East State Forest to the south.

Priority 6. Areas should be selected that minimize edge effects:

a. Areas within existing patches should be selected in preference to entire patches with edges;
b. Patches with high area to circumference ratios (circular or block shaped patches) should be selected over patches with low area to circumference ratios (thin linear patches).

The proposed Biodiversity Offset Area is part of a well connected area of woodland forming part of the regional Pilliga forest area. The proposed Biodiversity Offset Area is contiguous with neighbouring habitat on all sides except to the east where it is bordered by agricultural grazing land. The establishment of a conservation agreement across the proposed Biodiversity Offset Area would minimise or eliminate future possible increases in edge of the woodland areas. The encouragement of natural regeneration across the proposed offset area, principally through the removal of stock and associated grazing pressure, would likely result in an increased woodland area and a reduction of edge effects over time.

Priority 7. Areas of high diversity (flora and/or fauna) should be selected over less diverse areas.

a. Riparian vegetation should be selected in preference to mid slope or ridge line vegetation to conserve a likely higher diversity of fauna species.

The three vegetation communities included in the proposed Biodiversity Offset Area are the three most species diverse communities recorded across the Mine Site. All three vegetation communities (Communities 1 to 3) contained diverse canopy, mid-storey and ground cover flora species which supported a diverse range of fauna species. The vegetation communities not included in the proposed offset strategy (Callitris Forest and Weeping Myall) were dominated by monoculture canopies, a lack of understorey species and a low diversity of ground cover species.

Priority 8. Areas should be selected that are the least disturbed of the available areas.

The proposed Biodiversity Offset Area is dominated by a large area of woodland with little disturbance. With the exceptions of edge effects and very few vehicle tracks, the woodland area within the proposed offset area is predominately undisturbed.

4.2.5.2 DECC Principles for the use of Biodiversity Offsets in NSW

The DECC has developed a set of 13 principles for the use of biodiversity offsets in NSW (http://www.environment.nsw.gov.au/biocertification/offsets.htm). Of the 13 principles, seven are relevant to the ecological assessment of proposed offset areas, and each is discussed below. The remaining principals have been addressed in the relevant sections of the *Environmental Assessment* .

Principle 3: Offsets must never reward ongoing poor performance

During site visits the proponent appeared to be managing the potential areas of impact and biodiversity offset for conservation (woodland areas to the west) or grazing at low stocking rates (scattered woodland and open pasture paddocks in the eastern two thirds of the Mine Site). Both management strategies represent appropriate environmental management of the proponents land within the Mine Site.

Principle 4: Offsets will complement other government programs

The establishment of the Biodiversity Offset Area will increase the total area of conservation lands within the region and complement other nearby conservation areas such as Mount Kaputar National Park (to the north-east) and Pilliga Nature Reserve (to the south-west).

Principle 5: Offsets must be underpinned by sound ecological principles

The proposed biodiversity offset strategy comprises the conservation of existing habitat and the promotion of natural regeneration. It is a commonly understood ecological principle that the conservation of existing habitats is preferred to the reconstruction of habitat in disturbed areas. The proposed Biodiversity Offset Area was selected based on numerous sound ecological principals identified above in the offset selection priority criteria (**Section 4.2.3.1**). They comprise:

- Offsetting like-for-like areas, including areas of known threatened species, population and ecological community habitat areas;
- Conserving areas of high landscape value;
- Conserving areas with low disturbance levels; and
- Conserving areas of high flora and fauna diversity.

Principle 6: Offsets Should Aim to Produce a Net Improvement in Biodiversity Over Time

The proposed offset strategy would be likely to result in a net improvement in biodiversity over time through the removal of threats to the vegetation communities and the encouragement of natural regeneration. The creation of a conservation agreement on the proposed Biodiversity Offset Area would protect it from future possible grazing, tree harvesting, firewood collection, track creation and other possible detrimental land management actions. The removal of such threats, combined with management to encourage natural regeneration, would be likely to result in an increase in the area of Communities 1 to 3 over time and, as a result a net improvement in biodiversity.

Principle 9: Offsets Should be Quantifiable – The Impacts and Benefits Must be Readily Estimated

The proposed Biodiversity Offset Area is directly comparable in structure, species diversity and abundance to the areas of potential impact. Additionally both areas occur within the Mine Site and the proposed Biodiversity Offset Area includes some of the areas of impact. Vegetation communities within the proposed offset area are the same as those within the areas that would be impacted. As the impact areas and proposed Biodiversity Offset Area are identical in structure, species diversity and abundance, the proposed offsets are quantifiable by the direct comparison of unit areas (see **Table 13** above). **Section 4.2.3** above identifies that the proposed offset area will conserve the two largest vegetation communities within the Mine Site at offsetting ratios of greater than 2.5:1.

Principle 10: Offsets must be targeted

See the biodiversity offset selection priority criteria above (**Section 4.2.3.1**).

Principle 11: Offsets Must be Located Appropriately

The proposed Biodiversity Offset Area is directly comparable to the areas of impact as both areas occur within the Mine Site. Vegetation communities within the proposed offset area are the same communities as those within the impacted areas of the Mine Site. In addition, the proposed offset areas have the same ecological characteristics as the areas to be impacted. Further, within the landscape the proposed Biodiversity Offset Area is positioned ideally as part of a well connected area of woodland forming part of the regional Pilliga forest area (connected to Jack's Creek State Forest to the west and Pilliga East State Forest to the south).

4.3 NSW State Legislative Requirements

4.3.1 Part 3A of the Environmental Planning & Assessment Act 1979 (EP&A Act)

This proposal will be assessed under Part 3A of the Environmental Planning & Assessment Act 1979. Part 3A was introduced by the NSW government in July, 2005. This allows the Minister for Planning to call in 'major projects' or anything deemed as 'critical infrastructure'. A new *State Environmental Planning Policy (Major Projects) 2005* defines what projects are subject to Part 3A and require ministerial approval. The proposed Narrabri Coal Mine Stage Two Longwall Project has been declared by the government as 'critical infrastructure'. Such a declaration can only be made where the Minister is of the opinion the project is 'essential to the State for economic, environmental or social reasons'.

Under Part 3A, The Department of Planning prepares the matters that the Proponent must address in the environmental assessment for the Proposal, known as the Director-General's requirements (DGR's) for environmental assessment. The requirements are developed in consultation with State agencies such as the Department of Environment and Climate Change (DECC) and other relevant authorities including local councils. Under Part 3A, the Proponent is required to prepare an Environmental Assessment, including a statement of commitments, to

demonstrate how the project's likely environmental impacts will be minimised or managed. If the project is approved, the Proponent will be required to honour these commitments as part of the conditions of approval. Following preparation of the impact assessment, the Director-General prepares a statement to the Minister as to whether the assessment is considered to have met the DGR's. The Minister must take this statement into account when deciding whether to approve the proposed development, but is not obliged to be bound by it.

The consulted government agency input to the DGR's that is relevant to flora and fauna is as follows.

DECC input to the DGR's.

- The EA must follow the 'draft guidelines for threatened species assessment"
- A field survey of the site should be conducted and documented in accordance with those guidelines
- Likely impact on threatened species and their habitat need to be assessed, evaluated and reposted on. The assessment should specifically report on the considerations listed in Step 3 of the draft guideline.
- The EA must describe the actions that will be taken to avoid or mitigate impacts or compensate to prevent unavoidable impacts of the project on threatened species and their habitat. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.
- Step 4 of the draft guidelines requires that where measures to avoid or mitigate are not possible, offset strategies need to be considered.
- The EA needs to clearly state whether it meets each of the key thresholds set out in Step 5 of the draft guideline.
- The EA must consider the corridor values or connective importance of any vegetation on the subject land. The DECC prefers that vegetation on adjoining land that exhibits these corridor vales should be retained and, where necessary, rehabilitated.
- The EA needs to address the potential impact on native vegetation, specifically:
  - The hectares of native vegetation that will have to be cleared to accommodate the proposed surface infrastructure,
  - The floristics of the botanical communities of native vegetation that will need to be cleared,
  - The extent of native vegetation on the site which may be remnant vegetation, protection re-growth or non-protected regrowth as defined by the Native Vegetation Act 2003,
  - The requirement to develop suitable offset(s) to improve or maintain environmental outcomes for the lawful clearing of native vegetation, in relation to four environmental values: water quality, soils, salinity and biodiversity (including threatened species).

DPI input to the DGR's.

- Baseline studies for the project proposal should include ecological (terrestrial and aquatic flora and fauna) – both for the mine footprint and surrounding areas to identify opportunities for biodiversity offsets.
- The Narrabri Coal Mine Stage 2 proposal does contain some Key Fish Habitats (3rd order streams or higher – Strahler stream order system) and so the proposal may potentially have adverse impacts on aquatic habitats and threatened species, populations or ecological communities listed under the Fisheries Management Act 1994. The EA needs to address the impacts of surface water, groundwater and aquatic ecosystems such as the impacts on fish and fish habitat.
- The EA should include
  - A general description of any aquatic habitat
    - Description and maps of aquatic habitat areas (creeks, wetlands, and floodplains) within the study area.
    - Hydrological information of watercourses such as bed substrate and flow duration.
    - Discuss the potential impact the proposal may have on aquatic habitat. Predicted subsidence ranging from 1.6 to 2.4 metres will cause changes in flow patterns which may result in the death of aquatic and riparian vegetation that relies on surface water/shallow ground water flows and may result in the isolation of aquatic habitats and impact on the migratory nature of most aquatic species which rely on connectivity within streams/watercourses to complete their lifecycles.
    - Aspects of the management of the proposal which relate to impact minimisation e.g. Environmental Management Plans.
  - Details of any potential blockages to fish passage
    - Information regarding potential blockages to fish passage as a result of creek subsidence
    - Information regarding potential blockages to fish passage as a result of transport routes (causeways, culverts, etc) and potential alteration to natural bed levels or works in a stream that change flow or morphological characteristics.
    - Culvert or causeway construction associated with access roads within drainage lines should be in accordance with DPI's Policy and Guideline document: *Why do Fish need to Cross the Road? Fish Passage Requirements for Waterway Crossings*.
  - An assessment of the extent of any dredging or reclamation activities within 'water land'. This assessment should include any need for stream or creek realignment or placement of overburden on 'water land' or construction of roads/access routes though watercourses.

- Sedimentation and erosion into the nearby waterways as a result of mining operations may result in direct and indirect impacts on fish habitat. DPI expect Best Management Practice with regards to controlling erosion and sedimentation.
- If the proposal includes likely disturbance to fish habitat, the EA should include a threatened aquatic species assessment (as per Part 5C, EP&A Act 1979) to address whether there are likely to be any significant impacts on listed threatened species on the DPE- Fisheries website. This should include initial 'Seven-part Tests' and consultation with DPI.
- DPI has guidelines for compensatory habitat outlined in the document Policy and Guidelines Aquatic Habitat Management and Fish Conservation 1999. Compensatory habitats may be a requirement if the environmental assessment indicates there may be a loss of aquatic or riparian habitats, and may need to be included in site rehabilitation plans or compensatory aquatic habitat offsets elsewhere in the catchment on other aquatic rehabilitation projects.

Namoi CMA input to the DGR's.

- The EA should address the potential impacts on both flora and fauna biodiversity especially with regard to loss of biodiversity due to surface slumping and cracking. The EA needs to identify any significant natural features including threatened species.
- The EA should address the potential impacts on terrestrial and aquatic biodiversity and any nature features that could result from subsidence within all creeks and drainage lines. There is the potential to create pools and riffles along with deep tension cracks in the ephemeral streams which has the potential to change aquatic habitats.
- The EA needs to consider the impacts of clearing, maintaining access, installation of infrastructure and rehabilitation on any natural feature and biodiversity when the lines of boreholes are installed. These activities may have impacts including fragmentation of vegetation communities, destruction of habitat, loss of corridors, ease of predation and weed introduction.
- The EA needs to consider the siting of boreholes in relation to riparian areas. Riparian areas should be avoided when locating boreholes, clearing and maintaining access.

Narrabri Council input to the DGR's.

- No requirements specifically related to flora and fauna.

The steps to follow in the assessment process for a Part 3A assessment as recommended in the *Draft Guidelines for Threatened Species Assessment* (DECC 2004) are listed below, with each step addressed in relation to the proposed development.

Step 1. Preliminary Assessment

The main purpose of the preliminary assessment is to determine the likelihood of the study area and Mine Site supporting threatened species.

This has been addressed by **Section 2** and **Section 4.1** of this report, in which the likelihood of threatened species, endangered populations or threatened ecological communities occurring within the study area has been assessed on the basis of the nature and quality of habitats available and the presence of previous records in the study locality

Step 2. Field Survey and Assessment

Field surveys should be conducted by suitably qualified and experienced investigators using currently accepted survey methodologies.

The methodology and results of the field surveys have been fully documented in **Section 3** of this report.

Step 3. Evaluation of Impacts

An assessment of the impact on the EECs and any threatened flora or fauna species that actually or could potentially occur within the study area is presented in **Section 4.3.1.1**. This section addresses the nominated heads of consideration provided in *Appendix 3* of the *Draft Guidelines for Threatened Species Assessment* under Part 3A of the *Environmental Planning and Assessment Act 1979* (DEC, 2004). It should be noted that at this stage this checklist is part of a draft document, hereafter referred to as the Part 3A Guidelines, which is yet to be finalised. Therefore, the questions currently have no legal standing and are used here for guidance only.

4.3.1.1 Assessment of Impact on Threatened Flora Species and EECs

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

No threatened flora species or endangered populations were recorded within the study area during the field survey. However, one threatened flora species, *Bertya opponens* (Coolabah bertya) has previously been recorded either just within or just outside the Mine Site near its western boundary. Two additional threatened flora species, *Cadellia pentastylis* (ooline) and *Lepidium ascheronii* (spiny peppercress) also could not be ruled out as potentially occurring due to the large size of the study area. Potential affects on the lifecycles of these species is discussed below:

- ***Bertya opponens* (=*Bertya* sp. A Cobar-Coolabah) (Coolabah bertya)** if it occurs in the Mine Site it is unlikely to be present at high density, and would represent the outer fringe of the substantial known population in Jacks Creek State Forest, estimated to be in excess of 5 million plants (NPWS 2002). Given the known presence of this nearby extensive source of propagules, the lifecycle of the locally occurring population of Coolabah bertya is unlikely to be significantly affected, even if individual plants happen to be removed or disturbed within the Mine Site due to the proposal.

- ***Cadellia pentastylis* (ooline)** if it occurs in the Mine Site would be more likely to be present in the flat plains area of the eastern part of the Mine Site. Not all of its potential habitat area would occur in the potential disturbance area. Given its generally wide distribution both regionally and in the state, it is unlikely that any removal of or disturbance individuals of the species within the Mine Site would affect the lifecycle of the species on a regional basis.
- ***Lepidium aschersonii* (spiny peppercress)** as for *Cadellia pentastylis*.

No threatened populations of flora occur in the study area.

b) How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Threatened flora species

- ***Bertya opponens:*** Potential habitat occurs within the pilliga community (Vegetation Community 1) at the western end of the Mine Site. A significant occupied area of habitat occurs to the west in Jacks Creek State Forest, where a large population is known to occur (NPWS 2002). Potential habitat within the Mine Site would be affected by the subsidence associated with the longwall mining and the associated changes in hydrology and drainage. In a worst case scenario, this could indirectly result in the deaths of individual plants, if present. Direct impacts to plants could also occur due to clearing for the power transmission easement and creation of tracks, goaf holes and ventilation shafts, if any happen to occur in these areas.
- ***Cadellia pentastylis:*** Part of the potential habitat that occurs in the flat plains area of the eastern part of the Mine Site could be affected as for *Bertya opponens* above, but a large area of potential habitat would remain unaffected in the flat plains area.
- ***Lepidium aschersonii: as*** for *Cadellia* pentastylis.

Threatened Ecological Communities

- ***Inland Grey Box Woodland:*** Patches of known occupied habitat occur on the flat plains area in the eastern part of the site. An area of 24.8ha of this habitat would be removed for mine infrastructure, access paths. Parts of this habitat in the western part of the plains area could be affected by subsidence and the associated changes in hydrology and drainage. In a worst case scenario, this could indirectly result in the deaths of individual plants that make up the community.
- ***Brigalow:*** Patches of marginal occupied habitat occur in the undulating pilliga community in the western part of the site. This area could be affected by subsidence and the associated changes in hydrology and drainage. In a worst case scenario, this could indirectly result in the deaths of individual plants that make up the community. An area of 178.9 ha of Pilliga community would be removed for mine infrastructure and access paths. Areas of brigalow within the Pilliga community may be cleared as part of the 178.9 ha.

- ***Myall Woodland:*** At least one small disturbed remnant of the community occurs by a dirt road in the south-eastern part of the subject site. This does not occur in the proposed mining area, but its habitat could be affected if road works involving widening or other disturbances in this area are proposed. The two small patches of the EEC by the road to the Namoi River appear to be sufficiently distant from the edge of the road to be unaffected by construction of the pipeline.

No threatened populations of flora occur in the study area.

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

On the basis of records from BioNet, the following subject flora species if they occurred in the Mine Site would be at the limit of their currently known distribution.

- ***Bertya opponens*** being a species highly restricted in known distribution would be at both the southern and northern limits of its overall known distribution, and at the eastern limit of the Jack's Creek State Forest sub-population in the Mine Site.
- ***Cadellia pentastylis*** would be at the western limit of its known distribution in the Mine Site.
- ***Lepidium aschersonii*** would be at the eastern limit of its known distribution in the Mine Site.

Any populations of these species within the Mine Site are likely to be affected to some degree as discussed in (a) and (b) above. No threatened flora populations would be affected.

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

Current disturbance regimes within the study area include:

- Stock grazing,
- Fire,
- Weed invasion, and
- Human presence.

The level of stock grazing is not expected to change significantly during the life of the proposed long-wall mine. Temporary grazing relief may occur during the timing of the goaf collapse and for a short period afterwards until surface cracks are repaired or deemed safe for livestock. The prevalence of fire is also unlikely to change significantly during the life of the proposed Longwall Project, however the increased movements of people and vehicles across the Mine Site may see a rise in the number of accidental fires.

The area and level of weed invasion may also increase due to the increased number of people and vehicle movements across the Mine Site. The increased level of human activity across the Mine Site will see a resulting increased level of wildlife disturbance.

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

A 30m wide power line easement and access track traversing the Mine Site in an east-west direction will split the western woodland area in half and may fragment habitat for potential threatened flora species and the marginal occurrence of the brigalow EEC. Minor fragmentation of the Inland Grey Box Woodland EEC and riparian habitat (Vegetation Community 3) would also occur further to the east. Further minor fragmentation will occur during the construction of the goaf boreholes at 200m intervals along the longwalls. Each series of goaf boreholes will require an access track for construction and maintenance running in a north-south direction. These tracks are expected to be minor tracks (removal of some trees and shrubs, and the ground cover driven over) and in woodland areas where the tracks pass around large trees, are not expected to result in significant fragmentation of habitat.

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

No areas of critical habitat proclaimed under the TSC Act to date occur in the vicinity of the study area. Critical habitat will not be affected by the proposal.

Conclusion to Part 3A Assessment for Threatened Flora and EECs

The proposal may directly or indirectly impact on one or more threatened flora species with potential to occur, but if they do occur the impacts would be minimal given the known distributions and abundances of the species elsewhere. The proposal would also have minor direct or indirect temporary impacts on the *Inland Grey Box Woodland*, *Brigalow* and *Weeping Myall* EECs due to subsidence and consequent hydrological changes; and direct clearing for easements, goaf holes, ventilation shafts and access tracks and invasions of weeds. Adequate implementation of the recommendations (section 5.0) would successfully mitigate the expected impacts.

4.3.1.2 Assessment of Impact on Threatened Fauna

This assessment addresses the potential effects of the Longwall Project on threatened fauna species or their habitats in accordance with nominated headings for consideration provided in *Appendix 3* of the Part 3A Guidelines. Threatened fauna species known or with potential to occur within the study area are listed below.

Threatened fauna recorded within the Mine Site:

- Pale-headed snake (*Hoplocephalus bitorquatus*),
- Glossy black-cockatoo (*Calyptorhynchus lathami*),
- Turquoise parrot (*Neophema pulchella*),
- Superb parrot (*Polytelis swainsonii*),
- Speckled warbler (*Pyrrholaemus sagittatus*),
- Grey-crowned babbler (*Pomatostomus temporalis temporalis*),
- Varied sittella (*Daphoenositta chrysoptera*),

- Diamond firetail (*Stagonopleura guttata*),
- Koala (*Phascolarctos cinereus*),
- Eastern pygmy-possum (*Cercartetus nanus*),
- Black-striped wallaby (*Macropus dorsalis*),
- Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*),
- Eastern long-eared bat (*Nytophilus timoriensis*),
- Little pied bat (*Chalinolobus picatus*), and
- Delicate mouse (*Pseudomys delicatulus*).

Threatened Fauna considered likely to occur within the Mine Site:

- Squirrel glider (*Petaurus norfolcensis*); and
- Spotted-tailed quoll (*Dasyurus maculates*).

Threatened Fauna that may occur within the Mine Site:

- Australian brush-turkey (*Alectura lathami*);
- Magpie goose (*Anseranas semipalmata*);
- Black-necked stork (*Ephippiorhynchus asiaticus*);
- Black-breasted buzzard (*Hamirostra melanosternon*);
- Little eagle (*Hieraaetus morphnoides);*
- Barking owl (*Ninox connivens*);
- Masked owl (*Tyto novaehollandiae*);
- Hooded robin (*Melanodryas cucullata cucullata*);
- Black-chinned honeyeater (*Melithreptus gularis gularis*);
- Swift parrot (*Lathamus discolour*);
- Regent honeyeater (*Xanthomyza phrygia*);
- Little lorikeet (*Glossopsitta pusilla*); and
- Large-eared pied bat (*Chalinolobus dwyeri*).

For the purposes of this report, where appropriate the subject species have been grouped according to similar behavioural characteristics or habitat requirements and assessed below using the nominated headings for consideration provided in *Appendix 3* of the Part 3A Guidelines.

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

Australian brush-turkey (*Alectura lathami*) – endangered population under the NSW TSC Act.

The Australia brush-turkey was not recorded during field surveys, however suitable habitat is present and the species may occur.

The Australian brush-turkey was not recorded on the Mine Site during field surveys for this report. However 10 records for the species occur within a 10 kilometre radius of the site. Due to the failure to find the distinctive mounds this species builds for egg incubation it is unlikely that resident birds occur on the Mine Site. However the site was too large to search all areas. A known population of the Australian brush-turkey occurs to the north-east, approximately 25 kilometres from the Mine Site.

If the Australian brush-turkey occurs on the site the lifecycle of the species may be affected by the proposed longwall mining. Cracking resulting from subsidence may damage the species nest mounds and reduce the reproductive output of some pairs and reduce the overall reproductive output of any local population.

Magpie goose (*Anseranas semipalmata*) (TSC Act – Vulnerable species).
Black-necked stork (*Ephippiorhynchus asiaticus*) (TSC Act – Endangered species).

The magpie goose was not recorded during field surveys, however suitable habitat is present and the species may occur.

The magpie goose and Black-necked stork may on rare occasions utilise farm dam and nearby grassland habitats within the Mine Site. While surface cracking following subsidence may drain farm dams and reduce the available habitat for the magpie goose and black-necked stork, the highly mobile nature of the two species and the likely infrequency of visits to the Mine Site suggest that the life cycles of the magpie goose and black-necked stork are unlikely to be significantly affected by the proposed longwall mine.

Black-breasted buzzard (*Hamirostra melanosternon*) (TSC Act – Vulnerable species).
Little eagle (*Hieraaetus morphnoides*) (TSC Act – Vulnerable species preliminary listing).

The black-breasted buzzard and little eagle were not recorded during field surveys, however suitable habitat is present and both species may occur.

The black-breasted buzzard may utilise habitat areas across the Mine Site on an occasional or rare basis. As there is no suitable breeding habitat for the species (timbered water courses) and the species is only likely to visit the Mine Site on an occasional or rare basis, it is unlikely that the proposed longwall mine would significantly affect the life cycle of the black-breasted buzzard.

The little eagle may utilise habitat areas across the Mine Site on an occasional or rare basis. As all trees to be removed will be inspected for fauna prior to felling and no tree-fall is expected during subsidence the proposed longwall mine is unlikely to significantly affect the life cycle of the little eagle.

Hollow dependent woodland bird species:

- **Glossy black-cockatoo (*Calyptorhynchus lathami*)** (TSC Act – Vulnerable species)
- **Little lorikeet (*Glossopsitta pusilla*)** (TSC Act – Vulnerable species preliminary listing)
- **Turquoise parrot (*Neophema pulchella*)** (TSC Act – Vulnerable species)
- **Swift parrot (*Lathamus discolor*)** (TSC and EPBC Acts – Endangered species)
- **Superb parrot (*Polytelis swainsonii*)** (TSC and EPBC Acts – Vulnerable species)
- **Masked owl (*Tyto novaehollandiae*)** (TSC Act – Vulnerable species)
- **Barking owl (*Ninox connivens*)** (TSC Act – Vulnerable species)

The glossy-black cockatoo and superb parrot were recorded during field surveys. The little lorikeet, turquoise parrot, swift parrot, masked owl and barking owl were not recorded during field surveys, however suitable habitat is present for each species.

The above seven woodland bird species require tree hollows for breeding and either woodland areas or woodland/grassland ecotone areas for foraging. Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf boreholes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. All clearing activities will be undertaken according to a tree clearing protocol to avoid breeding periods and the felling of trees while birds may remain in hollows. The loss of potential foraging and nesting trees during clearing activities is unlikely to affect the lifecycle of the above hollow dependent bird species due to the small area of vegetation to be removed relative to the remaining woodland. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur. The life cycles of hollow dependent woodland bird species are unlikely to be significantly affected by the proposed longwall mine.

Non-hollow dependent woodland bird species:

- **Speckled warbler (*Pyrrholaemus sagittatus*)** (TSC Act – Vulnerable species)
- **Black-chinned honeyeater (*Melithreptus gularis gularis*)** (TSC Act – Vulnerable species)
- **Regent honeyeater (*Xanthomyza phrygia*)** (TSC and EPBC Acts – Endangered species; EPBC Act – Migratory species)
- **Hooded robin (*Melanodryas cucullata cucullata*)** (TSC Act – Vulnerable species)
- **Grey-crowned babbler (*Pomatostomus temporalis temporalis*)** (TSC Act – Vulnerable species)
- **Varied sittella *(Daphoenositta chrysoptera)*** (TSC Act – Vulnerable species preliminary listing)
- **Diamond firetail (*Stagonopleura guttata*)** (TSC Act – Vulnerable species)

The speckled warbler, grey-crowned babbler, varied sitella and diamond firetail were recorded during field surveys. The black-chinned honeyeater, regent honeyeater and hooded robin were not recorded during field surveys, however suitable habitat is present for each species.

The above seven bird species forage and nest in woodland areas. The black-chinned honeyeater and regent honeyeater feed on blossom and canopy invertebrates, and the speckled warbler, hooded robin, grey-crowned babbler and diamond firetail require woodland trees for shelter while foraging on the ground or from perches. The varied sitella forages on the branches and trunks of trees. All seven species build nests in woodland trees.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Where identifiable nests (such as grey-crowned babbler nests) occur within an area to be cleared the implementation of a tree clearing protocol will minimise or eliminate the chance of injury to individuals. Clearing will be required to provide access tracks to goaf boreholes, however hollow-bearing and nest-bearing habitat trees will be avoided during the positioning of goaf access tracks. The loss of potential foraging and nesting trees during clearing activities is unlikely to affect the lifecycle of the above woodland bird species due to the small area of vegetation to be removed relative to the remaining woodland. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur. The life cycles of non-hollow dependent woodland bird species are unlikely to be significantly affected by the proposed longwall mine.

Spotted-tailed quoll (*Dasyurus maculates*) (TSC Act – Vulnerable species)

The spotted-tailed quoll was not recorded during field surveys, however suitable habitat is present and the species may occur.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf boreholes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. The loss of some woodland areas during clearing activities is unlikely to affect the lifecycle of the spotted-tailed quoll or its prey species due to the small area of vegetation to be removed relative to the remaining woodland.

Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur. While the spotted-tailed quoll consumes a wide variety of prey species, some prey species such as small ground dwelling species such as rats and mice may be affected by surface cracking during subsidence. Surface cracks may result in the death or injury of individuals which fall into cracks. However due to the wide range of prey species selected it is unlikely that the life-cycle of the spotted-tailed quoll would be significantly affected by a possible reduction in the density of ground small mammal species.

Koala (*Phascolarctos cinereus*) (TSC Act – Vulnerable species)

The koala was recorded from a single scat sample during field surveys.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). All clearing

activities will be undertaken according to a tree clearing protocol requiring the inspection of all tree canopies for koalas (and other species) prior to felling. The loss of some woodland areas during clearing is unlikely to affect the lifecycle of the koala due to the small total area of vegetation to be removed relative to the remaining woodland and the scattered pattern of the areas to be cleared (only a small portion of any single koala home range is likely to be removed). Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur. The life-cycle of the koala is unlikely to be affected by the proposed longwall mine.

Eastern pygmy-possum (*Cercartetus nanus*) (TSC Act – Endangered species)

The eastern pygmy-possum was recorded on two occasions during field surveys.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf boreholes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. All clearing activities will be undertaken according to a tree clearing protocol to minimise harm to native species. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur.

The loss of some woodland areas during tree clearing may affect the lifecycle of the eastern pygmy-possum. Due to their small size individual pygmy possums may not be detected during felling and individuals may perish or become injured during the clearing process. Additionally some entire pygmy possum home range areas may be lost during clearing, particularly along the east-west power-line easement. Average eastern pygmy-possum home ranges for adult males and females are 0.68 ha and 0.35 ha respectively (DEC threatened species website). Additionally the clearing of the east-west power-line easement may fragment parts of the existing population if individuals are unable or unwilling to cross the cleared power-line easement.

The life-cycle of the eastern pygmy possum may be affected by surface cracking during subsidence. Surface cracks may result in the death or injury of individuals which fall into cracks while moving between trees. The extent or likelihood of individual pygmy-possums falling into surface cracks is unknown, however eastern-pygmy possums are known to fall into 300 mm wide holes in the ground along pitfall trap lines and the possibility of individuals perishing in surface cracks cannot be eliminated. Due to the large area across which surface cracking is predicted to occur the life-cycle of the eastern pygmy-possum may be negatively affected through the loss of breeding individuals.

However due to the large area of similar woodland to the west and south it is likely that the population of eastern pygmy possums extends beyond the boundaries of the Mine Site and that the possible loss of some individuals and potential fragmentation of part of the population are unlikely to significantly impact on the life cycle of the species. Additionally an undertaking by the Proponent to monitor for and fill-in surface cracks as they appear should minimise potential harm to the eastern pygmy possum. As the majority of surface cracking is expected to occur shortly after longwall collapse (within a week) the Proponent should be able to rapidly detect and begin repairs to surface cracks. The staging of longwall collapses, approximately 12 months apart should also minimise the level of impact on the eastern pygmy possum.

Overall, if mitigation measures are undertaken as planned, the proposed longwall mine is unlikely to significantly impact on the life cycle of the eastern pygmy possum.

Squirrel glider (*Petaurus norfolcensis*) – (Vulnerable – TSC Act)

The squirrel glider was not recorded during field surveys, however suitable habitat is present and the species may occur.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf boreholes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. All clearing activities will be undertaken according to a tree clearing protocol to avoid the felling of trees while gliders could remain within hollows. The loss of potential foraging and nesting trees during clearing activities is unlikely to affect the lifecycle of the squirrel glider due to the small area of vegetation to be removed relative to the remaining woodland. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur. The life cycle of the squirrel glider is unlikely to be affected by the proposed longwall mine.

Black-striped wallaby (*Macropus dorsalis*) (TSC Act – Endangered species)

The black-striped wallaby was recorded from a single hair tube sample during field surveys.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf boreholes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. The loss of some woodland areas during clearing is unlikely to affect the lifecycle of the black-striped wallaby due to the small total area of vegetation to be removed relative to the remaining woodland and the scattered pattern of the areas to be cleared. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur.

Black-striped wallabies may be affected by surface cracking during subsidence. Surface cracks may result in the death or injury of individuals which trip on cracks while hopping through areas of surface cracking. The likelihood of black-striped wallabies tripping on surface cracks is unknown but is expected to be minimal. An undertaking by the Proponent to monitor for and fill-in surface cracks as they appear should minimise potential harm to the black-striped wallaby. The life-cycle of the black-striped wallaby is unlikely to be significantly affected by the proposed longwall mine.

Hollow roosting bat species:

- **Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)** (Vulnerable – TSC Act)
- **Eastern long-eared bat (*Nytophilus timoriensis*)** (TSC and EPBC Acts – Vulnerable species)
- **Little pied bat (*Chalinolobus picatus*)** (TSC Act – vulnerable species)

The yellow-bellied sheathtail-bat, little pied bat and eastern long-eared bat were recorded during field surveys.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf boreholes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. All clearing activities will be undertaken according to a tree clearing protocol to avoid breeding periods and the felling of trees while bats may remain in hollows.

The loss of potential roosting and breeding trees and a reduction in potential foraging area following clearing activities is unlikely to affect the lifecycle of hollow roosting bat species due to the small area of vegetation to be removed relative to the remaining woodland. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur. The life cycles of hollow roosting bat species are unlikely to be affected by the proposed longwall mine.

Cave roosting bat species:

- **Large-eared pied bat (*Chalinolobus dwyeri*)** (TSC and EPBC Acts – Vulnerable species)
- **Little pied bat (*Chalinolobus picatus*)** (TSC Act – vulnerable species)

The large-eared pied bat was not recorded during field surveys, however suitable habitat is present and the species may occur. The little pied bat was recorded during field surveys and may roost in caves, mines or tree hollows, and is thus again assessed here.

No caves or mine shafts for roosting were identified on the site during field surveys and it is unlikely that any occur in areas not covered during the survey. Across the Mine Site 210.5 ha of woodland (foraging area) is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf bore holes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur. The reduction in potential foraging area resulting from the clearing of vegetation for mine infrastructure is unlikely to affect the life cycle of cave roosting bat species due to the small areas of woodland habitat to be removed relative to the remaining area of suitable habitat.

Delicate mouse (*Pseudomys delicatulus*) (TSC Act – Endangered species; EPBC Act – Vulnerable species)

The delicate mouse was recorded during field surveys. A single individual was captured in a pitfall trap.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. powerline easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf bore holes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. All clearing activities will be undertaken according to a tree clearing protocol to minimise harm to native species. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur.

The loss of some woodland areas during tree clearing may affect the lifecycle of the delicate mouse. Due to their small size individual delicate mice may not be detected during felling and individuals may perish or become injured during the clearing process. Additionally the clearing of the east-west power-line easement may fragment parts of the existing population if individuals are unable or unwilling to cross the cleared power-line easement.

The life-cycle of the delicate mouse may also be affected by surface cracking during subsidence. Surface cracks may result in the death or injury of individuals which fall into cracks while moving between trees. The extent or likelihood of individual delicate mice falling into surface cracks is unknown, however delicate mouse are known to fall into 300 mm wide holes in the ground along pitfall trap lines and the possibility of individuals perishing in surface cracks cannot be eliminated.

However due to the large area of similar woodland to the west and south it is likely that the population of delicate mice extends beyond the boundaries of the Mine Site and that the possible loss of some individuals and potential fragmentation of part of the population are unlikely to significantly impact on the life cycle of the species. Additionally an undertaking by the Proponent to monitor for and fill-in surface cracks as they appear should minimise potential harm to the delicate mouse. As the majority of surface cracking is expected to occur shortly after longwall collapse (within a week) the Proponent should be able to rapidly detect and begin repairs to surface cracks. The staging of longwall collapses, approximately 12 months apart should also minimise the level of impact on the delicate mouse.

The life-cycle of the delicate is unlikely to be significantly affected by the proposed longwall mine.

Pale-headed snake (*Hoplocephalus bitorquatus*) (TSC Act – Vulnerable species)

The pale-headed snake was recorded during field surveys.

Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. power-line easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf bore holes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. All clearing activities will be

undertaken according to a tree clearing protocol to avoid the felling of trees while snakes could remain within hollows or canopies. However due to the difficultly of sighting snakes in tree canopies, some individuals may perish or be injured during the felling of trees. The loss of potential foraging and roosting trees during clearing is unlikely to affect the lifecycle of the pale-headed snake due to the small area of vegetation to be removed relative to the remaining woodland. Although as the average area of a pale-headed snake home range is unknown, it's possible that home ranges are small and could be significantly affected if the species occurs along the proposed east-west power-line easement. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur.

The life-cycle of the pale-headed snake may also be affected by surface cracking during subsidence. Surface cracks may result in the death or injury of individuals, particularly smaller juveniles, which fall into cracks while moving between trees. The likelihood of individual pale-headed snakes falling into surface cracks is unknown, however pitfall trapping is a valid survey method for many snake species and the possibility of individuals perishing in surface cracks cannot be eliminated.

Due to the potential for harm to individuals during clearing, including possible home range reductions, and the large area across which surface cracking is predicted to occur, the life-cycle of the pale-headed snake may be negatively affected by the proposed longwall mine.

b) How is the proposal likely to affect the habitat of a threatened species, endangered population or endangered ecological community?

The proposal will see a reduction in the total area of available habitat for all species. Across the Mine Site 210.5 ha of woodland is expected to be cleared for mine infrastructure (i.e. power-line easement, ventilation shafts, goaf boreholes and surface facilities). Clearing will be required to provide access tracks to goaf bore holes, however hollow-bearing habitat trees will be avoided during the positioning of goaf access tracks. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur. For most species the reduction in potential habitat area is unlikely to have a significant effect on the species. Those species include the:

- Australian brush-turkey,
- Magpie goose,
- Black-necked stork,
- Black-breasted buzzard,
- Little eagle,
- Glossy black-cockatoo,
- Little lorikeet,
- Turquoise parrot,
- Swift parrot,
- Superb parrot,

- Masked owl,
- Barking owl,
- Speckled warbler Black-chinned honeyeater,
- Regent honeyeater,
- Hooded robin,
- Grey-crowned babbler,
- Varied sittella,
- Diamond firetail,
- Spotted-tailed quoll,
- Koala,
- Squirrel glider,
- Black-striped wallaby,
- Yellow-bellied sheathtail-bat,
- Eastern long-eared bat,
- Little pied bat, and
- Large-eared pied bat.

The reduction in habitat area may affect species with small home range areas such as the:

- Eastern pygmy-possum,
- Delicate mouse, and
- Pale-headed snake.

Clearing of the east-west power-line easement may result in the loss of some entire home range areas or significant reductions in some home range areas for the three above species. Additionally the east-west power-line easement may fragment populations of the eastern pygmy possum, delicate mouse and pale-headed snake on either side of the easement. However due to the large area of woodland present relative to the amount to be removed, and a staged removal of the woodland areas over the life of the mine, it is unlikely that the removal of up to 210.5 ha of woodland habitat would significantly any of the above species.

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

The study area is at the limit of the southern distribution of the delicate mouse. The identification of the delicate mouse extends its southern most record by approximately 210 km to the south-east. Individual delicate mice may be lost into surface cracks however it is unlikely that species would be significantly impacted by the proposed longwall mine.

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

Current disturbance regimes within the study area include:

- Stock grazing,
- Fire,
- Weed invasion, and
- Human presence.

The level of stock grazing is not expected to change significantly during the life of the proposed long-wall mine. Temporary grazing relief may occur during the timing of the goaf collapse and for a short period afterwards until surface cracks are repaired or deemed safe for livestock. The prevalence of fire is also unlikely to change significantly during the life of the proposed long-wall mine, however the increased movements of people and vehicles across the Mine Site may see a rise in the number of accidental fires.

The area and level of weed invasion may also increase due to the increased number of people and vehicle movements across the Mine Site. The increased level of human activity across the Mine Site will see a resulting increased level of wildlife disturbance.

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

A 30m wide power line easement and access track traversing the Mine Site in an east-west direction will split the western woodland area in half and may create a barrier to movement for species weary of open areas. The 30m wide power line easement will be rehabilitated at the end of mining activities. Further fragmentation will occur during the construction of the goaf boreholes at 200m intervals along the longwalls. Each series of goaf boreholes will require an access track for construction and maintenance running in a north-south direction. These tracks are expected to be minor tracks (less than 10m wide, removal of some trees and shrubs, and the surface graded) and in woodland areas where the tracks pass around large trees, are not expected to result in significant fragmentation of the habitat. However where these tracks pass through low dense stands of regenerating shrubs and/or trees they will create openings that fragment habitat areas on either side of the tracks. As these tracks are expected to be less than 10m in width it is unlikely that they will create significant barriers to the movement for species.

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

No critical habitat is currently listed in the NSW TSC Act or Commonwealth EPBC Act for the subject species within the study area.

Step 4. Avoid, Mitigate and then Offset

Impacts to be mitigated include:

- Removal of habitat along power line corridors, in particular the northern corridor to the north of longwall panels 1 to 13. This disturbance has the potential to impact on:
  - Brigalow EEC;
  - *Bertya opponens;*
  - eastern pygmy possum;
  - pale-headed snake; and
  - delicate mouse.
- Removal of vegetation for the construction and operation of ventilation shafts. Vegetation would also be disturbed as a consequence of development of access roads to these ventilation shaft areas.
- Removal of vegetation for gas drainage infrastructure (including access tracks). Notably, this disturbance would be progressive over the life of the mine and rehabilitated once gas drainage from each longwall panel is completed.
- Construction of additional surface facilities within the Pit Top Area and as part of the development of the reject emplacement area.

The above impacts are unavoidable as they are critical for the operation of the longwall mine. The following mitigation measures are proposed to minimise or reduce the impacts of the proposed longwall mine.

- Surface cracks will be filled as they are identified.
  - Small cracks will be filled in by the action of wind, water and natural soil movement,
  - Large cracks will be filled in by a bulldozer or grader,
  - Wider than expected cracks or those through drainage lines will be filled with subsoil material.
- Changes to surface drainage will be monitored and any stream re-direction or modification works will be undertaken after consultation with an appropriately qualified hydrological professional, an appropriately qualified ecologist, and/or the DEW.
- To minimise the potential impacts of erosion and steeply eroded creek banks toppling the Proponent would:
  - Monitor surface slope displacement along subsidence cross lines

  - Infill cracks as they appear,
  - Regrade or revegetate areas significantly affected by erosion, and
  - Regularly review and appraise any significant changes to surface slopes after each longwall is extracted.
- Treed areas to be cleared will be inspected by an ecologist for roosting or nesting fauna prior to clearing, and will relocate any identified fauna.
- The location of access tracks will be influenced by an ecologist after inspecting each proposed route and determining the path with least impact on environmental values.
- A flora and fauna management plan will be developed to ensure regular reassessment of the ecological values of disturbed and natural areas.

In addition to the above mitigation measures, offsets are likely to be required.

- Offsets are likely to be required to compensate for loss of vegetation – See mitigation measures.

Mitigation of potential impacts would involve the management of invasion and spread of noxious and environmental weeds, management of sedimentation and runoff and the implementation of protocols to prevent the introduction of pathogens and disease, such as *Phytophthora cinnamomi*. Full details are given in **Section 5**.

Step 5. Key Thresholds

The development application needs to contain a justification of the preferred option based on:

- *whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.*

  Assuming the loss of approximately 210.5 ha of woodland will be offset by the conservation of nearby woodland areas, the proposal should maintain overall biodiversity values.

- *whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.*

  The proposal is unlikely to reduce the long-term viability of any local population of flora or fauna species.

- *whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction*

  The proposal will not accelerate the extinction of or place any species, population or ecological community at risk of extinction.

- *whether or not the proposal will adversely affect critical habitat.*

The proposal will not affect any areas of identified critical habitat.

Conclusion to Part 3A Assessment for Threatened Fauna

It is considered unlikely that the Proposal would result in any significant negative impacts on threatened species.

4.3.1.3 Koala Habitat Assessment – SEPP 44

Assessment of potential koala habitat under SEPP 44 requires the following step be undertaken:

a) identification of "potential Koala Habitats" within the proposed development area; if the total tree cover contains 15% or more of the koala food tree species listed in Schedule 2 of SEPP 44 then it is deemed to be "potential" koala habitat. Identification of 'potential koala habitat requires the determination of the presence of 'core koala habitat';

b) identification of "core Koala habitat" within the development area. "Core Koala habitat" is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (females with young), recent sightings and historical records of a Koala population;

c) identification of "core Koala habitat" will require that a plan of management must accompany the DA application;

d) if the rezoning of lands, other than to environmental protection, involves potential or core Koala habitat then the Director of planning may require a local environmental study be carried out.

A single food tree species, *Eucalyptus albens*, listed on Schedule Two of SEPP 44 occurs on the Mine Site. However *E. albens* was present at a canopy density of less than 15 % in woodland areas. *E. albens* also occurred as scattered trees in some parts of the Mine Site.

The koala was identified as present on the Mine Site from a single scat sample collected opportunistically during other fauna survey activities. Spotlighting and call playback surveys failed to detect the koala on the Mine Site. It is unknown if a low density population occurs on the Mine Site or if the Mine Site only provides dispersal/immigration/emigration habitat for the koala. Both types of populations are unlikely to be significantly affected by the proposed longwall mine. The relatively small area of woodland to be removed (210.5 ha) and linear nature of most areas to be removed within a much larger block of woodland suggests that even individual koalas are unlikely to be affected. If resident koalas do occur on the Mine Site, home ranges are likely to be large (50-150 ha) and therefore should be minimally affected by the loss of small habitat areas. Additional tree losses due to longwall subsidence are unlikely as tree death (due to hydrological changes or mass gas movements) and tree fall are not predicted to occur.

The east-west powerline easement is unlikely to fragment any resident koala population as koalas readily move across much larger un-treed areas. The koala is unlikely to be significantly affected by the proposed longwall mine.

Regardless of the likely lack of impact on the koala from the proposed longwall mine, a koala plan of management may be required if 'core koala habitat' occurs on the Mine Site. Due to the large size of the Mine Site further survey work will be required to determine if the Mine Site forms core koala habitat.

4.3.1.4 NSW Native Vegetation Act 2003 (NV Act)

Since Narrabri Shire is not one of the LGAs that are exempt from the NV Act, and the current zoning is not one of the exempt categories of residential (but not rural residential), village, township, industrial or business; under the current zoning any proposed development is likely to be subject to the provisions of the NV Act. This usually involves full assessment of the site by the local CMA and the preparation of a Property Vegetation Plan (PVP), the aim of which would be to "maintain or improve environmental outcomes" as a result of the development proposal. In relation to the remnant native vegetation to be removed for various components of the proposal, it is likely that an outcome of the plan would be to require managed offsets to be provided to compensate for the vegetation lost, even if the intention is to progressively restore native vegetation on cleared areas when the area is no longer required. Offset ratios are typically several times the area of vegetation cleared. It is recommended that the Namoi Catchment Management Authority (CMA) be consulted for advice on this matter.

4.3.1.5 NSW Water Management Act 2000 (WM Act)

As a result of the proposed redirection of or disturbance to the natural flow of major watercourses within the Mine Site, input will be required from the Namoi Catchment Management Authority and the Department of Water and Energy (as to the legislative requirements of any proposed modification to the watercourses pursuant to the Act).

The NSW Department of Water and Energy are likely to require that an assessment of potential impacts on Groundwater Dependent Ecosystems be undertaken as part of the overall assessment of impacts due to the proposal. Groundwater Dependent Ecosystems are ecosystems that can depend on groundwater and that may support threatened or endangered species, communities and populations.

They include:

- Terrestrial vegetation communities that show seasonal or episodic reliance on groundwater
- River base flow systems which are aquatic and riparian ecosystems in or adjacent to streams/rivers dependent on the input of groundwater to base flows.
- Aquifers.
- Wetlands.
- Estuarine and near-shore marine discharge ecosystems.
- Fauna which directly depend on groundwater as a source of drinking water or that live within water which provide a source.

No obvious groundwater dependent ecosystems were recorded during field surveys for this report. Due to the large area of the Mine Site, not all areas could be sampled during the field survey.

4.4 Commonwealth Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)

4.4.1 Matters of National Environmental Significance

The EPBC Act was gazetted in 2000 and replaced several earlier Commonwealth statutes. This Act focuses Commonwealth interests on matters of national environmental significance (NES) including integrated biodiversity conservation and the management of important protected areas. The Act also establishes a streamlined environmental assessment and approvals process.

The matters of NES as identified in the Act which require assessment and approval to be addressed by the Commonwealth include:

- World Heritage properties
- National Heritage places
- RAMSAR wetlands
- Nationally threatened species and ecological communities (Part 13, Division 1, Subdivision A of the EPBC Act)
- Migratory species
- Commonwealth Marine areas
- Nuclear actions (including uranium mining)

The assessment and approval process applies to any action that has, will have or is likely to have a significant impact on a matter of NES. An 'action' is defined as a project, development, undertaking or an activity or series of activities. As of 18 January 2007, a bilateral agreement has been signed between the Commonwealth and the state of NSW which essentially accredits the NSW assessment process of environmental impact for the purposes of the EPBC Act, provided that the assessment has been done in accordance with the bilateral agreement. This has effectively removed the need for duplication of assessment effort by both the Commonwealth and state.

With regard to flora and fauna, the only matters of NES relevant to the study area are nationally listed threatened species, ecological communities and migratory species. Those that occur or could potentially occur within the study area and are subject to assessment pursuant to the Act are as follows:

Endangered Ecological Communities

- Brigalow (*Acacia harpophylla* dominant and co-dominant) – marginal occurrence only.
- Weeping Myall Woodlands – trace occurrence only.

Endangered Species

- Swift parrot.
- Regent honeyeater.
- Spotted-tailed quoll.

Vulnerable Species

- *Cadellia pentastylis* (ooline).
- *Lepidium ascheronii* (spiny peppercress).
- Superb parrot.
- Eastern long-eared bat.
- Large-eared pied bat.
- Delicate mouse.
- Border thick-tailed gecko.
- Five-clawed worm skink.

Migratory Species

- Cattle egret.
- Great egret.
- Latham's snipe.
- White-throated needletail.
- Rainbow bee-eater.
- Regent honeyeater.

An assessment of whether there is a real chance or possibility that the action is likely to have a significant impact on the relevant nationally threatened or migratory species or ecological communities, according to the relevant criteria given in the administrative guidelines for the Act, is presented in **Table 13**.

Table 14
Assessment of Potential Impact on Matters of NES Listed Under the EPBC Act 1999

Significant Impact Criteria and Assessment	
Critically Endangered and Endangered Ecological Communities Brigalow (*Acacia harpophylla* dominant and co-dominant) and Weeping Myall Woodlands	
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:	*a) reduce the extent of an ecological community;* Brigalow: Given the limited and patchy distribution of the community in the western portion of the Mine Site, the limited surface works proposed are unlikely to significantly reduce the extent of the community, if at all. Weeping Myall: Unless there is a particular requirement to widen the dirt road along which the weeping myalls were found to occur, the current extent of the ecological community (which is very small already) would not be reduced. The small patches of the EEC by the road to the Namoi River are likely to be successfully avoided by the construction of the pipeline.
	b) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines; Brigalow: It is possible that the proposed 30m wide transmission line easement could fragment an intact patch of the community along the alignment, but other patches would remain unaffected, or suffer minor temporary disturbance due to the provision of tracks and goaf boreholes. Weeping Myall: Already highly fragmented and isolated from other patches by past clearing. The proposal is unlikely to significantly increase fragmentation of the community.
	c) adversely affect habitat critical to the survival of an ecological community; No habitat critical to the survival of either community occurs in the study area.
	d) modify or destroy abiotic (non-living) factors (such as water, nutrients or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns; Brigalow: Although some hydrological changes and alteration of surface water drainage patterns could occur within some patches of the community's habitat due to subsidence in the underground mining area, the community is not critically dependent on strict maintenance of the current hydrological regime for its survival. Weeping Myall: No major modifications of the abiotic environment are anticipated in the vicinity of the habitat for the community, unless substantial roadworks occur in the Mine Site area or the pipeline is constructed a considerable distance from the road edge in the Pipeline Corridor.
	e) cause a substantial change in the species composition of an occurrence of an ecological community, causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting ; No substantial changes in the species composition of either ecological community are expected as a direct or indirect result of the proposal.

Table 14 (Cont)
Assessment of Potential Impact on Matters of NES Listed Under the EPBC Act 1999

Significant Impact Criteria and Assessment	
Critically Endangered and Endangered Ecological Communities Brigalow (*Acacia harpophylla* dominant and co-dominant) and Weeping Myall Woodlands	
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:	*f) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:* – *Assisting invasive species , that are harmful to the listed ecological community, to become established; or* – *Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community;* The proposal has the potential to increase the risk of invasive weeds and diseases becoming established in or beyond new edge areas created by the power transmission easement and tracks to goaf boreholes throughout currently undisturbed vegetation in the western part of the Mine Site. These risks can be substantially reduced by implementation of a weed management plan and protocols to prevent the introduction and spread of pathogens, as outlined in the Recommendations.
	g) interfere with the recovery of an ecological community. While the proposal could potentially result in the incremental loss or modification of either community, this would not interfere significantly with the recovery of the ecological communities.
Critically Endangered and Endangered Species <u>Flora</u>: None <u>Fauna</u>: Swift parrot, regent honeyeater and spotted-tailed quoll	
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	*a) lead to a long-term decrease in the size of a population;* The swift parrot and regent honeyeater are only likely to visit the study area on an opportunistic, occasional basis. The spotted-tailed quoll may be a resident species. Due to the small area of vegetation to be removed the proposed longwall mine is unlikely to lead to a long-term decrease in the size of any populations of the swift parrot, regent honeyeater or spotted-tailed quoll.
	b) reduce the area of occupancy of the species; While 210.5 ha of potential habitat for the swift parrot, regent honeyeater and spotted-tailed quoll would be lost as a result of the proposal, this is unlikely to have a significant impact on any of these species.
	c) fragment an existing population into two or more populations; The proposal would not fragment an existing population of the swift parrot, regent honeyeater or spotted-tailed quoll into two or more populations.
	d) adversely affect habitat critical to the survival of a species; The proposal would not adversely affect habitat critical to the survival of the swift parrot, the regent honeyeater or spotted-tailed quoll.
	e) disrupt the breeding cycle of a population;

Table 14 (Cont)
Assessment of Potential Impact on Matters of NES Listed Under the EPBC Act 1999

Significant Impact Criteria and Assessment	
Critically Endangered and Endangered Species Flora: None Fauna: Swift parrot, regent honeyeater and spotted-tailed quoll	
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	No breeding habitat for the swift parrot or regent honeyeater has been recorded within the study area and none is likely to be affected. The proposal would not disrupt the breeding cycle of a population of any of these species. Breeding habitat may be present for the spotted-tailed quoll, however the breeding cycle of the spotted-tailed quoll is unlikely to be disrupted.
	f) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; The proposal would not affect the habitat of the swift parrot, the regent honeyeater or spotted-tailed quoll to such an extent that one or more of these species would be likely to decline.
	g) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;* The proposal is highly unlikely to result in an invasive species harmful to the swift parrot, regent honeyeater or spotted-tailed quoll from becoming established within the study area.
	h) introduce disease that may cause the species to decline; o The proposal is highly unlikely to result in the introduction of a disease that would cause the swift parrot, regent honeyeater or spotted-tailed quoll to decline.
	i) interfere with the recovery of the species. While the proposal would result in the loss of some potential habitat for the swift parrot, regent honeyeater and spotted-tailed quoll, this would not interfere significantly with the recovery of these species.
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	*a) lead to a long-term decrease in the size of an important population** of a species;* Flora: Due to the extent of the known distributions and abundances of all three species, which may not include the Mine Site, the disturbances to potential habitat due to the proposal are unlikely to lead to a long-term decrease in the size of important populations of any of the species. Superb parrot, eastern long-eared bat and large-eared pied bat – Due to the relatively small area (210.5 ha) and linear nature of potential habitat to be removed, the proposed longwall mine is unlikely to lead to a long-term decrease in the size of an important population of these species. Delicate mouse, border thick-tailed gecko and five-clawed worm skink – Surface cracking associated with the proposed longwall mine may lead to a loss of some individuals. However the staged occurrence of possible surface cracks and the surrounding areas of similar habitat suggest that there is unlikely to be a long-term decrease in the size of an important population of these species. The population of the delicate mouse on the Mine Site is likely an important population as it occurs at the southern limit of its known distribution.

Table 14 (Cont)
Assessment of Potential Impact on Matters of NES Listed Under the EPBC Act 1999

Significant Impact Criteria and Assessment	
Vulnerable species Flora – *Bertya opponens* (Coolabah bertya), *Cadellia pentastylis* (ooline) and *Lepidium ascheronii* (spiny peppercress) Fauna – Superb parrot, eastern long-eared bat, large-eared pied bat, delicate mouse, border thick-tailed gecko and five-clawed worm skink.	
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	*b) reduce the area of occupancy of an important population;* Coolabah bertya: The species occupies a large area within Jack's Creek State Forest to the west of the Mine Site, comprising an estimated population in excess of 5 million individuals (NPWS 2002). Impacts within the Mine Site (subsidence; easement, track and goaf hole creation) could potentially reduce the area of occupation of this important population incrementally. Ooline and spiny peppercress: Potential habitat for both species occurs on the flat plains area, of which only a minor proportion would be directly disturbed due to the proposal. The area of occupancy of both species is likely to remain unchanged, or at least not significantly altered. Superb parrot, eastern long-eared bat and large-eared pied bat – Due to the relatively small area and linear nature of potential habitat to be removed, the proposed longwall mine is unlikely to lead to a reduction of the area of occupancy of an important population of these species. Delicate mouse, border thick-tailed gecko and five-clawed worm skink – Due to the relatively small area and linear nature of potential habitat to be removed, the proposed longwall mine is unlikely to lead to a reduction of the area of occupancy of an important population of these species.
	c) fragment an existing important population into two or more populations; Flora: There is a small potential for an important population of any of the three species in the Mine Site to be fragmented into two or more populations by the power line easement, particularly Coolabah bertya. Superb parrot, eastern long-eared bat and large-eared pied bat – Due to the relatively small area and linear nature of potential habitat to be removed and each of these species' high level of mobility, the proposed longwall mine is unlikely to fragment an important population of these species. Delicate mouse, border thick-tailed gecko and five-clawed worm skink – There is potential for the east-west powerline easement to fragment part an important population of each of these species. However if each of these species is widespread throughout the Mine Site and the surrounding State Forests, the level of fragmentation would be significantly reduced.
	d) adversely affect habitat critical to the survival of a species; Flora: The proposal would not adversely affect habitat critical to the survival of ooline or spiny peppercress. Superb parrot, eastern long-eared bat and large-eared pied bat – The proposal would not adversely affect habitat critical to the survival of the superb parrot, eastern long-eared bat or large-eared pied bat. Delicate mouse, border thick-tailed gecko and five-clawed worm skink – The proposal would not adversely affect habitat critical to the survival of the delicate mouse, border thick-tailed gecko or five-clawed worm skink

Table 14 (Cont)
Assessment of Potential Impact on Matters of NES Listed Under the EPBC Act 1999

Significant Impact Criteria and Assessment	
Vulnerable species Flora – *Bertya opponens* (Coolabah bertya), *Cadellia pentastylis* (ooline) and *Lepidium ascheronii* (spiny peppercress) Fauna – Superb parrot, eastern long-eared bat, large-eared pied bat, delicate mouse, border thick-tailed gecko and five-clawed worm skink.	
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	*e) disrupt the breeding cycle of an important population;* Flora: Since substantial potential habitat for all three species would be retained within the proposal area, the breeding cycles for these species are unlikely to be disrupted. Superb parrot, eastern long-eared bat and large-eared pied bat – Due to the relatively small area and linear nature of potential habitat to be removed and each of these species high level of mobility, the proposed longwall mine is unlikely to disrupt the breeding cycle an important population of these species. Delicate mouse, border thick-tailed gecko and five-clawed worm skink – Due to the relatively small area (210.5ha) and linear nature of potential habitat to be removed, the proposed longwall mine is unlikely to disrupt the breeding cycle of an important population of these species.
	f) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; Flora: The proposal would not affect the habitat of Coolabah bertya, ooline or spiny peppercress to such an extent that one or more of these species would be likely to decline. Superb parrot, eastern long-eared bat and large-eared pied bat, delicate mouse, border thick-tailed gecko and five-clawed worm skink - The proposal would not affect the habitat of any of these species to such an extent that one or more of these species would be likely to decline.
	*g) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***;* Flora: Invasive species (including noxious weeds) are currently present at low abundance in the Mine Site. With simple preventive and management measures (see Recommendations) these species or others are unlikely to significantly increase in abundance in any areas of potential habitat for threatened flora. Superb parrot, eastern long-eared bat and large-eared pied bat, delicate mouse, border thick-tailed gecko and five-clawed worm skink – the proposal is unlikely to result in invasive species that are harmful to any of these species becoming established in the their habitat.
	h) introduce disease that may cause the species to decline; or Flora: There is a risk that the action could introduce plant diseases or pathogens such as *Phytophthora cinnamomi* into the species' potential habitat, but this risk could be substantially reduced by implementation of protocols to prevent the introduction and spread of pathogens, as outlined in the Recommendations. Superb parrot, eastern long-eared bat and large-eared pied bat, delicate mouse, border thick-tailed gecko and five-clawed worm skink – the proposal is unlikely to introduce disease that may cause the species to decline.
	i) interfere substantially with the recovery of the species. Flora: The proposal is unlikely to interfere significantly with the recovery of any species. Superb parrot, eastern long-eared bat and large-eared pied bat, delicate mouse, border thick-tailed gecko and five-clawed worm skink – the proposal is unlikely to interfere substantially with the recovery of any of these species.

Table 14 (Cont)
Assessment of Potential Impact on Matters of NES Listed Under the EPBC Act 1999

Significant Impact Criteria and Assessment	
Migratory Species Cattle egret, great egret, Latham's snipe, white-throated needletail, rainbow bee-eater and regent honeyeater.	
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	*a) substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat[#] for a migratory species;* Due to the relatively small area and linear nature of potential habitat to be removed, the proposed longwall mine is unlikely to substantially modify, destroy or isolate an area of important habitat for any of the above migratory species.
	b) result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or It is highly unlikely that an invasive species that is harmful to any of the above listed migratory species would become established within the study area as a result of the proposal.
	c) seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion[##] of the population[###] of a migratory species. The proposal would not seriously disrupt the lifecycle of any of the above listed migratory species.

^ 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- *for activities such as foraging, breeding, roosting or dispersal*
- *for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)*
- *to maintain genetic diversity and long term evolutionary development*
- *for the reintroduction of populations or recovery of the species or ecological community*

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- *a geographically distinct regional population, or collection of local populations or*
- *a population, or collection of local populations, that occurs within a particular bioregion.*

** Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

***An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:*

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

****Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.*

[#]An area of 'important habitat' for a migratory species is:

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

[##]Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

[###] 'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

4.4.2 Key Threatening Processes

Seventeen key threatening processes have been finally determined under the EPBC Act. Those that could be potentially relevant to the proposal are discussed below:

1) Land clearance

The proposal is expected to result in the clearing of 210.5ha of woodland vegetation from the Mine Site. Additional areas will also be partially cleared to allow vehicle access to goaf boreholes and to construct two pipelines to the Namoi River.

4.4.3 Summary of impacts on EBPC Act matters of NES

According to the criteria given in the administrative guidelines for the EPBC Act, the proposal is unlikely to have a significant impact on any nationally listed threatened or migratory flora or fauna species, ecological communities or any other matters of NES. However due to the large number of threatened fauna species and the large size of the project, the longwall project should be referred to the Department of Environment, Water, Heritage and the Arts for assessment.

4.5 Impacts on non-listed species and communities

The study area contained a high diversity of flora species, but none of those recorded were listed on the ROTAP database (Briggs & Leigh 1996) or were otherwise locally or regionally significant. There is a possibility that one or more ROTAP species could nevertheless occur particularly in the more undisturbed vegetated area in the western part of the Mine Site. However, in a worst case scenario where one or more of these species might be impacted, the minor level of removal or temporary disturbance to some of these species is unlikely to place their local populations at risk of extinction.

The riparian vegetation communities (Communities 3 and 5), which are not listed by legislation, could possibly suffer incremental reductions in their areas due to the construction of goaf boreholes, access roads, pipeline and pumping station infrastructure. Any losses of habitat could be compensated for by on-site offsets of the same community, as detailed in the Recommendations.

One hundred and forty non-listed native fauna species were recorded during the field survey. The loss of habitat associated with the proposal would decrease the extent of fauna habitat available. However given the small area of habitat to be removed relative to the large area of remaining habitat, it is not expected that the proposal would greatly impact any of these fauna species.

5 Mitigation Measures

The project will involve clearing of approximately 210.5ha of native vegetation and disturbance to flora and fauna habitat, including threatened fauna species and at least two EEC's, within the Mine Site.

The following measures are recommended to ameliorate the minor impacts that may occur on flora and fauna habitat as a result of the Longwall Project.

- Implement the proposed offset strategy identified in **Section 4.2.3**.
- A weed management strategy would need to be implemented, possibly as part of a vegetation management plan, for any retained or rehabilitated natural vegetation within the operations area and any offset areas. All noxious weeds within the land shall be treated in accordance with their weed Class as per the *Noxious Weeds Act 1993*.
- Progressive rehabilitation of highly disturbed and bare areas following completion of operations in the area should use locally-occurring species (trees, shrubs and ground cover) characteristic of the relevant vegetation community for replanting. Suitable species to use are given in **Table 6**, **Appendix 2** or any species designated by an 'R' in **Appendix 1**.
- Drainage lines should be monitored regularly for ponding following subsidence. A ponding management plan should be developed to minimise the level of impact of ponding on flora and fauna species. The management plan should include a case by case approach to the management of individual ponding areas following the inspection of each ponding area by a suitable qualified ecologist and a suitably qualified hydrologist. In some cases it may be more harmful to flora and fauna species to undertake earthworks to re-open the drainage line than to leave the ponding.
- Where the proposed pipeline corridor runs along the road easement east of the 'Greylands' property and extending north of the mine site along the road running north-south along the western side of the railway line (were the road easement and stand of woodland vegetation is less than five metres wide), the proposed pipeline corridor should be moved out of the road easement and realigned within the adjacent cleared farm paddocks. Moving the proposed Pipeline Corridor into the farm paddocks would remove the need to fell areas of linear woodland that have an important linking function within the landscape.
- Temporary barriers should be placed along the road side of the two small patches of Weeping Myall Woodland along the roadside in the Pipeline Corridor (locations shown in Figure 3A) to prevent accidental intrusions into the habitat of this EEC during construction of the pipeline to the Namoi River.
- An annual fauna monitoring program targeting the delicate mouse, eastern pygmy possum and pale-headed snake will need to be implemented to ensure that these species are not negatively affected by the progressive longwall collapses and resulting surface cracks. The monitoring program should start immediately, prior to the beginning of longwall mining operations, to establish baseline population levels. The monitoring program would involve, as a minimum a large number of permanently established pitfall and funnel traps across unaffected and mined areas.

- A tree felling protocol will need to be developed to minimize harm to all fauna species during the clearing of trees for mining activities. The tree felling protocol should be developed by a suitably qualified and licensed ecologist with previous experience supervising the felling of trees. The tree felling protocol should involve as a minimum the following key steps of: establishment of the best time of the year for felling (depends on the likely species to be affected), pre-felling mapping of habitat trees, inspections of trees on the day of felling, procedures for the safe removal of fauna species from trees prior to and post felling, a relocation/release protocol, and a protocol for the salvaging of tree hollows for rehabilitation works. Where possible, tree felling should be undertaken during the best time of year as identified in the tree felling protocol. All tree felling should be supervised by the ecologist that developed the tree felling protocol (and in accordance with the tree felling protocol) or by another suitably qualified and licensed ecologist.
- The investigation of the potential impacts of the extraction and return of raffinate water to the Namoi River was beyond the scope of this study. Potential impacts on water quality, in-stream structures, aquatic plants and native and introduced fish species should be documented by a specialist aquatic consultant.
- Where trees are to be removed as part of the surface disturbing activities, an assessment of the surrounding level of tree hollow provision should be undertaken by a suitably qualified ecologist. The ecologist would determine the need for local supplementing of tree hollows (using salvaged tree hollows or nest boxes) based on the number of hollows lost during felling and the surrounding provision of remaining natural hollows.
- Runoff/ sedimentation from the proposed surface impact areas should be managed during both the construction and operation phases using current best practice sediment and erosion control measures. In particular, management of runoff into and protection of the water quality of the major creeks and watercourses should be implemented.
- In relation to all surface works, ensure that protocols are in place to prevent the importation of root-rot fungus (*Phytophthora cinnamomi*) on machinery, in imported soil or on boots and clothing. These should be certified as free of the disease, or decontaminated before entry to the site.

6 CONCLUSIONS

An assessment of the impacts on flora and fauna in relation to the Longwall Project has been made based on a combination of literature review and field survey. The resulting information has been used to address Part 3A of the *Environmental Planning and Assessment Act 1979, Environment Protection and Biodiversity Conservation Act 1999* and other relevant legislation or planning instruments.

No rare, threatened or locally significant flora species were recorded within the study area, although at least one vulnerable species, *Bertya opponens*, is considered likely to occur within the western part of the Mine Site. Two additional listed flora species are considered to have some potential to occur, and one or more ROTAP species have potential to occur but none are considered highly likely. Minor impacts on threatened flora species may occur due to the minor clearing required and subsidence effects but are unlikely to be significant.

Three endangered ecological communities (EECs) listed under the TSC Act were recorded within the Mine Site during field surveys. “Inland Grey Box Woodland” was found to be the dominant vegetation community within the flat plains area in the eastern two thirds of Mine Site. It occurred as modified and generally disturbed (grazed) remnant patches within the relevant area. A small, disturbed remnant patch of Myall Woodland occurred along a dirt road at the eastern end of the Mine Site (east of the underground workings area) and two smaller patches occurred along the road in the Pipeline Corridor, but set back a few metres from the road edge. Patches of marginal “Brigalow” EEC occurred in the pilliga community in the undulating western third of the site. The latter two EECs are also listed under the Commonwealth EPBC Act as “Weeping Myall Woodland” and “Brigalow (*Acacia harpophylla* dominant and co-dominant)” respectively. Minor impacts are expected on at least the Inland Grey Box Woodland and Brigalow EECs, but not to the extent that they would be at risk of local extinction. Offsets would ensure local conservation of the EECs and other vegetation types.

Seventeen threatened or migratory species under the TSC and EPBC Acts were recorded during field surveys (including one listed as a preliminary determination). An additional threatened species, the squirrel glider is likely to occur but was not recorded during field surveys. Potentially suitable habitat exists on the Mine Site for a further 18 threatened or migratory species that were not identified during field surveys. While impacts are expected to be minor on all species, there is potential for the loss of some individual delicate mice, eastern pygmy possums and pale-headed snakes. Such losses may occur if individuals fall into large surface cracks or are unable to climb out of surface cracks. The potential for impact on these species will need to be monitored regularly throughout the life of the mine.

REFERENCES

Barrett, G., Silcocks, A., Barry, S., Cunningham, R. & Poulter, R., 2003. The New Atlas of Australian Birds, RAOU

Benson, J.S., Allen, C.B., Togher, C. & Lemmon, J., 2006. New South Wales Vegetation Classification and Assessment: Part 1 Plant communities of the NSW Western Plains. Cunninghamia 9: 329-450.

Benson, J.S., 2008. New South Wales Vegetation Classification and Assessment: Part 2 Plant communities of the NSW South-western slopes Bioregion and update of NSW Western Plains plant communities, Version 2 of the NSWVCA database. Cunninghamia 10: 599-673.

Briggs, J. D. & Leigh, J. H., 1996. Rare or Threatened Australian Plants. CSIRO Publications.

Busby, J.R. 1991. BIOCLIM – a bioclimatic analysis and prediction system. pp. 64-68 in Nature Conservation: cost effective biological surveys and data analysis (Eds Margules, C.R. and M. P. Austin). CSIRO. Canberra.

Churchill 1998. Australian Bats. Reed New Holland, Sydney.

Cogger, H.G., 1995. Reptiles and Amphibians of Australia. Reed Books, Sydney.

Cropper, S. 1993. Management of Endangered Plants. CSIRO, Canberra.

DEC 2004. Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Working Draft. NSW Department of Environment and Conservation.

DECC 2007. Threatened species assessment guidelines: the assessment of significance. Department of Environment and Climate Change NSW, Sydney South.

Ditton Geotechnical Services Pty Ltd (2009). Narrabri Coal Mine Stage 2 Longwall Project Mine Subsidence Predictions and Impact Assessment.

Ecotone Ecological Consultants Pty Ltd 2006. Narrabri Coal Project Ecology Impact Assessment. Ecotone Ecological Consultants, Waratah, NSW. Specialist Consultant Studies Compendium - Volume 1, Part 3 - prepared for Narrabri Coal Pty Ltd.

Garnett, S. & Crowley, G. 2000. The Action Plan for Australian Birds. Environment Australia, Canberra

Geoff Cunningham Natural Resource Consultants 2005a. Proposed East Boggabri Coal Mine: Flora Assessment of the Proposed Mine Site. Specialist Consultant Studies Compendium - Volume 1, Part 5 - prepared for Narrabri Coal Pty Ltd.

Geoff Cunningham Natural Resource Consultants 2005b. Proposed East Boggabri Coal Mine: Flora Assessment of the Northern Section of the Proposed Transport Route. Specialist Consultant Studies Compendium - Volume 1, Part 4a - prepared for Narrabri Coal Pty Ltd.

Harden, G.J. (ed) 1990. Flora of New South Wales Volume 1. Royal Botanic Gardens and New South Wales University, Sydney

Harden, G.J. (ed) 1992. Flora of New South Wales Volume 3. Royal Botanic Gardens and New South Wales University, Sydney

Harden, G.J. (ed) 1993. Flora of New South Wales. Volume 4. Royal Botanic Gardens and New South Wales University, Sydney.

Harden, G.J. & Murray, L.J. (eds) 2000. Supplement to Flora of New South Wales. Volume 1. Royal Botanic Gardens and New South Wales University, Sydney.

Keith, D. 2004. Ocean Shores to Desert Dunes: The Native Vegetation of New South Wales and the ACT. NSW Department of Environment and Conservation, Hurstville.

Morcombe M., 2004. Field Guide to Australian Birds. Steve Parish Publishing, Archerfield, QLD.

NPWS 2002. Bertya sp. Cobar-Coolabah (Cunningham & Milthorpe s.n., 2/8/73) Recovery Plan. NSW National Parks and Wildlife Service, Hurstville NSW.

NSW Scientific Committee 2002a. Final Determination to list the White Box Yellow Box Blakely's Red Gum Woodland as an Endangered Ecological Community. NSW National Parks and Wildlife Service.

NSW Scientific Committee 2002b. Final Determination to list Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions as an Endangered Ecological Community. NSW National Parks and Wildlife Service.

NSW Scientific Committee 2005. Final Determination to Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW Western Slopes Bioregions as an Endangered Ecological Community. NSW Department of Environment and Conservation.

NSW Scientific Committee 2007. Final Determination to list Inland Grey Box Woodland in the Riverina, NSW Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions as an Endangered Ecological Community. NSW Department of Environment and Climate Change.

NSW DoP, 2008. Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield - Strategic Review. NSW Department of Planning.

Strahan, R. 2002, The Mammals of Australia. Reed Books and Australian Museum, Sydney.

This page has intentionally been left blank

Appendix 1

Flora Species Recorded in the Study Area

This page has intentionally been left blank

The following is a list of all flora species recorded within the study area. Please note that this list may be not fully comprehensive, and should be regarded as an indication of the flora present. A period of some years is often needed to identify all species present in an area, particularly for cryptic or seasonally detectable species (such as orchids and small grass-like herbs).

Notes:

* indicates an exotic or introduced native species
R indicates locally indigenous species that are potentially suitable for revegetation or replanting works

Nomenclature follows Harden (1990, 1992, 1993, 2002), Harden & Murray (2000) and subsequent recent revisions.

CLASS FILICOPSIDA (Ferns)

ADIANTACEAE		
Cheilanthes distans	R	Bristly cloak fern
Cheilanthes sieberi subsp. *sieberi*	R	Mulga fern

CLASS CYCADOPSIDA (Cycads)

ZAMIACEAE		
Macrozamia secunda	R	-

CLASS CONIFEROPSIDA (Conifers)

CUPRESSACEAE		
Callitris endlicheri	R	Black cypress pine
Callitris glaucophylla	R	White cypress pine

CLASS MAGNOLIOPSIDA (Flowering Plants)

Subclass Magnoliidae (Dicotyledons)

ACANTHACEAE		
Brunoniella australis	R	Blue trumpet/native yam
Rostellularia adscendens	R	Pink tongues
AMARANTHACEAE		
Alternanthera denticulata		Lesser joyweed
*Gomphrena celosioides**		Gomphrene weed
ANACARDIACEAE		
*Schinus ariera**		Pepper tree
APIACEAE		
Actinotus helianthi	R	Flannel flower
Platysace ericoides	R	Heathy platysace
APOCYNACEAE		
Alstonia constricta	R	Quinine bush / bitter bark
Parsonsia lanceolata		Rough silkpod
Parsonsia eucalyptophylla		Gargaloo
ARALIACEAE		
Astrotricha longifolia f. 'Inland'	R	Long-leaf star-hair
ASTERACEAE		
*Arctotheca calendula**		Capeweed/cape dandelion
*Bidens pilosa**		Cobblers pegs

*Bidens subalternans**		Greater beggar's ticks
Brachyscome dentata	R	-
Calotis cuneata		Mountain burr-daisy
Calotis lappulacea		Yellow burr-daisy
Cassinia arcuata	R	Sifton bush / Chinese shrub
Cassinia laevis	R	Cough bush
Chrysocephalum apiculatum	R	Yellow buttons
*Cirsium vulgare**		Spear thistle / black thistle
*Conyza bonariensis**		Flaxleaf Fleabane
*Hypochaeris radicata**		Flatweed/catsear
Hypochaeris sp.		A Flatweed
Ozothamnus diosmifolius	R	Ball everlasting/pill flower/ rice flower
Vernonia cinerea	R	-
Vittadinia cuneata		A fuzzweed
*Xanthium occidentale**		Noogoora burr
*Xanthium spinosum**		Bathurst burr
Xerochrysum bracteatum	R	Golden everlasting
BRASSICACEAE		
Lepidium sp.*		Peppercress
CACTACEAE		
Opuntia stricta var. *stricta**		Common prickly pear/smooth pest pear
CAMPANULACEAE		
Wahlenbergia communis	R	Tufted bluebell
Wahlenbergia gracilis	R	Sprawling / Australian bluebell
Wahlenbergia luteola	R	-
CAPPARACEAE		
Capparis mitchellii	R	Wild orange / native orange
CARYOPHYLLACEAE		
*Petrorhagia nanteuilli**		-
CASUARINACEAE		
Allocasuarina diminuta subsp. *diminuta*	R	A she-oak
Allocasuarina leuhmanniii	R	Bulloak / buloke
Casuarina cristata	R	Belah
Casuarina cunninghamiana subsp. *cunninghamiana*	R	River she-oak
CELASTRACEAE		
Maytenus cunninghamii	R	Yellow-berry bush
CHENOPODIACEAE		
Atriplex semibaccata		Creeping saltbush / berry saltbush
Atriplex spinibracteata		A saltbush
Chenopodium nitrariaceum		Nitre goosefoot
Einadia hastata		Saloop
Einadia nutans subsp. *nutans*		Climbing saltbush
Einadia trigonos		Fishweed
Rhagodia spinescens		Thorny saltbush
Sclerolaena birchii		Galvanized burr
CONVOLVULACEAE		
Dichondra repens	R	Kidney weed
CRASSULACEAE		
*Bryophyllum delagoense**		Mother of millions
Crassula sieberiana subsp. *sieberiana*	R	Austral stonecrop
DILLENIACEAE		

Hibbertia obtusifolia	R	Hoary guinea flower
Hibbertia riparia	R	Guinea flower
ERICACEAE - Subfamily Styphelioideae		
Brachyloma daphnoides	R	Daphne heath
Melichrus urceolatus	R	Urn heath
EUPHORBIACEAE		
Beyeria viscosa	R	Sticky wallaby bush / pinkwood
Breynia oblongifolia	R	Coffee bush
Chamaesyce dallachyana		Caustic weed
Chamaesyce drummondii		Caustic weed
Phyllanthus gunnii		A spurge
Phyllanthus sp.		A spurge
Phyllanthus virgtatus		A spurge
Poranthera microphylla		Small poranthera
FABACEAE - Subfamily Caesalpinoideae		
Senna form taxon *'zygophylla'*	R	-
FABACEAE - Subfamily Faboideae		
Bossiaea rhombifolia subsp. *concolor*		-
Daviesia ulicifolia	R	Gorse bitter pea
Glycine clandestina	R	A love creeper
Glycine tabacina sens. lat.	R	A love creeper
Glycine tomentella	R	Woolly glycine
Hardenbergia violacea	R	False sarsaparilla
Hovea lanceolata	R	-
Indigofera australis	R	Native indigo
*Medicago polymorpha**	R	Burr medic
*Medicago sativa**	R	Lucerne
Vicia sativa subsp. *nigra**	R	Narrow-leaved vetch
FABACEAE - Subfamily Mimosoideae		
Acacia burrowii	R	Burrow's wattle
Acacia deanei subsp. *deanei*	R	Deane's wattle / green wattle
Acacia harpophylla	R	Brigalow
Acacia homalophylla	R	Yarran
Acacia ixiophylla	R	A wattle
Acacia neriifolia	R	Silver wattle / oleander wattle
Acacia pendula	R	Weeping myall / boree
Acacia penninervis var. *penninervis*	R	Mountain hickory
Acacia pilligaensis	R	Pilliga wattle
Acacia rubida	R	Red-stemmed wattle
Acacia stenophylla	R	River cooba / river myall / belalie
Acacia sp. (planted)		A wattle
FUMARIACEAE		
Fumaria sp.*		Fumitory
GERANIACEAE		
Geranium solanderi	R	Native geranium
GOODENIACEAE		
Dampiera adpressa	R	Purple beauty-bush
Goodenia glabra	R	-
Goodenia hederacea var. *hederacea*	R	Ivy goodenia/forest goodenia
Goodenia rotundifolia	R	-
HALORAGACEAE		
Gonocarpus elatus	R	A raspwort
Gonocarpus longifolius	R	A raspwort

LAMIACEAE		
Ajuga australis	R	Austral bugle
Chloanthes parviflora	R	-
*Marrubium vulgare**		White horehound
Mentha diemenica		Slender mint
Prostanthera denticulata	R	Rough mint bush
Spartothamnella puberula	R	-
LAURACEAE		
Cassytha pubescens		Devil's twine
LOBELIACEAE		
Isotoma axillaris	R	Showy isotome
LOGANIACEAE		
Logania albiflora	R	-
LORANTHACEAE		
Amyema cambagei		She-oak mistletoe
Amyema miquelii		Box / drooping mistletoe
Dendrophthoe glabrescens		A mistletoe
MALVACEAE		
Abutilon leucopetalum		Velvet lantern flower
Abutilon oxycarpum		Straggly lantern bush
*Malva parviflora**		Small-flowered mallow
*Pavonia hastata**		Pink pavonia
Sida corrugata		Corrugated sida
Sida cunninghamii		-
*Sida rhombifolia**		Paddy's lucerne
MORACEAE		
Maclura cochinchinensis?		Cockspur thorn
MYOPORACEAE		
Eremophila debilis	R	Amulla / winter apple
Eremophila mithcellii	R	Budda / false sandalwood
Myoporum montanum	R	Western boobialla / water bush
MYRTACEAE		
Angophora floribunda	R	Rough-barked apple
Calytrix tetragona	R	Fringe-myrtle
Corymbia trachyphloia subsp. *stomatica*	R	White / brown bloodwood
Eucalyptus albens	R	White box
Eucalyptus blakelyi	R	Blakely's red gum
Eucalyptus bridgesiana	R	Apple box / apple gum
Eucalyptus camaldulensis	R	River red gum
Eucalyptus crebra	R	Narrow-leaved ironbark
Eucalyptus fibrosa	R	Broad-leaved red ironbark
Eucalyptus melanophloia	R	Silver-leaved Ironbark
Eucalyptus microcarpa	R	Western / inland grey box
Eucalyptus pilligaensis	R	Narrow-leaved / Pilliga grey box
Eucalyptus populnea subsp. *bimbil*	R	Bimble box / poplar box
Homoranthus flavescens	R	-
Leptospermum polygalifolium subsp. *transmontanum*	R	Tantoon / lemon-scented tea-tree
Melaleuca erubescens	R	Rosy paperbark
Micromyrtus sessilis	R	Micromyrtus
OLEACEAE		
Notelaea microcarpa var. *microcarpa*	R	A native olive
OXALIDACEAE		

*Oxalis corniculata**		Creeping oxalis
Oxalis perennans		A wood sorrell
PLANTAGINACEAE		
Plantago cunninghamii		A plantain
Plantago debilis		A plantain
Veronica plebeia	R	Trailing speedwell
POLYGONACEAE		
Rumex brownii		Swamp dock
*Rumex crispus**		Curly dock
PORTULACACEAE		
Portulaca oleracea		Pigweed / purslane
PROTEACEAE		
Grevillea floribunda subsp. *floribunda*		Seven dwarfs grevillea / rusty spider flower
Persoonia sericea	R	A geebung
RHAMNACEAE		
Alphitonia excelsa	R	Red ash
Cryptandra longistaminea	R	New England cryptandra
RUBIACEAE		
Galium binifolium	R	A bedstraw
Opercularia diphylla	R	A stink weed
Pomax umbellata	R	Pomax
RUTACEAE		
Geijera parviflora	R	Wilga
Phebalium squamulosum subsp. *gracile*	R	Scaly phebalium
SANTALACEAE		
Exocarpus cupressiformis	R	Cherry ballart
SAPINDACEAE		
Dodonaea boroniifolia	R	Fern-leaf hop bush
Dodonaea viscosa subsp. *spatulata*	R	A hop bush
SOLANACEAE		
*Lycium ferocissimum**		African boxthorn
Solanum amblymerum		Spiny kangaroo apple
Solanum ferocissimum		Spiny potato bush
Solanum parvifolium subsp. *parvifolium*		-
Solanum tetrathecum?		-
STACKHOUSIACEAE		
Stackhousia monogyna	R	Creamy candles
Stackhousia vimenea	R	Slender stackhousia
STERCULIACEAE		
Brachychiton populneus subsp. *populneus*	R	Kurrajong
THYMELAEACEAE		
Pimelea linifolia	R	Rice flower
URTICACEAE		
Urtica incisa		Stinging Nettle
VERBENACEAE		
*Glandularia aristigera**		Moss verbena / Mayne's pest
*Verbena bonariensis**		Purple top
VISCACEAE		

Korthalsella rubra subsp. *geijericola*		Jointed mistletoe
Subclass Liliidae (Monocotyledons)		
AMARYLLIDACEAE		
Crinum flaccidum	R	Darling lily / Macquarie lily
ANTHERICACEAE		
Arthropodium milleflorum	R	Vanilla lily
Dichopogon strictus	R	A chocolate lily
Laxmannia gracilis	R	Slender wire lily
Tricoryne elatior	R	Yellow rush-lily
CYPERACEAE		
Cyperus gracilis	R	Slender flat-sedge
Eleocharis acuta	R	Common spike-rush
Fimbristylis dichotoma	R	-
Gahnia aspera	R	Rough saw sedge
Isolepis inundata	R	Swamp club-rush
Lepidosperma laterale	R	Flat sword-sedge
Schoenus ericetorum	R	Heath bog-rush
JUNCACEAE		
Juncus usitatus	R	Common rush
LOMANDRACEAE		
Lomandra filiformis subsp. *filiformis*	R	Iron grass
Lomandra longifolia	R	Spiny-headed mat-rush
Lomandra multiflora subsp. *multiflora*	R	Many-flowered mat-rush
PHORMIACEAE		
Dianella longifolia var. *longifolia*	R	Blue Flax-Lily
Dianella revoluta var. *revoluta*	R	Spreading flax lily
POACEAE		
Aristida benthamii	R	A three-awn speargrass
Aristida jerichoensis	R	Jericho wiregrass
Aristida leichardtiana	R	A wiregrass
Austrodanthonia sp.	R	Wallaby grass
Austrostipa aristiglumis	R	Plains grass
Austrostipa ramosissima	R	Stout bamboo speargrass
Austrostipa verticillata	R	Slender bamboo grass
Bothriochloa decipiens var. *decipiens*		Red grass / red-leg grass
*Cenchrus longispinus**		Innocent weed / spiny burrgrass
*Chloris gayana**		Rhodes grass
Chloris truncata		Windmill grass
Chloris ventricosa		Plump windmill grass / tall chloris
Cleistochloa rigida		-
Cymbopogon refractus		Barbed-wire grass
Digitaria brownii	R	A fingergrass
Digitaria diffusa	R	A fingergrass
Enneapogon gracilis	R	Slender bottle washers / slender nineawn
Entolasia stricta	R	Wiry panic
Eragrostis brownii	R	Brown's love grass
*Eragrostis cilianensis**		Stinkgrass
Eragrostis megalosperma	R	A love grass
*Lolium perenne**		Perennial rye grass
Microlaena stipoides var. *stipoides*	R	Weeping grass
Panicum simile	R	Two colour panic
Paspalidium distans	R	-
Paspalidium gracile	R	-
Paspalum dilatatum	R	Paspalum

Perotis rara	R	Comet grass
Phragmites australis	R	Common Reed
Poa labillardierei var. *labillardierei*	R	Tussock grass
Poa sieberiana var. *sieberiana*	R	Snowgrass
Setaria sp.*		Pigeon grass
*Sorghum halepense**		Johnson grass
Sporobolus caroli	R	Fairy grass / yakka grass
Sporobolus creber	R	Western rat's tail grass
Themeda australis	R	Kangaroo grass
Tragus australianus		Small burrgrass
XANTHORRHOEACEAE		
Xanthorrhoea glauca	R	A grass-tree

This page has intentionally been left blank

Appendix 2

LOCATIONS AND PHYSICAL CHARACTERISTICS OF THE 400m^2 FLORA QUADRATS

This page has intentionally been left blank

Vegetation Structure and Dominant Species in the 400m^2 Flora Quadrats

Quadrat	Size (m)	AMG (GDA 94) Zone 55		Veg. Comm.	Slope	Soil type & colour	Disturbances	Signs of Fire
		Easting	Northing					
1	20x20	772039	6821176	1	Flat on undulating upper slope	Sandy loam (red/brown)	Minor feral animals (pigs etc.)	Minor old charring (>10 yr)
2	20x20	772340	6824432	1	Almost flat – wet depression on upper slope	Silty sand (red)	Minor feral animals	No visible evidence
3	20x20	775264	6823112	2	Flat floodplain	Alluvial – clay / loam	Past clearing/grazing	No visible evidence
4	20x20	772387	6817739	1	Flat – crest	Sandy (light brown/yellow)	Long past clearing/logging	Old charring (>10 yr)
5	20x20	773304	6816870	1	Almost flat – mid slope	Sandy (light brown)	Minor feral animals	Extensive old charring on Ironbark (<5 yr)
6	20x20	774039	6822526	2	Flat – mid slope	Sandy loam (light brown)	Past clearing/ intermittentgrazing	No visible evidence
7	20x20	776039	6820211	4	Flat – lower slope	Clay/ loam – laterite (red/orange)	Past clearing/current grazing	No visible evidence
8	20x20	775169	6821035	2	Very gently undulating – lower slope	Silty sand/clay (light brown)	Past clearing/current grazing	No visible evidence
9	20x20	776209	6821729	3	Flat floodplain	Alluvial – silty clay / loam (brown)	Past clearing/current grazing	No visible evidence
10	20x20	773887	6820175	1	Almost flat – lower slope	Sandy (red)	Intermittent grazing	No visible evidence
11	20x20	774521	6817510	1	Moderate – upper slope	Sandy (light brown) – very rocky (sandstone outcrops)	Minor intermittent grazing	Minor old charring (>10 yr)
12	20x20	774986	6819333	3	Flat – watercourse	Loamy alluvial – dark, rich brown	Past clearing/heavy grazing	No visible evidence
13	20x20	779080	6820595	3	Flat – floodplain	Loamy alluvial – brown	Past clearing/current grazing	No visible evidence
14	20x20	778903	6821085	2	Almost flat	Sandy loam – light brown	Past clearing/current grazing	No visible evidence
15	40x10	779320	6831988	5	Moderate – river bank to 10m height	Loamy alluvial – dark, rich brown	Past clearing/past grazing	No visible evidence
16	40x10	777410	6827582	2	Flat	Sandy / stony - laterite	Roadside maintenance	No visible evidence
17	40x10	777648	6825334	2	Flat	Loam – light brown	Roadside maintenance	No visible evidence

Vegetation Structure and Dominant Species in the 400m^2 Flora Quadrats

Quadrat	Stratum	Height (m)	%Cover*	Dominant Species	Weed Infestation
1	Tree	8	20-35	*Corymbia trachyphloia, Eucalyptus pilligaensis, E. fibrosa, Acacia homalophylla*	Nil
	Shrub	2-3	70-80	*Calytrix tetragona, Phebalium squamulosum*	
	Ground	0-1	0-2	*Goodenia hederacea, Dampiera adpressa, Cleistochloa rigida*	
2	Tree	20-22	30-35	*Callitris glaucophylla, Eucalyptus fibrosa*	Nil
	Shrub	1.5	1	*Calytrix tetragona*	
	Ground	0-1	2-3	*Pomax umbellata, Phebalium squamulosum, Melichrus urceolatus, Dianella revoluta*	
3	Tree	18-22	15-25	*Eucalyptus microcarpa, E. crebra*	Minor – herbaceous pasture weeds
	Sm. tree	4-5	15-20	*Callitris glaucophylla, Capparis mitchellii*	
	Shrub	1-2	5	*Geijera parviflora*	
	Ground	0-1	50-60	Grasses, herbs	
4	Tree	20-22	10-20	*Eucalyptus pilligaensis, E. fibrosa, Callitris glaucophylla*	Nil
	Shrub	1-2	30-40	*Melaleuca erubescens, Leptospermum polygalifolium, Calytrix tetragona*	
	Ground	0-1	20-30	*Homoranthus flavescens, Dianella revoluta, Austrostipa aristiglumis, Eragrostis brownii*	
5	Tree	8	35-40	*Acacia homalophylla, Eucalyptus pilligaensis*	Nil
	Shrub	2	80	*Calytrix tetragona, Phebalium squamulosum, Acacia burrowii*	
	Ground	0-1	2	*Cleistochloa rigida, Eragrostis brownii*	
6	Tree	22-25	20-30	*Eucalyptus microcarpa*	Minor – prickly pear
	Sm. tree	8-10	5-10	*Geijera parviflora, Callitris glaucophylla*	
	Shrub	2	5-15	*Senna* form taxon 'zygophylla'	
	Ground	0-1	60-70	*Aristida benthamii, Chloris ventricosa, Wahlenbergia gracilis, Solanum ferocissimum*	
7	Tree	18-20	50-60	*Callitris glaucophylla*	Minor – prickly pear, pasture weeds
	Ground	0-1	40-50	*Eragrostis cilianensis, Goodenia rotundifolia, Aristida benthamii*	
8	Tree	20-22	10-20	*Eucalyptus microcarpa*	Minor – prickly pear, mother of millions
	Sm. tree	8-10	20-30	*Casuarina cristata*	
	Shrub	3-4	30-40	*Geijera parviflora*	
	Ground	0-1	40-50	*Austrostipa ramosissima, Aristida benthamii, Glycine clandestina, Gonocarpus elatus*	
9	Tree	20-22	10-25	*Eucalyptus microcarpa, E. populnea, Casuarina cristata*	Minor – prickly pear
	Shrub	4-5	20-30	*Geijera parviflora*	
	Ground	0-0.5	50-60	*Austrostipa ramosissima, Chloris truncata, Calotis lappulacea, Einadia* spp.	
10	Tree	15-18	15-25	*Corymbia trachyphloia, Eucalyptus pilligaensis, E. fibrosa, Acacia homalophylla*	Nil
	Shrub	1-2	20-30	*Calytrix tetragona, Persoonia sericea*	
	Ground	0-1	60-70	*Perotis rara, Microlaena stipoides, Eragrostis brownii, Pomax umbellata*	

Quadrat	Stratum	Height (m)	%Cover*	Dominant Species	Weed Infestation
11	Tree	22-25	10-20	*Eucalyptus fibrosa*	Nil
	Sm. tree	8-10	15-25	*Callitris glaucophylla*	
	Shrub	2-3	5-10	*Geijera parviflora, Beyeria viscosa*	
	Ground	0-1	2-3	*Einadia hastata, Austrodanthonia* sp., *Galium binifolium*	
12	Tree	22-25	15-25	*Eucalyptus microcarpa, Casuarina cristata*	Minor – prickly pear, pasture weeds, peppercress
	Sm. tree	6-8	20-30	*Eremophila mitchellii, Beyeria viscosa*	
	Shrub	2-3	5-10	*Geijera parviflora, Acacia penninervis*	
	Ground	0-1	10-20	*Austrostipa verticillata, Sporobolus caroli, Chloris truncata, Gomphrena celosoides*	
13	Tree	22-25	10-20	*Eucalyptus microcarpa, E. blakelyi*	Moderate – mother of millions, African boxthorn
	Sm. Tree	10-12	30-40	*Casuarina cristata, Geijera parviflora*	
	Shrub	1-2	0-5	*Lycium ferocissimum*	
	Ground	0-1	10-20	*Austrostipa aristiglumis, Digitaria diffusa, Lomandra longifolia, Einadia hastata*	
14	Tree	20-23	10-20	*Eucalyptus populnea* subsp. *bimbil, E. microcarpa*	Moderate – African boxthorn
	Sm. tree	8-10	0-10	*Casuarina cristata, Geijera parviflora*	
	Shrub	1-2	0-5	*Lycium ferocissimum*	
	Ground	0-0.5	40-50	*Austrostipa verticillata, Eragrostis brownii, Solanum parvifolium*	
15	Tree	28-32	0-20	*Eucalyptus camaldulensis*	Moderate – exotic pasture grasses and minor herbaceous weeds
	Sm. tree	8-10	0-10	*Acacia stenophylla*	
	Ground	0-1	80-90	*Lolium perenne, Chloris truncata, Marrubium vulgare*	
16	Tree	10-15	0-20	*Eucalyptus populnea* subsp. *bimbil, E. microcarpa, Casuarina cristata*	Minor – roadside herbs
	Sm. tree	7-8	20-30	*Geijera parviflora, Callitris glaucophylla, Eremophila mitchellii*	
	Ground	0-1.5	20-30	*Poa labillardieri, Lolium perenne, Chloris truncata, Aristida benthamii*	
17	Tree	20-22	30-40	*Eucalyptus populnea* subsp. *bimbil*	Moderate – cobblers pegs
	Sm. tree	6-8	40-50	*Geijera parviflora*	
	Ground	0-1.5	60-70	*Chloris truncata, Themeda australis, Bidens pilosa*	

*projective foliage canopy cover

Species Recorded in the 20 x 20 m Flora Quadrats

Species	Quadrat																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Abutilon leucopetalum						6											
Abutilon oxycarpum			3			6	7	8									
Acacia burrowii					5												
Acacia deanei subsp. *deanei*			3			6	7									16	
Acacia homalophylla	1				5					10							
Acacia ixiophylla				4				8									
Acacia neriifolia					5												
Acacia penninervis var. *penninervis*										10							
Acacia pilligaensis		2															
Acacia stenophylla															15		
Acacia sp. (planted)		2															
Actinotus helianthi	1																
Ajuga australis						6											
Allocasuarina diminuta subsp. *diminuta*										10							
Alphitonia excelsa					5			8		10							
Amyema miquelii									9				13				
*Arctotheca calendula**																16	
Aristida benthamii			3			6	7	8		10		12				16	
Austrodanthonia sp.								8			11	12			15		
Austrostipa aristiglumis			3	4				8				12	13	14			
Austrostipa ramosissima			3					8	9								
Austrostipa verticillata		2												14			
Beyeria viscosa											11	12					
*Bidens pilosa**															15		17
Bothriochloa decipiens var. *decipiens*												12			15		
Brachychiton populneus subsp. *populneus*											11						17
Breynia oblongifolia											11						
Brunonielia australis						6			9		11	12					
*Bryophyllum delagoense**								8					13				
Callitris glaucophylla	1	2	3	4	5	6	7	8			11		13			16	
Calotis lappulacea			3			6	7		9					14			
Calytrix tetragona	1	2		4	5					10							
Capparis mitchellii			3														
Cassinia arcuata		2															
Cassytha pubescens	1																
Casuarina cristata												12	13	14		16	
Casuarina cunninghamii						6		8	9				13				

Species	Quadrat																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Casuarina sp. (planted)															15		
*Cenchrus longispinus**			3														
Chamaesyce dallachyana												12					
Chamaesyce drummondii			3														
Chellanthes distans											11						
Chellanthes sieberi subsp. *sieberi*				4	5			8	9				13				
Chloanthes parviflora	1															16	
Chrysocephalum apiculatum																16	
*Chloris gayana**								8	9			12			15		17
Chloris truncata						6											
Chloris ventricosa						6											
Cleistochloa rigida	1				5	6				10							
Corymbia trachyphloia subsp. *sfomatica*	1	2						8	9			12					
Crassula sieberiana subsp. *sieberiana*				4													
Cryptandra longistaminea						6											
Cymbopogon refractus												12			15		
Cyperus gracilis	1																17
Dampiera adpressa																	
Dianella longifolia var. *longifolia*		2	3	4		6		8			11						
Dianella revoluta var. *revoluta*						6	7	8				12			15		17
Dichondra repens													13				
Digitaria diffusa						6		8									
Dodonaea viscosa subsp. *spatulata*								8	9		11		13	14			
Einadia hastata											11	12	13		15		17
Einadia nutans subsp. *nutans*								8	9			12					
Einadia trigonos				4	5			8		10				14			17
Eragrostis brownii							7										
*Eragrostis cilianensis**						6					11	12				16	
Eremophila debilis																	
Eremophila mitchellii			3											13	14		
Eucalyptus albens															15		
Eucalyptus blakelyi																	
Eucalyptus camaldulensis																	
Eucalyptus crebra			3														
Eucalyptus fibrosa	1	2		4						10	11						
Eucalyptus microcarpa			3			6		8	9			12	13	14		16	
Eucalyptus pilligaensis	1			4	5					10							
Eucalyptus populnea subsp. *bimbil*									9					14		16	17
Exocarpus cupressiformis				4													
Fimbristylis dichotoma							7	8									17

Species	Quadrat																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fumaria sp.*																	17
Gahnia aspera						6											
Galium binifolium											11						
Geijera parviflora			3			6		8	9		11	12		14	15	16	17
Geranium solanderi													13				
*Glandularia aristigera**															15	16	
Glycine clandestina				4				8									
Glycine tabacina sens. lat.							7					12					17
*Gomphrena celosioides**								8	9			12					
Gonocarpus elatus	1	2						8	9	10							
Goodenia hederacea var. *hederacea*	1	2		4						10							
Goodenia rotundifolia							7										
Homoranthus flavescens				4													
*Hypochaeris radicata**													13	14			
Hypochaeris sp.			3														
Isolepis inundata		2															
Isotoma axillaris											11						
Laxmannia gracilis						6		8									
Lepidium sp.*									9						15		17
Lepidosperma laterale	2																
Leptospermum polygalifolium subsp. *transmontanum*				4													
Logania albiflora					5												
*Lolium perenne**															15		
Lomandra longifolia													13				
Lomandra multiflora subsp. *multiflora*			3														
*Lycium ferocissimum**													13	14			
Maclura cochinchensis?											11						
*Malva parviflora**														14	15		
*Marrubium vulgare**															15		
Maytenus cunninghamii			3														
Melaleuca erubescens				4													
*Medicago polymorpha**															15		
*Medicago sativa**																16	
Melichrus urceolatus	1	2		4						10							
Microlaena stipoides var. *stipoides*										10	11						
Myoporum montanum									9							16	
Notelaea microcarpa var. *microcarpa*						6			9								
Opuntia stricta var. *stricta**			3			6	7	8	9			12	13	14			17
Oxalis perennans				4								12	13	14			
Parsonsia eucalyptophylla			3		5						11						

Species	Quadrat																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Paspalidium distans															15		17
*Paspalum dilatatum**															15		
*Pavonia hastata**															15		
Perotis rara										10							
Persoonia sericea		2		4						10							
Phebalium squamulosum subsp. *gracile*	1	2		4	5												
Phragmites australis															15		
Phyllanthus gunnii												12					
Phyllanthus sp.								8									
Platysace ericoides	1																
Plantago cunninghamii													13				
Poa labillardierei var. *labillardierei*																16	
Poa sieberiana var. *sieberiana*														14			
Pomax umbellata	1	2		4		6				10							
Rhagodia spinescens									9			12					
Rostellularia adscendens			3														
Rumex brownii													13				
Sclerolaena birchii								8						14	15		
Senna form taxon 'zygophylla'						6											
Setaria sp.																	17
Sida corrugata									9			12		14			
*Sida rhombifolia**															15		
Solanum amblymerum							7					12					
Solanum ferocissimum				4		6		8			11		13	14			
Solanum parvifolium subsp. *parvifolium*			3											14	15		
Solanum tetrathecum?									9								
Sporobolus caroli												12					
Themeda australis																	17
Urtica incisa														14			
*Verbena bonariensis**															15		17
Vicia sativa subsp. *nigra**															15		
Vittadinia cuneata			3			6		8			11			14	15		
Wahlenbergia gracilis						6											
*Xanthium occidentale**															15		

This page has intentionally been left blank

Appendix 3

Actions Required in Relation to Notifiable Weeds Pursuant to the *Noxious Weeds Act 2003*

This page has intentionally been left blank

Section 8 of the amended Noxious Weeds Act 1993 classifies noxious weeds into 5 weed control classes as follows:

(a) Class 1 - State Prohibited Weeds,
(b) Class 2 - Regionally Prohibited Weeds,
(c) Class 3 - Regionally Controlled Weeds,
(d) Class 4 - Locally Controlled Weeds,
(e) Class 5 - Restricted Plants.

The characteristics of each class are as follows:

(a) Class 1 noxious weeds are plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.
(b) Class 2 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.
(c) Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.
(d) Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.
(e) Class 5 noxious weeds are plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

A noxious weed that is classified as a Class 1, 2 or 5 noxious weed is referred to in the Act as a "**notifiable weed**".

The relevant sections of the Act that define the actions required in relation to **notifiable weeds** are reproduced below:

Section 15: An occupier of land (other than a local control authority) on which there is a **notifiable weed** must notify the local control authority for the land of that fact within 3 days after becoming aware that the **notifiable weed** is on the land. ***Maximum penalty (for an occupier other than a public authority): 20 penalty units***

Section 16: For the purpose of proving in any prosecution under section 15 (1) that an occupier of land was aware that a **notifiable weed** was located on the land, if it is proved that the occupier or an employee of the occupier or other person using the land ought reasonably to have known that a **notifiable weed** was located on the land, that is evidence that the occupier was aware that it was on the land.

Section 28:
(1) A person (including a public authority) must not sell or purchase:
(a) any **notifiable weed** material or other noxious weed material prescribed by the regulations, or
(b) any animal or thing which has on it, or contains, **notifiable weed** material or other noxious weed material prescribed by the regulations, knowing it to be, or to have on it or to contain, any such weed material.
(2) An occupier of land (including a public authority) must not knowingly remove or cause to be removed from the land any animal or thing which has on it, or contains, **notifiable weed material** or other noxious weed material prescribed by the regulations. ***Maximum penalty: 50 penalty units.***
(3) Notifiable weed material:

(a) in subsection (1) extends to the weed material of a weed that is a **notifiable weed** in any part of the State, and
(b) in subsection (2) is limited to the weed material of a weed that is a **notifiable weed** in that part of the State that includes the land that is relevant for the purposes of that subsection.

Section 29: An occupier of land (including a public authority) must not use or permit the land to be used for the purpose of disposing of, transporting or selling soil, turf or fodder, if the occupier knows, or ought reasonably to know, that there is a weed on the land that is a **notifiable weed** in any part of the State.
***Maximum penalty: 50 penalty units*.**

Section 40: An inspector who has reasonable cause to suspect that **notifiable weed** material of a weed that is a notifiable weed in any part of the State is or may be present in an agricultural machine may require the person apparently in charge of the machine to treat the machine immediately, in the manner specified by the inspector, to remove any such weed material.

For further information about notifiable noxious weeds, contact: Weeds Hotline 1800 680 244 or email: weeds@dpi.nsw.gov.au (NSW Department of Primary Industries).

Appendix 4

Fauna Recorded within the Study Area

This page has intentionally been left blank

FAUNA RECORDED WITHIN THE STUDY AREA

Notes:
* indicates introduced species (not native to the area), **Bold** indicates a threatened species, V - Vulnerable, E – Endangered, M- Migratory, X – species recorded.
H – Hair tube sample, S – Scat identification, P – Probable identification, D – Definite identification.

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Amphibians = 10							
Family: MYOBATRACHIDAE							
Lechriodus fletcheri	Fletcher's frog						X
Limnodynastes ornatus	Ornate burrowing frog			X	X	X	X
Limnodynastes tasmaniensis	Spotted grass frog						X
Limnodynastes terraereginae	Northern banjo frog				X		
Uperoleia rugosa	Wrinkled burrowing toadlet				X		
Cyclorana alboguttata	Striped burrowing frog						X
Family: HYLIDAE							
Litoria caerulea	Green tree frog						X
Litoria latopalmata	Broad-palmed frog					X	
Litoria peronii	Peron's tree frog					X	X
Litoria rubella	Desert tree frog						X
Reptiles = 16							
Family: *CHELIDAE*							
Chelodina longicollis	Eastern snake-necked turtle						X
Family: *GEKKONIDAE*							
Diplodatylus vittatus	Wood gecko			X	X		
Gehyra dubia	Dubious dtella			X		X	X
Heteronotia binoei	Bynoe's dtella					X	X

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Strophurus williamsi	Eastern spiny-tailed gecko				X	X	
Family: *AGAMIDAE*							
Amphibolurus nobbi	Nobbi				X	X	X
Pogona barbata	Bearded dragon						X
Family: *VARANIDAE*							
Varanus gouldii	Sand monitor						X
Varanus varius	Lace monitor			X			X
Family: *SCINCIDAE*							
Cryptoblepharus carnabyi	Spiny-palmed shinning-skink			X			X
Egernia striolata	Tree skink			X	X	X	X
Lygisaurus foliorum	Tree-base litter-skink				X		X
Lerista punctatovittata	Spotted lerista			X		X	X
Menetia greyii	Common dwarf skink				X		
Morethia boulengeri	South-eastern morethia Skink				X		
Family: ELAPIDAE							
Demansia psammophis	Yellow-faced whip snake						X
Hoplocephalus bitorquatus	**Pale-headed snake**	V				**X**	
Birds = 93							
Family: *CASUARIIDAE*							
Dromaius novaehollandiae	Emu						X
Family: *PHASIANIDAE*							
Cortumix pectoralis	Stubble quail						X

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Family: *ANATIDAE*							
Chenonetta jubata	Australian wood duck						X
Anas superciliosa	Pacific black duck						X
Family: *PODICIPEDIDAE*							
Tachybaptus novaehollandiae	Australasian grebe						X
Family: *ARDEIDAE*							
Egretta novaehollandiae	White-faced heron						X
Ardea pacifica	Pacific heron						X
Family: *THRESKIORNITHIDAE*							
Threskiomis molucca	Australian white ibis						X
Family: *ACCIPITRIDAE*							
Elanus axillaris	Black-shouldered kite						X
Accipiter cirrhocaphalus	Collared sparrowhawk			X			X
Aquila audax	Wedge-tailed eagle						X
Family: *FALCONIDAE*							
Falco berigora	Brown falcon						X
Falco cenchroides	Nankeen kestrel						X
Falco longipennis	Australian hobby						X
Family: *TURNICIDAE*							
Turnix varia	Painted button-quail				X		
Family: *CHARADRIIDAE*							
Vanellus miles	Masked lapwing						X

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Family: *COLUMBIDAE*							
Phaps chalcoptera	Common bronzewing			X	X	X	X
Ocyphaps lophotes	Crested pigeon			X	X		X
Geopelia placida	Peaceful dove			X			X
Geopelia humeralis	Bar-shouldered dove			X			X
Family: *CACATUIDAE*							
Calyptorhynchus lathami	**Glossy black-cockatoo**	V				X	X
Eolophus roseicapillus	Galah			X			X
Cacatua sanguinea	Little corella						X
Nymphicus hollandicus	Cockatiel						X
Family: *PSITTACIDAE*							
Glossopsitta concinna	Musk lorikeet				X	X	X
Alisterus scapularis	Australian king parrot						X
Platycercus eximius	Eastern rosella						X
Aprosmictus erythropterus	Red-winged parrot						X
Northiella haematogaster	Blue bonnett						X
Barnardius zonarius	Australian ringneck						X
Psephotus haematonotus	Red-rumped parrot						X
Polytelis swainsonii	**Superb parrot**	V					X
Family: *CUCULIDAE*							
Chalcites osculans	Black-eared cuckoo					X	
Chalcites basalis	Horsefield's bronze-cuckoo			X			
Family: *STRIGIDAE*							
Ninox boobook	Southern boobook			X		X	X
Family: *PODARGIDAE*							
Podargus strigoides	Tawny frogmouth			X	X	X	X

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Family: *AEGOTHELIDAE*							
Aegotheles cristatus	Australian owlet-nightjar			X	X	X	X
Family: *APODIDAE*							
Hirundapus caudacutus	White-throated needletail		M	X			X
Family: *ALCEDINIDAE*							
Dacelo novaeguineae	Laughing kookaburra				X	X	X
Todiramphus sanctus	Sacred kingfisher			X		X	
Family: *MEROPIDAE*							
Merops ornatus	Rainbow bee-eater		M	X		X	X
Family: *CORACIIDAE*							
Eurystomus orientalis	Dollarbird			X		X	
Family: *CLIMACTERIDAE*							
Cormobates leucophaeus	White-throated Treecreeper			X	X	X	X
Family: *MALURIDAE*							
Malurus cyaneus	Superb fairy-wren				X		X
Malurus lamberti	Variegated fairy-wren				X		X
Family: *PARDALOTIDAE*							
Pardalotus punctatus	Spotted pardalote			X		X	X
Pardalotus striatus	Striated pardalote			X			X
Chthonicola sagittata	**Speckled warbler**	V			X	X	X
Smicrornis brevirostris	Weebill			X	X	X	X
Gerygone fusca	Western gerygone			X			X
Acanthiza pusilla	Brown thornbill				X		X

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Acanthiza reguloides	Buff-rumped thornbill				X	X	X
Acanthiza chrysorrhoa	Yellow-rumped thornbill						X
Acanthiza nana	Yellow thornbill			X			X
Family: *MELIPHAGIDAE*							
Acanthagenys rufogularis	Spiny-cheeked honeyeater			X			X
Plectorhyncha lanceolata	Striped honeyeater			X		X	X
Philemon corniculatus	Noisy friarbird			X	X	X	X
Entomyzon cyanotis	Blue-faced honeyeater						X
Manorina melanocephala	Noisy miner				X	X	X
Lichenostomus chrysops	Yellow-faced honeyeater			X			X
Lichenostomus leucotis	White-eared honeyeater			X	X	X	X
Lichenostomus chrysops	White-plumed honeyeater						X
Lichenostomus virescens	Singing honeyeater						X
Melithreptus brevirostris	Brown-headed honeyeater			X	X		X
Family: *PETROICIDAE*							
Microeca fascinans	Jacky winter						X
Petroica goodenovii	Red-capped robin						X
Eopsaltria australis	Eastern yellow robin				X	X	X
Family: *POMATOSTOMIDAE*							
Pomatostomus temporalis	**Grey-crowned babbler**	**V**			X		X
Family: *NEOSITTIDAE*							
Daphoenositta chrysoptera	Varied sitella						X
Family: *PACHYCEPHALIDAE*							

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Pachycephala rufiventris	Rufous whistler			X		X	X
Colluricincla harmonica	Grey shrike-thrush			X	X		X
Family: *DICRURIDAE*							
Myiagra rubecula	Leaden flycatcher			X			X
Myiagra inquieta	Restless flycatcher						X
Grallina cyanoleuca	Magpie-lark						X
Rhipidura fuliginosa	Grey fantail			X	X		X
Rhipidura leucophrys	Willie wagtail						X
Family: *CAMPEPHAGIDAE*							
Coracina novaehollandiae	Black-faced cuckoo-shrike						X
Coracina tenuirostris	Cicadabird						X
Lalage sueurii	White-winged triller						X
Family: *ORIOLIDAE*							
Oriolus sagittatus	Olive-backed oriole						X
Family: *ARTAMIDAE*							
Cracticus torquatus	Grey butcherbird				X		X
Cracticus nigrogularis	Pied butcherbird					X	X
Gymnorhina tibicen	Australian magpie					X	X
Strepera graculina	Pied currawong				X	X	X
Family: *CORVIDAE*							
Corvus coronoides	Australian raven						X
Family: *CORCORACIDAE*							
Corcorax melanorhamphos	White-winged chough				X		X
Stuthidae cinerea	Apostlebird						X

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Family: *PTILONORHYNCHIDAE*							
Chlamydera maculata	Spotted bowerbird						X
Family: *MOTACILLIDAE*							
Anthus novaeseelandiae	Richard's pipit						X
Family: *PASSERIDAE*							
Taeniopygia bichenovii	Double-barred finch				X		X
Stagonopleura guttata	**Diamond firetail**	V					X
Family: *DICAEIDAE*							
Dicaeum hirundinaceum	Mistletoebird			X	X	X	X
Family: *HIRUNDINIDAE*							
Hirundo neoxena	Welcome swallow						X
Hirundo ariel	Fairy martin						X
Family: *SYLVIIDAE*							
Cincloramphus mathewsi	Rufous songlark						X
Cincloramphus cruralis	Brown songlark						X
Family: *STURNIDAE*							
Sturnus vulgaris *	Common starling						X
Acridotheres tristis *	Common myna						X
Mammals = 30							
Family: *TACHYGLOSSIDAE*							
Tachyglossus aculeatus	Short-beaked echidna			X	X		X
Family: *DASYURIDAE*							
Antechinus flavipes	Yellow-footed antechinus				X		

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Antechinus stuartii	Brown antechinus			P			X
Sminthopsis murina	Common dunnart						
Family: *PHASCOLARCTIDAE*							
Phascolarctos cinereus	**Koala**	V				S	
Family: *BURRAMYIDAE*							
Cercartetus nanus	**Eastern pygmy-possum**	V			X		
Family: *PETAURIDAE*							
Petaurus breviceps	Sugar glider			X			X
Family: *PHALANGERIDAE*							
Trichosurus vulpecula	Common brushtail possum				H	X	X
Family: *MACROPODIDAE*							
Macropus giganteus	Eastern grey kangaroo						X
Macropus dorsalis	**Black-striped wallaby**	E				P	
Macropus robustus	Common wallaroo						X
Macropus rufogriseus	Red-necked wallaby					X	X
Wallabia bicolor	Swamp wallaby			H	P		X
Family: *Pteropodidae*							
Pteropus scapulatus	Little red flying-fox			X	X		X
Family: *EMBALLONURIDAE*							
Saccolaimus flaviventris	**Yellow-bellied sheath-tail bat**	V		D	D	D	

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic	
Family: *MOLOSSIDAE*								
Mormopterus sp. 2 (Adams et al)	A freetail-bat			P		P		
Mormopterus sp. 3 (Adams et al)	Inland freetail-bat			D		P	X	
Mormopterus sp. 4 (Adams et al)	Southern freetail-bat			D	D	D	X	
Tadarida australis	White-striped freetail-bat			D	D	D	X	
Family: *VESPERTILIONIDAE*								
Nyctophilus geoffroyi	Lesser long-eared bat						X	
Nyctophilus gouldi	Gould's long-eared bat						X	
Nyctophilus timoriensis	**Greater long-eared bat**	V	V				X	
Chalinolobus gouldii	Gould's wattled bat			D	D	D	X	
Chalinolobus morio	Chocolate wattled bat			D	D	D	X	
Chalinolobus picatus	**Little pied bat**	V				P		
Scotorepens balstoni	Inland broad-nosed bat			D	D	D	X	
Scotorepens greyi	Litte broad-nosed bat			D	D	D	X	
Vespadelus vultumus	Little forest bat			D	D	D	X	
Family: *MURIDAE*								
Pseudomys delicatulus	**Delicate mouse**	E	E			X		
Mus musculus *	House mouse						X	
Rattus rattus *	Black rat						X	
Rattus spp.				P				
Family: *CANIDAE*								
Canis familiaris *	Dog					H		
Vulpes vulpes *	Fox					X	X	
Family: *LEPORIDAE*								

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Southern Site	Central Site	Northern Site	Opportunistic
Oryctolagus cuniculus *	Rabbit						X
Lepus capensis *	Brown hare						X
Family: *SUIDAE*							
Sus scrofa *	Pig			X			X
Family: *BOVIDAE*							
Capra hircus *	Goat						X

This page has intentionally been left blank

Appendix 5

Project Personnel and Relevant Licenses

This page has intentionally been left blank

REPORT COMPONENT	STUDY TEAM MEMBERS	QUALIFICATIONS
Overall project management, fauna field surveys, habitat descriptions & impact assessment, report writing.	Steven Cox	B. Appl. Sci. (Hons), MECA
Flora field surveys, flora descriptions & impact assessment, report writing.	Stefan Rose	B.A. (Biol. Sci), M.Env.Stud., MAIBiol, MECA, DECC-Accredited Biobanking Assessor
Literature review	Amy Rowles	B. Sc. (Hons) Biology/Ecology
Fauna field survey, Anabat file analysis.	Narawan Williams	TAFE Cert II (Conserv. & Land Mgt. Nat. Area Rest.)
Flora and fauna field surveys, figure preparation.	Jenny Lewis	B.Sc (Res. & Env. Mgt.), TAFE Cert II (Conserv. & Land Mgt. Nat. Area Rest.), MECA
Report Review	Brian Wilson	B. Appl. Sc. (Env. Biol.) Adv. Dip. Bus. Mgmt MAIBiol, MEIANZ, MECA

Relevant licences held by Ecotone Ecological Consultants

TYPE	FOR	LICENCE NO	NAME	DATE VALID TO	ORGANISATION	LOCATION
Animal Research Authority	Vertebrate Fauna Surveys	08/8633	Brian Wilson	15-Nov-09	Animal care and ethics committee of the Director-General of NSW Agriculture	NSW
Certificate of Approval	Vertebrate Fauna Surveys	08/8633	Brian Wilson	15-Nov-11		
Licence to	Access NPWS Wildlife Atlas Data Base	CON93002	Brian Wilson	30-Jun-09	NSW Department of Environment and Climate Change	
Scientific Licence	Harm/ trap/ release: protected fauna; pick/ hold: native flora	S10555	Brian Wilson Stefan Rose Jenny Lewis Amy Williams Narawan Williams Anne Williams Steven Cox	30-Nov-09		
	As above plus bat banding	S10556	Ray Williams	31-Dec-09		

This page has intentionally been left blank