APPENDIX H

Terrestrial ecology assessment

Cobbora Holding Company Pty Limited

EMM
EMGA Mitchell McLennan

Terrestrial ecology assessment

Cobbora Coal Project

Prepared for Cobbora Holding Company Pty Limited | 17 September 2012

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065

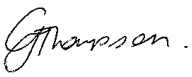
T +61 2 9493 9500
F +61 2 9493 9599
E info@emgamm.com

emgamm.com

Terrestrial ecology assessment

Final

Report J11030RP5 | Prepared for Cobbora Holding Company Pty Limited | 17 September 2012

Prepared by	**C. Thompson, R. Baker and K. Whiting**	Approved by	**P. Towler**
Position	Senior Ecologists	Position	Associate Director
Signature		Signature	
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EMM
EMGA Mitchell McLennan

T +61 (0)2 9493 9500 | F +61 (0)2 9493 9599

Ground Floor | Suite 01 | 20 Chandos Street | St Leonards | New South Wales | 2065 | Australia

emgamm.com

Executive Summary

ES1 Introduction

The Cobbora Coal Project (the Project) is an open cut coal mine proposed by Cobbora Holding Company Pty Limited (CHC). The Project will supply thermal coal, primarily to power stations in New South Wales (NSW). In addition, some coal will be produced for a combination of the export and spot domestic markets. Construction is planned to commence in mid-2013, with mine operations starting in the first half of 2015. A mine life of 21 years is proposed.

The Project will include an open cut coal mine, a coal handling and preparation plant, mine infrastructure area, coal stockpiling and train loading facility. Associated infrastructure will include a rail spur line, water supply pipeline, pumping station, access roads, power lines and an electricity substation.

The Project is located near Cobbora in the central west of NSW on the boundary between the Warrumbungle, Wellington and Mid-Western Regional local government areas (LGAs). It occurs within the Central West Catchment Management Authority (CMA) area and the Talbragar Valley CMA subregion.

The study area encompasses a project application area (PAA) of 24,600 hectares (ha), with a Project footprint of up to 4,700 ha. Six areas protected under the NSW *National Parks and Wildlife Act* 1974 (NPW Act) occur within, or in close proximity to, the study area. These are the Goodiman State Conservation Area (SCA); Yarrobil National Park (NP); Cobbora SCA and surrounding land vested under the NPW Act; Dapper Nature Reserve (NR); and Goonoo SCA. Tuckland State Forest (SF) also occurs within the study area.

The Project is being assessed under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), with an environmental assessment (EA) being prepared by EMGA Mitchell McLennan Pty Ltd (EMM). The Project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) in December 2011 and was declared a 'controlled action' under the *Environment Protection and Biodiversity Conservation Act 199*9 (EPBC Act).

The Director General's environmental assessment requirements (DGRs) requested a biodiversity impact assessment be undertaken for the Project. This report forms the terrestrial component of the biodiversity impact assessment, comprising a terrestrial ecology impact assessment report (TEIA). The purpose of this TEIA is to provide a baseline of the flora and fauna species, populations and communities that occur within the study area and assess impacts to these as a result of the proposed Project. The TEIA specifically aims to:

- identify and describe the terrestrial ecology of the study area;
- determine if threatened species, populations and communities occur within the study area;
- determine the potential impacts likely as a result of the Project and assess the significance of any impacts to threatened species, populations and communities; and
- provide recommendations to ameliorate or compensate (via offsets) for any potential impacts.

ES2 Methods

Relevant literature, databases and vegetation mapping were reviewed to characterise the ecological attributes of the PAA. The reviewed information was used to inform and design detailed field surveys to identify threatened species, populations and communities and their habitat within the PAA, in accordance with the OEH and DPI guidelines.

Biodiversity surveys were undertaken in the PAA between 2009 and 2012 (Table ES.1). The survey period spanned all seasons and surveys were undertaken in both dry and wet periods. This maximised the chances of recording species occurring within the PAA.

Table ES.1 Summary of terrestrial biodiversity surveys within the PAA

Taxa group	Survey method	Survey timing
Flora	Preliminary vegetation surveys	Winter and Spring 2009
	Plot surveys	Spring 2009 and 2011
	Rapid vegetation assessments	Spring 2009 and 2011
	Targeted threatened flora searches	Summer-Autumn 2010, Spring-Summer 2011
Fauna	Habitat assessments and searches for signs	Spring 2009, Summer-Autumn 2010, Spring-Summer 2011
Reptiles	Active search	Summer 2011
	Nocturnal search	Summer 2011
Birds	Timed diurnal search	Winter and Spring 2009, Summer and Autumn 2010, Winter and Summer 2011
Microchiropteran bats	Anabat detection	Spring 2009 and 2011
	Harp trapping	Spring 2011
Non-flying mammals	Arboreal hair tubes	Spring-Summer 2011
	Ground hair tubes	Spring 2009, Summer 2011
	Koala spot assessment	Summer 2011
	Infrared camera surveys	Spring 2009, Summer 2011
Nocturnal birds and mammals	Call broadcasting and spotlighting	Spring and Summer 2009, Spring and Summer 2011

ES2.1 Flora surveys

Flora surveys were undertaken to identify and characterise the vegetation types occurring in the PAA and to identify threatened species, populations and ecological communities present or potentially occurring in the PAA.

Flora surveys and vegetation mapping consisted of:

- reviewing vegetation mapping projects previously undertaken within the PAA;
- aerial photograph interpretation;
- field validation of spatial vegetation patterns using rapid assessments;
- quantitative plot-based surveys (400 m^2) of each vegetation type; and

- targeted flora searches for rare and/or threatened flora using formal transect surveys and the random meander method.

Vegetation plots were placed in areas indicative of each vegetation type present to ensure that the composition and condition of the vegetation present was appropriately represented. The number of plots surveyed complied with requirements according to site stratification (DEC and DPI, 2005). Plot data was used for the identification of threatened ecological communities in accordance with SEWPaC and OEH identification guidelines.

ES2.2 Fauna surveys

Fauna surveys were undertaken to determine the faunal assemblages occurring in the PAA and to identify threatened species and populations present or potentially occurring in the PAA. Habitat for threatened fauna species was identified based on mapped vegetation types, landscape position and species records for the area. Methods used to identify fauna of the PAA included:

- review of database records and existing literature;
- fauna habitat assessments;
- active diurnal and nocturnal searches for reptiles and amphibians;
- diurnal and nocturnal bird surveys and call broadcasting;
- microbat echolocation detection, trapping and roost surveys;
- mammal hair sampling, infrared camera surveys, spotlighting and Koala (*Phascolarctos cinereus*) spot assessments; and
- active searches for tracks, scats and signs of use.

Survey effort for threatened fauna generally met or exceeded applicable guidelines. However, Elliot and cage trapping were not undertaken. The mammal species targeted by surveys were considered to be detectable using other methods including hair sampling, scat analysis, infrared cameras, spotlighting and call playback, which had recorded the target species in nearby reserves (NPWS, 2000).

ES3 Results

ES3.1 Regional and local setting

The PAA is on the boundary of the South West Slopes and Brigalow Belt South bioregions which is characterised by diverse and varied habitat types and an array of flora and fauna assemblages. The Brigalow Belt South Bioregion lies on the transition zone between eastern, western and northern biotic elements and is an important area for biodiversity as it contains unique assemblages of fauna and flora (NPWS, 2000).

The PAA is within the Central West Catchment Management Area. The landform changes from tablelands to plains in this region and there is a decrease in rainfall in an east-west gradient, creating an ecological transition area where a number of species converge (Bauer and Goldney, 2000). In particular, the eastern part of the region contains the highest diversity of vertebrate fauna species in the region (Goldney *et al*, 2007). However, the region has a history of agricultural land use, with approximately 60% of woody native vegetation estimated to have been cleared (Benson *et al,* 2010). This past disturbance has been linked with a vertebrate species decline in the region (Bauer and Goldney, 2000).

An estimated 10% of remnant native vegetation in the Brigalow Belt South Bioregion is within protected areas (Goldney *et al*, 2007). There are three protected areas in the PAA; Yarrobil National Park (NP), Goodiman State Conservation Area (SCA) and Tuckland State Forest, which constitute 10% of the total PAA area. Large reserves in the study area, but outside the PAA include Cobbora SCA, Goonoo SCA and Dapper Nature Reserve. Threatened species recorded within these large protected areas include the Malleefowl (*Leipoa ocellata*), Glossy Black-cockatoo (*Calyptorhynchus lathami*), Pilliga Mouse (*Pseudomys pilligaensis*), Koala, Eastern Pygmy-possum (*Cercartetus nanus*), Squirrel Glider (*Petaurus norfolcensis*), Barking Owl (*Ninox connivens*), Ingram's Zieria (*Zieria ingramii*) and Ausfeld's Wattle (*Acacia ausfeldii*).

ES3.2 Ecological communities

The PAA has been highly disturbed by agricultural land uses including intensive grazing, fire wood collection and pasture improvement. Remnant and regenerating woodland vegetation only covers 36% of the PAA, including that within protected areas. In general, remnant vegetation of the PAA is confined to roadside verges and areas of steeper topography. The remaining area (64%) is made up of agricultural areas dominated by grasslands.

Eighteen vegetation types were recorded within the PAA. The most common were:

- Grasslands (Native Pasture and Introduced Pasture/Disturbed);
- Blue-leaved Ironbark Woodland;
- Regrowth (representative of the Blue-leaved Ironbark Woodland community);
- Grey Box Woodland;
- Slaty Gum Woodland;
- Cypress Pine Woodland;
- Red Stringybark Woodland;
- Box Gum Grassy Woodland; and
- Dwyer's Red Gum Woodland.

Three threatened ecological communities (TECs) were identified in the PAA:

- Box Gum Grassy Woodland (incorporating the Box Gum Grassy Woodland, Blakely's Red Gum Woodland and Rough-barked Apple Woodland vegetation types), listed as *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community* under the EPBC Act and *White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community* under the TSC Act;

- Inland Grey Box Woodland (comprising the mapped Grey Box Woodland vegetation type) listed as *Grey Box* (*Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia endangered ecological community* under the EPBC Act and *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions endangered ecological community* under the TSC Act; and

- Fuzzy Box Woodland (comprising the Fuzzy Box Woodland type) listed as *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions endangered ecological community* under the TSC Act.

In general box woodlands, including those listed as TECs, occurred on the floodplains in the PAA. These areas have been heavily disturbed through cropping, pasture improvement and intensive grazing regimes, with remnant vegetation in these areas often occurring in small patches which had not been substantially impacted by agricultural activities. This included along the major creeks and their floodplain, and the roadside verges.

Red gum woodlands occurred on flat topography at the foot of gentle and steep slopes. Cypress woodlands occurred on gentle midslopes to steep upper slopes, while ironbark/stringybark woodlands occurred on gentle midslopes to steep upper slopes. These usually contained large rocky sandstone or granite outcrops, while those dominated by ironbark contained sandstone or lateritic outcropping. Feral herbivores and firewood collection appeared to be impacted on these vegetation types.

Grasslands occurred in the lower lying more fertile parts of the PAA. Grasslands present are either poor condition and low diversity native pastures or improved pastures dominated by exotic species. Native pasture areas were not representative of vegetation communities that would have occurred prior to clearing and agricultural activities, and were not considered to be consistent with the definition of any derived native grassland listed under the TSC Act or the EPBC Act.

ES3.3 Groundwater dependent ecosystems

Rain-fed springs were identified at the intersection of the basalt hilltops in the south of the PAA and the northern side of the Talbragar River. The vegetation associated with these areas is likely to be dependent on groundwater availability. These areas occur outside the Project footprint and are dependent on the rain-fed aquifers associated with the basalt hilltops.

Ground and surface water interactions are likely to occur in the riparian zones of the PAA where alluvial sediments retain shallow groundwater systems fed by rainwater infiltration. Groundwater modelling has identified that these may provide baseflow to deep pools in the creeks and rivers, with groundwater potentially available to deep-rooted terrestrial vegetation.

Modelling of the distribution of alluvial sediments where the water table may be within tree rooting depth (within 3 m of the surface) does not correlate with any specific vegetation types. Only 4.5 ha of wooded vegetation occurs in these areas, with more than six vegetation communities represented. The vegetation within the riparian zone of the PAA is not typically known for groundwater dependence with dominant species including Yellow Box (*Eucalyptus melliodora*), Fuzzy Box (*Eucalyptus conica*), Blakely's Red Gum (*Eucalyptus blakelyi*) and Rough-barked Apple (*Angophora floribunda*). These communities also occur elsewhere within the PAA where alluvium is deep or absent. Any groundwater use by terrestrial vegetation in riparian areas is therefore assumed to be opportunistic rather than dependent where alluvial sediments occur.

ES3.4 Flora

Four threatened flora species were recorded in the PAA. These species, along with their conservation status and details of occurrence are listed in Table ES.2.

Table ES.2 Recorded threatened flora

Common name	Status		Details of occurrence
	TSC Act	EPBC Act	
Ausfeld's Wattle *Acacia ausfeldii*	V	-	Recorded along roadsides, along Brooklyn Road in Goodiman State Conservation Area within Blue-leaved Ironbark and Slaty Gum Woodland, and along Spring Ridge Road and Sandy Creek Road in Mugga Ironbark Grey Box Woodland. A large sub-population was recorded in regrowth vegetation, where it was the dominant species, adjacent to Goodiman SCA. The sub-population in this area was estimated at 55,000 individuals, based on 10 m by 10 m plots recording 100 plants. It is estimated that 56,000 plants occur within the study area.
Ingram's Zieria *Zieria ingramii*	E	E	Recorded on gentle slopes and relatively flat topography in Blue-leaved Ironbark Woodland, Red Stringybark Woodland or less commonly in Dwyer's Red Gum Woodland; 1,255 individual plants in 15 sub-populations were recorded.
Homoranthus darwinioides	V	V	Two sub-populations were recorded as 427 individuals in Dwyer's Red Gum Woodland, Blue-leaved Ironbark Woodland and surrounding regrowth. *H. darwinioides* was most abundant where the canopy was sparse. In the regrowth areas, it occurred as large solitary plants on bare ground amongst dense patches of Sifton Bush. The sub-population occurs on a light brown sandy loam with loose sandstone rocks at the surface.
Tylophora linearis	V	E	Nine individuals were recorded in two sub-populations in Blue-leaved Ironbark and Red Gum Woodlands.

Note: 1. TSC Act (NSW) - Threatened Species Conservation Act 1995, EPBC Act (Cth) - Environment Protection and Biodiversity Conservation Act 1999, V - vulnerable, E – endangered.

The majority of flora species recorded within the PAA were native. Of the 257 species recorded, only 18% were exotic. Of the exotic species recorded, four are listed as noxious weeds:

- St John's Wort (*Hypericum perforatum*);
- African Boxthorn (*Lycium ferocissimum*);
- Common Prickly Pear (*Opuntia stricta*); and
- Blackberry (*Rubus fruticosus sp. aggreagata*).

ES3.5 Fauna

ES3.5.1 Fauna habitat

The PAA provides a range of habitat resources for fauna species, including hollow-bearing trees, fallen timber, flowering trees and shrubs, woody fruits and seeds, rocky outcrops and bush rock, persistent waterholes and large artificial water sources.

While the PAA has been subject to clearing for agriculture and ongoing firewood collection, hollow-bearing tree density was typical of undisturbed woodlands within box woodlands, ironbark/stringybark woodlands and red gum woodlands (NSWSC, 2007).

Winter flowering species including mistletoes occur throughout the PAA providing important foraging resources for fauna, particularly birds. The woody fruits of the Buloke (*Allocasuarina luehmanni*) provide a significant resource for the Glossy Black-cockatoo. Native grass seeds provide important foraging habitat for the Diamond Firetail (*Stagnopleura guttata*).

Rock outcropping occurs throughout the PAA, providing fauna shelter and roosting sites, particularly for bats. These areas also provide important habitat for reptile species.

ES3.5.2 Threatened fauna

Amphibian and bird diversity recorded in the PAA is moderate to high for the Brigalow Belt South bioregion, while reptile and mammal diversity was found to be low to moderate when compared with other studies (Goldney *et al*, 2007). Threatened species recorded within the study area were either bird or bat species. However, potentially suitable habitat is available within the PAA for mammal, reptile and frog species (Table ES.3).

Seventeen bird species listed as threatened under the TSC Act, two of which are also listed under the EPBC Act, were recorded in the PAA. In addition, three migratory bird species listed under the EPBC Act were recorded. The most commonly recorded threatened species were the Brown Treecreeper (*Climacteris picumnus victoriae*), Speckled Warbler (*Chthonicola sagittata*) and Varied Sittella (*Daphoensitta chrystoptera)*. Less commonly recorded species included the Hooded Robin (*Melanodryas cucullata)*, Glossy Black-cockatoo, Diamond Firetail and Grey-crowned Babbler (*Pomatostomus temporalis).*

Bat activity levels and species diversity are high in the PAA. Both cave-roosting and tree-roosting bat species were recorded within the PAA. Sixteen bat species were recorded, five of which are listed as threatened under the TSC Act (Table ES.3). Two of these species, the Large-eared Pied Bat (*Chalinolobus dwyeri*) and the Southern Long-eared Bat (*Nyctophilus corbeni*) are also listed as threatened under the EPBC Act.

Table ES.3 Threatened fauna species recorded or likely to occur within the PAA

Species	Status		Recorded within the PAA
	TSC Act	EPBC Act	
Amphibians			
Sloane's Froglet (*Crinia sloanei)*	V	-	No – moderate potential for occurrence
Reptiles			
Pale-headed Snake (*Hoplocephalus bitorquatus)*	V	-	No – moderate potential for occurrence
Birds			
Australasian Bittern (*Botaurus poiciloptilus)*	E	E	Yes
Barking Owl (*Ninox connivens)*	V	-	Yes
Black-breasted Buzzard (*Hamirostra melanosternon)*	V	-	No – moderate potential for occurrence
Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis)*	V	-	No – moderate potential for occurrence
Blue-billed Duck (*Oxyura australis)*	V	Mi	Yes
Brolga (*Grus rubicund)*	V	-	No – moderate potential for occurrence
Brown Treecreeper (*Climacteris picumnus victoriae)*	V	-	Yes
Bush Stone-curlew (*Burhinus grallarius)*	E	-	No – high potential for occurrence
Cattle Egret (*Ardea ibis)*	-	Mi	Yes
Diamond Firetail (*Stagnopleura guttata)*	V	-	Yes
Flame Robin (*Petroica phoenicea)*	V	-	No – moderate potential for occurrence
Freckled Duck (*Stictonetta naevosa)*	V	-	No – moderate potential for occurrence
Gilbert's Whistler (*Pachycephala inornata)*	V	-	No – moderate potential for occurrence
Glossy Black-Cockatoo (*Calyptorhynchus lathami)*	V	-	Yes
Great Egret (*Ardea alba)*	-	Mi	Yes
Grey-crowned Babbler (*Pomatostomus temporalis)*	V	-	Yes
Hooded Robin (*Melanodryas cucullata)*	V	-	Yes
Little Eagle (*Hieraaetus morphnoides)*	V	-	No – moderate potential for occurrence
Little Lorikeet (*Glossopsitta pusilla)*	V	-	Yes
Masked Owl (*Tyto novaehollandiae)*	V	-	Yes
Malleefowl (*Leipoa ocellata)*	E	E, Mi	Yes (disused nests)
Painted Honeyeater (*Grantiella picta*)	V	-	No – moderate potential for occurrence
Powerful Owl (*Ninox strenua)*	V	-	Yes
Rainbow Bee-eater (*Merops ornatus)*	-	Mi	Yes
Regent Honeyeater (*Anthochaera phrygia)*	CE	E	No – high potential for occurrence
Scarlet Robin (*Petroica boodang)*	V	-	No – moderate potential for occurrence
Speckled Warbler (*Chthonicola saggitata)*	V	-	Yes
Spotted Harrier (*Circus assimilis)*	V	-	No – moderate potential for occurrence
Square-tailed Kite (*Lophoictinia isura)*	V	-	No – high potential for occurrence
Superb Parrot (*Polytelis swainsonii)*	V	V	Yes
Swift Parrot (*Lathamus discolour)*	E	E	No – moderate potential for occurrence
Turquoise Parrot (*Neophema pulchella)*	V	-	Yes
Varied Sittella (*Daphoensitta chrystoptera)*	V	-	Yes
White-fronted Chat (*Epthianura albifrons)*	V	-	Yes

Table ES.3 Threatened fauna species recorded or likely to occur within the PAA

Species	Status		Recorded within the PAA
	TSC Act	EPBC Act	
Bats			
Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis)*	V	-	Yes
Eastern Cave Bat (*Vespadelus troughtoni)*	V	-	No – high potential for occurrence
Large-eared Pied Bat (*Chalinolobus dwyeri)*	V	V	Yes
Little Pied Bat (*Chalinolobus picatus)*	V	-	Yes
Southern Long-eared Bat (*Nyctophilus corbeni syn. timoriensis)*	V	V	Yes
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris)*	V	-	Yes
Non-flying mammals			
Eastern Pygmy-possum (*Cercartetus nanus)*	V	-	No – moderate potential for occurrence
Koala (*Phascolarctos cinereus)*	V	V	No – moderate potential for occurrence
Spotted-tailed Quoll (*Dasyurus maculatus)*	V	V	No – moderate potential for occurrence
Squirrel Glider (*Petaurus norfolkensis)*	V	-	No – moderate potential for occurrence

Note: *1. TSC Act* – Threatened Species Conservation Act 1995 *(NSW), EPBC Act* – Environment Protection and Biodiversity Conservation Act 1999 *(Cth), V – vulnerable, E – endangered, Mi – migratory.*

ES4 Environmental management

ES4.1 Avoidance

Design changes to avoid sensitive ecological features in the PAA include:

- the diversion of creeks to accommodate the mine has been avoided by reducing and reconfiguring the mining area, which has minimised;
  - the clearing of riparian vegetation;
  - impacts to large areas of terrestrial and aquatic TECs, and
  - impacts to threatened species habitat, particularly for the Freshwater Catfish population;
- removing a proposed coal conveyor and thereby minimising clearing requirements (particularly a large sub-population of Ingram's Zieria) and maintaining a wildlife corridor that will be further enhanced as part of biodiversity offset strategy;
- infrastructure and emplacement areas have been moved to avoid impacts to a large sub-population of Ingram's Zieria; and
- road diversions have been designed to avoid clearing of roadside vegetation, where possible, which consist mainly of TECs.

ES4.2 Mitigation

A biodiversity management plan will be prepared that details measures to minimise the potential impacts on terrestrial and aquatic biodiversity. This plan will include adaptive management measures, including monitoring, to manage, protect and enhance vegetation and fauna habitat within the mine area and its surrounds. A rehabilitation management plan will also be prepared for the Project to detail the progressive rehabilitation methods according to the rehabilitation strategy). The key management measures are described below.

i Mitigation measures - operation

Mitigation measures to minimise biodiversity impacts during operations will include the following:

- pre-clearing surveys completed by an experienced ecologist prior to any clearing of native vegetation to identify trees currently occupied by fauna or that provide fauna habitat, as well as any threatened flora species;
- native vegetation to be retained will be demarcated onsite as a 'no-go' zone for clearing and operations;
- weed control will be undertaken in retained vegetation and rehabilitated areas;
- a two-stage clearing protocol will be adopted where non-habitat trees are cleared 24 hours prior to any habitat trees being cleared, to allow fauna time to move out of an area;
- experienced fauna rescue personnel will be engaged where any habitat trees are to be cleared and will be present during any habitat tree clearing works;
- native, locally sourced seed will be used for rehabilitation activities, where possible;
- clearing works will coincide with tree seeding to maximise seed collection activities, where possible;
- clearing footprints will be minimised during staged clearing works and mined areas will be progressively rehabilitated;
- clearing zones will be demarcated to restrict access to retained vegetation during staged clearing;
- habitat features important to threatened fauna species will be retained and stored for reinstatement within rehabilitated areas;
- habitat features such as large logs and rocks from cleared areas will be relocated to rehabilitated areas;
- methods to mitigate the loss of hollow bearing trees (eg nest box installation) and the loss of rocky outcrops (eg artificial cave roost installation) will be investigated and implemented during the early stages of clearing for the Project;
- methods will be formulated and implemented to minimise potential introduction and spread of soil pathogens and disease prior to clearing;

- road kill will be monitored on access roads during operation with appropriate actions taken if it is found to be causing a substantial increase in wildlife road kill;
- identified habitat linkages severed for the Project will be reconnected as part of the rehabilitation;
- feral animal management will be undertaken in areas surrounding the progressive clearing and rehabilitation areas, in coordination with local NSW National Parks and Wildlife Service and State Forests;
- planting guides will be prepared for all rehabilitation areas including species lists and recommended planting densities;
- topsoil in cleared areas will be managed to preserve soil seed banks in areas containing native vegetation for progressive rehabilitation;
- light use will be minimised in proximity to remnant habitat areas to prevent light spill;
- dust deposition will be monitored in areas containing Ingram's Zieria to be retained with appropriate actions taken if it is found to be affecting plant health; and
- road kill will be monitored on access roads during operation with appropriate actions taken if it is found to be causing a substantial increase in wildlife road kill.

ii Mitigation measures - construction

Mitigation measures to minimise biodiversity impacts during construction will include the following:

- fauna fencing or mitigation structures (eg underpasses), as required, are to be installed during construction of the Project.

The requirements for progressive clearing works during operational stages discussed in Section ES4.2 (i), will also be incorporated into the construction stages of the Project where clearing is required.

ES4.3 Impacts

ES4.3.1 Vegetation and flora

Up to 1,867 ha of woodland vegetation and 967 ha of native pasture will be directly impacted by the Project. The majority of vegetation to be removed is within the proposed mining areas. Some smaller areas occur along the road diversions, pipeline route and rail spur corridor. This is 20% of the vegetation within the PAA and 7% of the non-reserved native vegetation within the Talbragar Catchment Management Area sub-region (clipped to the Dubbo 1:250,000 map sheet).

Four percent (79 ha) of the remnant and regenerating woodland to be removed contains threatened ecological communities: Fuzzy Box Woodland (13 ha), Box Gum Woodland (12 ha) and Inland Grey Box Woodland (54 ha).

Progressive clearing in the Project footprint will mean that only a proportion of the total vegetation will be removed at any one time. Progressive rehabilitation will re-instate more than 1,900 ha of woodland representative of the existing vegetation types, and 1,700 ha of pasture. The area of woodland vegetation in the PAA will be maintained and increased in the long-term as a result of the rehabilitation program and the implementation of the offset strategy.

The vegetation within the Project application area (PAA) is not considered to be dependent on groundwater resources, with woodland along the floodplains considered likely to only use shallow alluvial aquifers in dry periods opportunistically where it is within the root zone.

Four threatened flora species recorded within the PAA will be directly impacted by the Project. Impacts on Ausfeld's Wattle are not considered to be significant in accordance with Section 5a of the EP&A Act, given that only 0.4% of the local known population will be directly impacted. The Threatened Species Profile Database shows that this species can only withstand a loss of five individuals within the Central West CMA. However, the abundance and distribution of the species within the study area, particularly adjacent to the area to be impacted, is considered to reduce the potential impacts to this species within the locality. While a significant impact is not considered likely for this species, impacts will still be compensated by the Biodiversity Offset Strategy.

Significant impacts are likely for Ingram's Zieria, *Homoranthus darwinioides* and *Tylophora linearis*, as the Project will remove between 57%, 53% and 100% respectively of the locally identified populations. These loses will be compensated through biodiversity offsets by identification, protection and management of additional populations of these speciesand investigation of translocation and/or propagation of plants to be introduced into offset areas, and funding for conservation management in the region where land-based offsets are not available.

ES4.3.2 Fauna

Thirty-nine threatened fauna species, of which 20 were recorded onsite, may be directly or indirectly impacted by the Project. Due to the progressive removal of foraging and breeding habitat, significant impacts in accordance with Section 5a of the EP&A Act are likely for:

- forest owls: Barking Owl, Masked Owl and Powerful Owl;
- woodland birds: Brown Treecreeper, Diamond Firetail, Glossy Black-cockatoo, Grey-crowned Babbler, Hooded Robin, Speckled Warbler and Varied Sittella; and
- microbats: Southern Long-eared Bat and Yellow-bellied Sheathtail Bat, Large-eared Pied Bat, Little Pied Bat.

These species are associated with the woodland areas of the PAA, depending on habitat resources such as hollow-bearing trees and cliff lines. Progressive rehabilitation during the mining process will include replanting woodland habitat, the reinstatement of habitat features such as fallen timber and rock salvaged during clearing and methods to compensate for the loss of hollow-bearing trees. This will assist bird and bat species to maintain territories in the locality, by providing habitat features in the medium to long term.

Habitat resources also occur outside the proposed impact area, with abundant similar habitat available in the proposed offset areas adjacent to the Project area. In addition, large areas of contiguous vegetation occur for these species in nearby conservation areas in the PAA and the locality including Goonoo SCA and the Goulburn River NP. Offsets will aim to improve the connectivity of conservation areas and the quality of remnant vegetation within the locality and region. This will potentially increase movement corridors for genetic exchange, foraging habitat and increase breeding resources for threatened fauna species.

ES4.3.3 Protected areas

The Project will not have any direct impacts on any protected areas reserved under the *National Parks and Wildlife Act 1974*, *Brigalow and Nandewar Community Conservation Area Act 2005*, or *Forestry Act 1916*. The *Guidelines for developments adjoining land and water managed by the Department of Climate Change and Water* (DECCW, 2010) were used to assess the proposed rail loop which is nearto the Goodiman SCA, and the pipeline which is near Yarrobil NP in some locations. Potential indirect impacts on biodiversity values in these areas as a result of the Project will be minimised through implementing the recommended environmental management measures. Management actions will be coordinated with the local National Parks and Wildlife Service and Forestry offices under the biodiversity management plan, to ensure consistency with current management techniques.

ES5 Offset Strategy

In accordance with the OEH Policy and relevant offsetting principles, the key objectives of the biodiversity offset strategy are to:

- provide 'like for like' land-based offsets representing a 'no net loss' outcome for red flags (TECs and over-cleared vegetation types identified within the OEH vegetation types database for the Central West CMA) and threatened species for which species credits have been identified, based on the BioBanking assessment requirements (Tier 2 outcome under the OEH Policy);
- provide a minimum of a negotiated 'mitigated net loss' outcome using the variation criteria in the OEH Policy for all other vegetation communities (Tier 3 outcome under the OEH Policy); and
- ensure a minimum of 80% of offset requirements are land-based, with remaining offsets including investment in key projects, aimed at threatened species management in the region and to enhance land-based offsets, where land-based offset requirements cannot be achieved.

The Project will cause impacts equivalent to 124,091 ecosystem credits according to the Biobanking calculator due to clearing of native vegetation communities in moderate to good condition. In addition, impacts on threatened species will cause impacts equivalent to 49,541 species credits. These biodiversity credits need to be matched by credits generated in the offset areas to meet the strategy objectives.

High priority areas have been identified within and surrounding the PAA, south of Goodiman State Conservation Area (SCA) outside the disturbance areas on CHC-owned land. Significant wildlife corridors will be created in such areas by the permanent dedication and management of CHC lands. The aim of onsite offsets will be to provide vegetated links to existing conservation areas and large areas of retained native vegetation.

ES5.1 Offset package

A total of 5,667 ha of CHC-owned land has been identified as biodiversity offset areas. These areas will be conserved in perpetuity to protect and enhance the ecological values present. The offsets include approximately 1,758 ha of pasture areas which will be rehabilitated to represent adjacent remnant vegetation. More than 458 ha of TECs have been identified within the CHC-owned offset sites and an additional 991 ha will be rehabilitated within the offsets.

Offsets will be protected using formal conservation agreements and potentially dedication to the reserve network. An Offset Management Plan will be prepared to ensure biodiversity values are protected and enhanced in the offset areas. With the proposed compensatory measures outlined, the Project will improve the connectivity of remnant habitat within the locality.

ES5.1.1 Ecosystem offsets

In line with the OEH Offset Policy, the biodiversity values of the identified offset areas have been calculated using the Biobanking assessment methodology to compare biodiversity credit outcomes. CHC is committed to a 'no net loss' outcome for red flag vegetation types, which includes TECs and over-cleared vegetation types.

The Project will create a need for 7,954 ecosystem credits to compensate for the seven red flag vegetation types to be impacted. The offsets will provide a total of 26,393 ecosystem credits. This is triple the required credits when red flag vegetation types are combined, and represents a 'no net loss' outcome for all but one of these vegetation types, Fuzzy Box Woodland, when individual vegetation types are compared.

An additional 35,959 ecosystem credits were generated in the offset areas for other vegetation types not identified as red flags. These areas provide habitat for threatened species not identified as requiring species credits. The credits generated by the offsets do not meet the number required to gain a 'no net loss' outcome. Therefore non red flag vegetation types will be offset according to a 'mitigated net loss' outcome under the Offset Policy. CHC is committed to a minimum offset to impact ratio of 3:1 for these vegetation types using the variation criteria in the Offset Policy.

Additions to the offset package are being negotiated to meet outstanding ecosystem credit requirements to meet CHCs commitments. An additional 1,543 ha of identified potential offset areas occur adjacent to the Project. These areas have not been surveyed for biodiversity values but are likely to contain similar values to the existing offset areas and Project area given their proximity. It is likely that the minimum ecosystem offsets will be achievable with these proposed additions.

ES5.1.2 Threatened species

CHC is committed to a 'no net loss' outcome under the Offset Policy for threatened species which have generated species credits. Species credits were generated within the offset areas for five of the seven threatened species criteria requiring offsets from the Project impacts. Species credits have been met for three of these. Additional credits are required for *Homoranthus darwinioides, Tylophora linearis*, Ingram's Zieria and Large-eared Pied Bat breeding habitat to meet this outcome.

Proposed offset additions will add potential threatened species habitat to the offset package. Targeted surveys will be conducted in spring/summer to confirm the presence of threatened species and their habitat in the offset areas. Should further surveys and additional offsets still not meet the requirements for species credits, indirect offsets will be investigated and negotiated with OEH and SEWPaC or the outcomes may be reduced to a 'mitigated net loss'.

ES6 Conclusion

The Cobbora Coal Project occurs within an agricultural region that is dominated by agricultural grazing land with large tracts of remnant vegetation on the less fertile slopes and ridges. The Project will require the removal of 967 ha of native pasture and 1,867 ha of woodland and regrowth with a total impact area of up to 4,700 ha. This includes the removal of 12 ha Box Gum Woodland, 13 ha of Fuzzy Box Woodland and 54 ha of Grey Box Woodland, all of which are listed as threatened ecological communities.

CHC has incorporated a range of controls into the design and implementation of the Project, which will minimise potential impacts on threatened species, populations and ecological communities through avoidance, minimisation and mitigation. A detailed biodiversity management plan will be prepared to implement best practice management measures during progressive clearing, operation and rehabilitation for the Project. The efficacy of the plan will be monitored using an adaptive management approach.

Progressive rehabilitation will re-instate more than 1,900 ha of woodland representative of the existing vegetation types, and 1,700 ha of grassland, compensating for the loss of vegetation as a result of the Project. An offset package is being prepared for the Project to compensate for any remaining significant impacts to threatened species and their habitat after mitigation. This will provide further compensation for the loss of vegetation, the direct loss of threatened ecological communities, threatened flora and threatened fauna habitat. The offset package is still being finalised in consultation with OEH and SEWPaC.

Ongoing ecological management, rehabilitation works and the offset package will improve the connectivity of remnant habitat within the locality and result in an improvement to the quality, quantity and protection of biodiversity within the region in the medium to long term.

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Definitions and abbreviations

°C	degrees Celsius
ABS	Australasian Bat Society
anabat	an ultrasonic microphone used to record microbat calls
annual	a plant completing its life cycle within one year from germination to fruiting and then dying
API	aerial photograph interpretation
asl	above sea level
BBS	Brigalow Belt South bioregion
BMP	biodiversity management plan
BNCCA Act	NSW *Brigalow and Nandewar Community Conservation Area Act 2005*
BOM	Bureau of Meteorology
BVT	broad vegetation types
CAP	catchment action plan
CHC	Cobbora Holding Company Pty Limited
CHPP	coal handling and preparation plant
CMA	catchment management authority - thirteen CMAs have been established across New South Wales to ensure that regional communities have a say in how natural resources are managed in their catchments
cryptogams	a plant that reproduces by spores including lichens, liverworts, mosses and hornworts
CW	Central West
CWC	Central West Catchment
CWD	coarse woody debris (large fallen logs)
CWR	Central Western Region
DEC	NSW Department of Environment and Conservation - a former NSW environment department
DECC	NSW Department of Environment and Climate Change - a former NSW environment department
DECCW	NSW Department of Environment, Climate Change and Water - the former NSW environment department
DGRs	Director General's environmental assessment requirements
DIPNR	Department of Infrastructure Planning and Natural Resources
DLWC	Department of Land and Water Conservation
DPI	Department of Primary Industries
SEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EA	environmental assessment under Part 3A of the EP&A Act
EEC	endangered ecological community
EMM	EMGA Mitchell McLennan Pty Ltd
EMP	environmental management plan
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ERM	Environmental Resource Management (Australia) Pty Ltd
ESD	ecologically sustainable development - defined as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased' under Australia's *National Strategy for Ecologically Sustainable Development (1992*)
FM Act	NSW *Fisheries Management Act 1994*
forb	a herbaceous flowering plant that is not a graminoid
GDE	groundwater dependent ecosystem
gilgais	mounds or depressions associated with cracking and swelling clays

Definitions and abbreviations

GIS	geographic information system
GL	gigalitres
GPS	global positioning system
graminoids	grasses, sedges and rushes
granivorous	an animal that eats grains and seeds
ha	hectare
IBRA	interim biogeographic regionalisation of Australia - an IBRA region is a large geographically distinct area of similar climate, geology, landform, vegetation and animal communities. IBRA is the National Reserve System's planning framework, the fundamental tool for identifying land for conservation
IR camera	infrared, motion detecting cameras
km	kilometres
km^2	square kilometres
KTPs	key threatening processes listed under the TSC Act or EPBC Act
kV	kilovolt
m	metres
mm	millimetres
mNES	matters of national environmental significance listed under the EPBC Act
Mtpa	million tonnes per annum
MW	megawatts
NAN	Nandewar bioregion
NET	New England Tablelands bioregion
NP	National Park declared under the NPW Act
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	NSW National Parks and Wildlife Service
NR	Nature Reserve declared under the NPW Act
NSW	New South Wales
NSWSC	New South Wales Scientific Committee
NSW Trade and Investment	NSW Department of Trade, Investment, Regional Infrastructure and Services. This is the former Department of Industry and Investment
NSWVCA	NSW vegetation classification and assessment
OEH	NSW Office of Environment and Heritage - the current NSW environment department
offset strategy	strategy prepared to offset impacts after avoidance, minimisation and mitigation have been applied
PA	preliminary assessment under Part 3A of the EP&A Act
Part 3A	a part of the EP&A Act that determines the assessment requirements for developments that in the opinion of the Planning Minister, are of state or regional environmental planning significance. While Part 3A of the EP&A Act has now been repealed, the Project will be assessed under Part 3A as it entered the planning system prior to this repeal
PB	Parsons Brinckerhoff Pty Ltd
perennial	a plant whose life-span extends over more than one growing season
prior streams	streams that are higher in elevation than the present flood plains and are on alluvium deposited by meandering streams that were active prior to the last glacial period
Project	the Cobbora Coal Project including areas required for the open cut mine; a coal handling and preparation plant (CHPP); a train loading facility and rail spur; a mine infrastructure area and associated supporting infrastructure

Definitions and abbreviations

Project Application Area (PAA)	construction and operations activities that will cause physical land disturbance will generally be contained within the Project application area. Exceptions may include infrastructure upgrades, eg road improvements that will be approved outside of the *Environmental Planning and Assessment Act 1979* Part 3A process
Project footprint	the area of direct impact from construction and operation of the proposed Cobbora Coal Mine
Quadrat	survey techniques used in ecology where a square of a set size placed in an area in which all habitat and vegetation attributes are recorded
ROM	run-of-mine
RoTAP	rare or threatened Australian plant
SAT	spot assessment technique used to measure Koala activity (Phillips and Callaghan, 2011)
SCA	State Conservation Area declared under the NPW Act
SEPP 44	*State Environment Planning Policy 44: Koala Habitat Protection*
SF	State Forest
SPRAT	species profiles and threat database under the EPBC Act
study area	The area that has been surveyed and assessed for this ecological assessment. The study area for the Project is roughly bound by the Project Application Area (PAA), however some areas outside the PAA have been surveyed and assessed for offsetting and where unique habitat features were identified. The study area boundary is provided in Section 2.2.
TEIA	terrestrial ecology impact assessment. A supporting document to the EA report
TEC	threatened ecological community
TSC Act	NSW *Threatened Species Conservation Act 1995*
TSSC	Threatened Species Scientific Committee
URS	URS Corporation Pty Ltd
WoNS	weed of national significance
ZCAIM	zero crossings analysis interface module used to record Anabat data

1 Introduction

1.1 Project background

The Cobbora Coal Project (the Project) is an open cut coal mine proposed by Cobbora Holding Company Pty Limited (CHC). The mine will supply thermal coal, primarily to power stations in New South Wales (NSW). In addition, some coal will be produced for a combination of the export and spot domestic markets.

The Project is located approximately 5 km south of Cobbora, 22 km south-west of Dunedoo, 64 km north-west of Mudgee and 60 km east of Dubbo in the central west of NSW. The Project will include an open cut mine; a coal handling and preparation plant (CHPP); a train loading facility and rail spur; and a mine infrastructure area. Supporting infrastructure will include access roads; water supply and storage; and electricity supply. Construction is planned to commence in mid-2013. Mine operations will start in the first half of 2015 and a mine life of 21 years is proposed.

A Major Project application under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) was submitted to the NSW Department of Planning on 5 January 2010 (application number MP 10_0001). The Director General's environmental assessment requirements (DGRs) for the Project were issued on 4 March 2010. In response to changes in the proposed Project and government assessment requirements, revised DGRs were issued for the Project on 23 December 2011.

The Commonwealth Minister for the Department Sustainability, Environment, Water, Populations and Communities (SEWPaC) has determined the Project to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it is likely to have a significant impact on a number of matters of National Environmental Significance (NES) related to biodiversity. An assessment which specifically addresses matters of NES in line with Commonwealth's assessment requirements for the Project has been prepared and is provided at Appendix D.

A 2009-2011 Baseline Survey was undertaken by ERM (2012) across the original project application area (PAA). Since this survey was completed, the design of the Project has changed substantially. Ecological surveys were required for those areas not already assessed. These surveys (2011-2012 Surveys) were completed by EMGA Mitchell McLennan (EMM) from late 2011 to early 2012.

This terrestrial ecology impact assessment incorporates the work undertaken during the 2009-2011 Baseline Survey and the 2011-2012 Surveys. It assesses the potential impacts of the Project on terrestrial ecology and provides recommendations to mitigate and/or offset remaining impacts.

1.2 Objectives

This terrestrial ecology impact assessment aims to:

- provide a detailed baseline of the terrestrial ecology of the study area;
- determine the likelihood that threatened species, populations and communities occur within the study area;
- determine the potential impacts as a result of the Project and assess the significance of impacts to threatened species, populations, communities and habitat; and
- provide recommendations to ameliorate or compensate for any potential impacts.

2 Project context

2.1 Location and regional setting

The Project is located approximately 5 km south of Cobbora, 22 km south-west of Dunedoo, 64 km north-west of Mudgee and 60 km east of Dubbo in the central west of New South Wales (NSW). It occurs on a boundary between the Warrumbungle, Wellington and Mid-Western Regional Local Government Areas (Figure 2.1).

The Project Application Area (PAA) occurs within the Central West Catchment Management Authority (CMA) area and the boundary of the Talbragar Valley and Upper Slopes CMA subregions (Figure 2.1). The total PAA is 24,600 hectares (ha). It extends over two interim biogeographic regionalisation of Australia (IBRA) regions; Brigalow Belt South and South Western Slopes.

The Brigalow Belt South, lying on the transition zone between eastern, western and northern biotic elements is an important area in terms of its biodiversity and unique assemblages of fauna and flora (NPWS, 2000). This bioregion encompasses the cypress pine, box-ironbark and red gum forests and woodlands of the western slopes and adjacent plains. It also contains other vegetation formations such as grasslands, mallee, heathlands and shrublands (NPWS, 2000).

2.2 Study area overview

The study area is bound by the Golden Highway in the north and the Cudgegong River in the south (Figure 2.2). The western and eastern parts contain agricultural land and woodland areas, with the study area bound by Avonside Road and the Castlereagh Highway to the east and Sweenys Lane and Sandy Creek Road in the west. Spring Ridge Road runs through the centre of the study area.

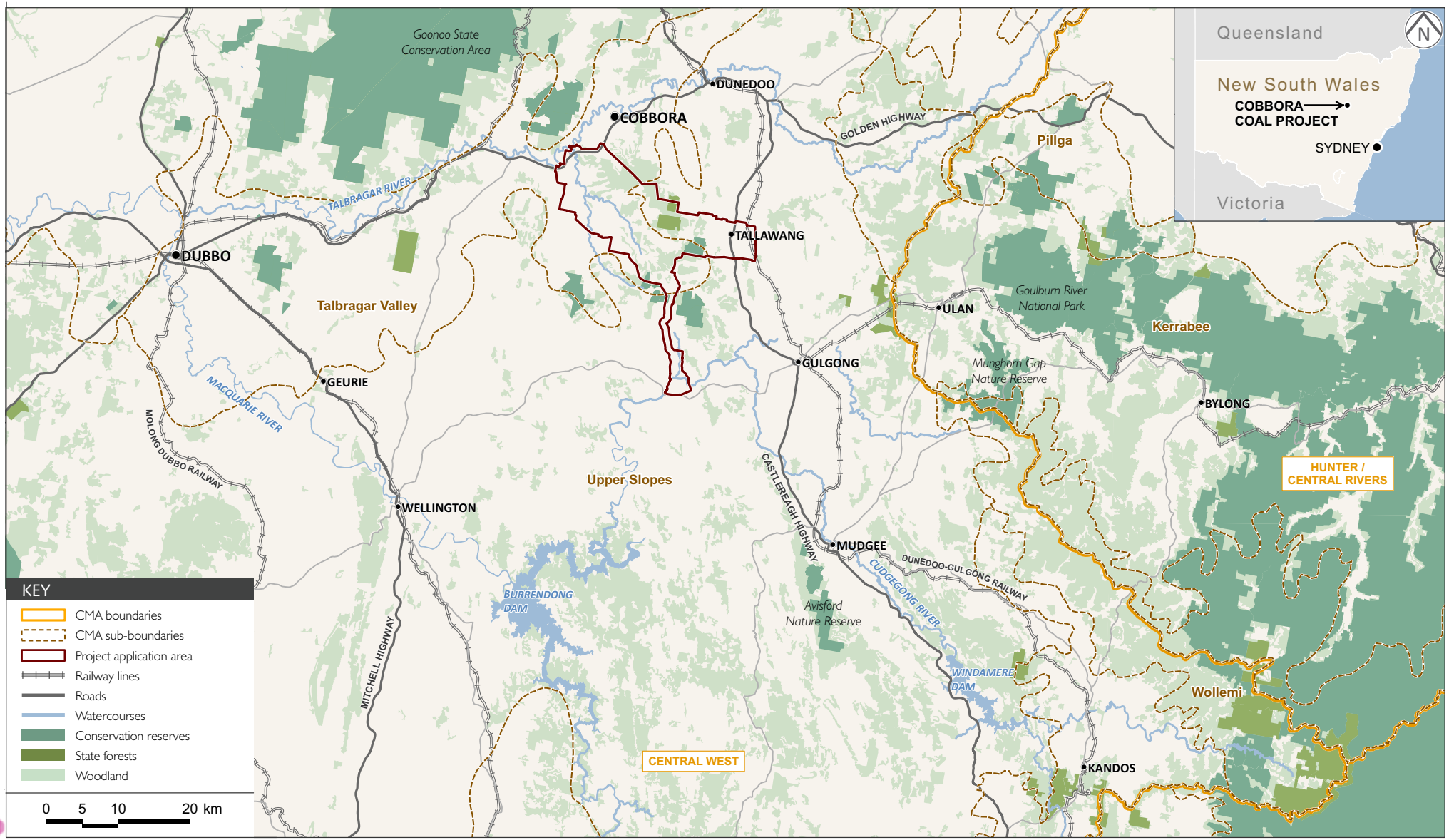
Narrow corridors extend from the proposed mine site, one to the south, providing a water pipeline for the Project from the Cudgegong River, and another to the east providing a rail spur for transport of the coal (Figure 2.2).

For the purposes of the ecological assessment, the study area is defined as the area that is bound by the PAA. Additional areas outside the PAA have been surveyed and assessed to assist with identifying areas for potential biodiversity offsets, as required.

2.2.1 Climate

The study area experiences semi-arid climatic conditions where hot summers (December to February) and cold winters (June to August) prevail, with average rainfall of 580 mm per year (Cobbora weather station, source: Bureau of Meteorology (BOM), 2011a). Rainfall is highest in spring and summer, with the highest temperatures experienced in summer with a mean maximum temperature of 32°C in January and lowest temperature in July with a minimum mean of 2°C (Dunedoo Post Office, source: BOM, 2011b). Average annual evaporation rates exceed average rainfall for all months of the year.

The study area has experienced fluctuations in rainfall and drought conditions over the past three years during the ecological surveys. The majority of the state, including the study area, was in drought from winter 2009 through to autumn 2010. The study area received some rainfall in autumn 2010, however was still considered to be in drought again by winter 2010 (BOM, 2011a). These conditions eased over summer 2011 but became drier again over winter and into autumn 2011.



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EMM

Cobbora Holding Company Pty Limited

Location of the Study Area

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 2.1

Since late autumn, rainfall across Australia has been varied. In south-eastern Australia, rainfall had generally been below average since the start of winter, though not low enough to declare drought over large areas. Most areas across Australia received above average rainfall in November 2011 (BOM, 2011b) including the study area.

The 2011-2012 Surveys were undertaken over spring and summer after a wet winter and spring. Rainfall and warm temperatures resulted in significant flowering events during the survey period. This may have also altered seasonal migration patterns for some species, particularly birds, due to the presence of foraging resources over the wider area.

2.2.2 Topography, geology, soils and waterbodies

i Topography

The study area ranges in elevation from the lowest points at approximately 360 metres (m) above sea level (asl) in the north around the Talbragar and into the Sandy Creek Valley, and 400 m asl in the south along the Cudgegong River. The highest parts of the study area occur at 'The Gap' along Spring Ridge Road and in parts of Tuckland State Forest which are approximately 580 m asl.

The study area contains a ridgeline along the eastern part of the study area, which extends to both the north and to the south of the proposed mine pits. The ridge areas contain rock outcropping of sandstone, conglomerates and siltstones, forming steep cliffs in some locations. The areas through the north-western part of the study area and the southern section associated with the pipeline corridor, are lower in elevation, with smaller rolling hills. These areas are associated with the Sandy Creek, Laheys Creek and Cudgegong River valleys, where the majority of intensive agriculture has been undertaken within the study area.

ii Geology and soils

The underlying geology of the study area is sedimentary with units from the Later Permian in the north, Early to Late Silurian in the west. Sandy Creek is associated with alluvial deposits, while Laheys Creek contains the Napperby Formation which consists of white, fine to medium-grained lithic-quartz and quartzose or sandstone with a white clayey matrix thinly interbedded or interlaminated with grey siltstone and minor conglomerate lenses (Meakin and Morgan, 1999). An overview of regional geology, soils and vegetation of the IBRA sub-regions within the study area is provided in Table 2.1.

Table 2.1 Regional description of geology, soils and vegetation

IBRA region and subregion	Geology and landforms	Soils	Vegetation
Brigalow Belt South Bioregion Talbragar Valley subregion	Near horizontal Mesozoic quartz sandstone, conglomerates and shales with minor Tertiary basalt caps and extensive alluvial wash plains. Residual rocky hills, undulating long slopes and wash plains, wide valley floors with sandy streams.	Thin stony loams and texture contrast soils over most of the landscape with deeper sands and brown earths on valley floors.	Ironbark and cypress pine communities on the hills and slopes, with patches of cypress pine, red gums and scrubby acacia species in rocky outcrops. Box-dominated communities on valley floors, with River Red Gum on larger streams and River Oak on tributaries.
South Western Slopes Bioregion Upper Slopes subregion	Upper Slopes Ordovician to Devonian folded and faulted sedimentary sequences with inter-bedded volcanic rocks and large areas of intrusive granites. Steep, hilly and undulating ranges and granite basins. Occasional basalt caps, confined river valleys with terrace remnants.	Shallow stony soils on steep slopes, texture contrast soils grading from red subsoils on upper slopes to yellow subsoils on lower slopes. Alluvial sands, loams and clays.	Open forests and woodlands with stringybarks on upper slopes with cypress pine, red gums and boxes on lower slopes. River Oak on upper tributaries and River Red Gum on lower and larger streams.

Notes: 1. Source: Thackway and Creswell, 1995.

The dominant landscapes within the study area are Laheys Creek and the Dapper Hill landscapes. The Laheys Creek landscape occurs in the lower lying and alluvial floodplain areas of the study area, particularly within the northern part of the study area. This soil landscape contains yellow solodic soils with low fertility, which is susceptible to waterlogging and the formation of sodic and saline subsoils. Dapper Hill soil landscape occurs on the higher elevation areas throughout the northern section of the study area. These soloth areas are interspersed throughout the yellow solodic soils of the Laheys Creek landscape and also contain low fertility and have a high erosive potential (Murphy and Lawrie, 1998).

The Ballimore landscape occurs in the north-western section of the study area, to the west of Sandy Creek. In this area, the Mitchell Creek landscape also occurs within the floodplain. The former landscape comprises red-brown earths which were formed on quartzose, lithic sandstone, conglomerate, ferruginous sandstone and shales (Murphy and Lawrie, 1998). The Mitchell Creek landscape soils formed on Quaternary aged transported material has a moderate fertility and a high water holding capacity (Murphy and Lawrie, 1998).

iii Waterbodies

Large water bodies in the greater Cobbora area include the Talbragar River and Cudgegong River. The study area lies within the catchment of Sandy Creek, a tributary of the Talbragar River. Laheys Creek, a tributary of Sandy Creek and a number of minor tributaries is within the study area.

The Talbragar River is the major water body close to the study area. The Talbragar River confluence with the Coolaburragundy River is at Dunedoo. It flows in a south westerly direction, joining the Macquarie River just north of Dubbo. Sandy Creek and Laheys Creek flow in a northerly direction, parallel to each other, with Laheys Creek joining Sandy Creek approximately 7 km upstream of the confluence with the Talbragar River.

2.2.3 Protected areas

Five areas protected under the NSW *National Parks and Wildlife Act* (1974) (NPW Act) occur within or in proximity to the study area (Figure 2.2). These are:

- Goodiman State Conservation Area (SCA);
- Yarrobil National Park (NP);
- Cobbora SCA and surrounding land vested under the NPW Act;
- Dapper Nature Reserve (NR); and
- Goonoo SCA.

Tuckland State Forest (SF) is the only area reserved under the *Forestry Act 1916* within or in close proximity to the study area (Figure 2.2).

2.3 Proposed project

The Project is a new open cut coal mine that will be developed near Dunedoo in the central west of NSW. The PAA is approximately 274 square kilometres (km^2). The primary purpose of the Project is to provide coal for five major NSW power stations.

The mine will extract around 20 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal. From this, approximately 9.5 Mtpa of product coal will be sold to Macquarie Generation, Origin Energy and Delta Electricity under long term contract. In addition, approximately 2.5 Mtpa will be produced for export or for the spot domestic market.

The Project's key elements are:

- an open cut mine;
- a coal handling and preparation plant (CHPP);
- a train loading facility and rail spur;
- a mine infrastructure area; and
- supporting infrastructure including access roads; water supply and storage; and electricity supply.

It is envisaged that construction activities will commence in mid-2013 with coal supplied to customers from the second half of 2015. The mine life will be 21 years.

2.3.1 Open cut mine

Multiple open cut mining pits will be developed within three mining areas:

- Mining Area A north of the infrastructure area;
- Mining Area B south of the infrastructure area; and

- Mining Area C north-east of the infrastructure area.

There will be three out-of-pit waste rock emplacements:

- AC-OOP between mining areas A and C;
- B-OOP E adjacent to Mining Area B on the east side of Laheys Creek; and
- B-OOP W adjacent to Mining Area B on the west side of Laheys Creek.

A conventional load and haul operation is proposed using excavators, front-end loaders and trucks. Initially, trucks will haul waste rock to out-of-pit emplacements. Following this, the majority of the waste rock will be placed in the mined-out voids.

Trucks will haul excavated ROM coal to the CHPP where it will be tipped into dump hoppers above the primary crushers or onto secondary ROM stockpiles for later rehandling.

2.3.2 Coal handling and preparation plant

The CHPP will treat the ROM coal so that product coal meets the sizing and coal quality requirements of the customers. Subject to the level of impurities (rejects) in the coal and washability characteristics, the ROM will be either crushed and bypassed or treated (washed) in the preparation plant. The rejects will typically include waste rock from above, below and within the coal seam as well as mineral matter dispersed within the coal.

The CHPP will be typical of those used by most coal mines in NSW and will be capable of treating up to 20 Mtpa of ROM coal. The washed product coal will be separated from rejects in a series of coal cleaning circuits (including heavy media separation) in the CHPP. The CHPP will also include a truck dump station; crushing plants; coal stockpiles; and infrastructure to move and stockpile the coal. Rejects from the CHPP will be disposed within the footprint of the mining area.

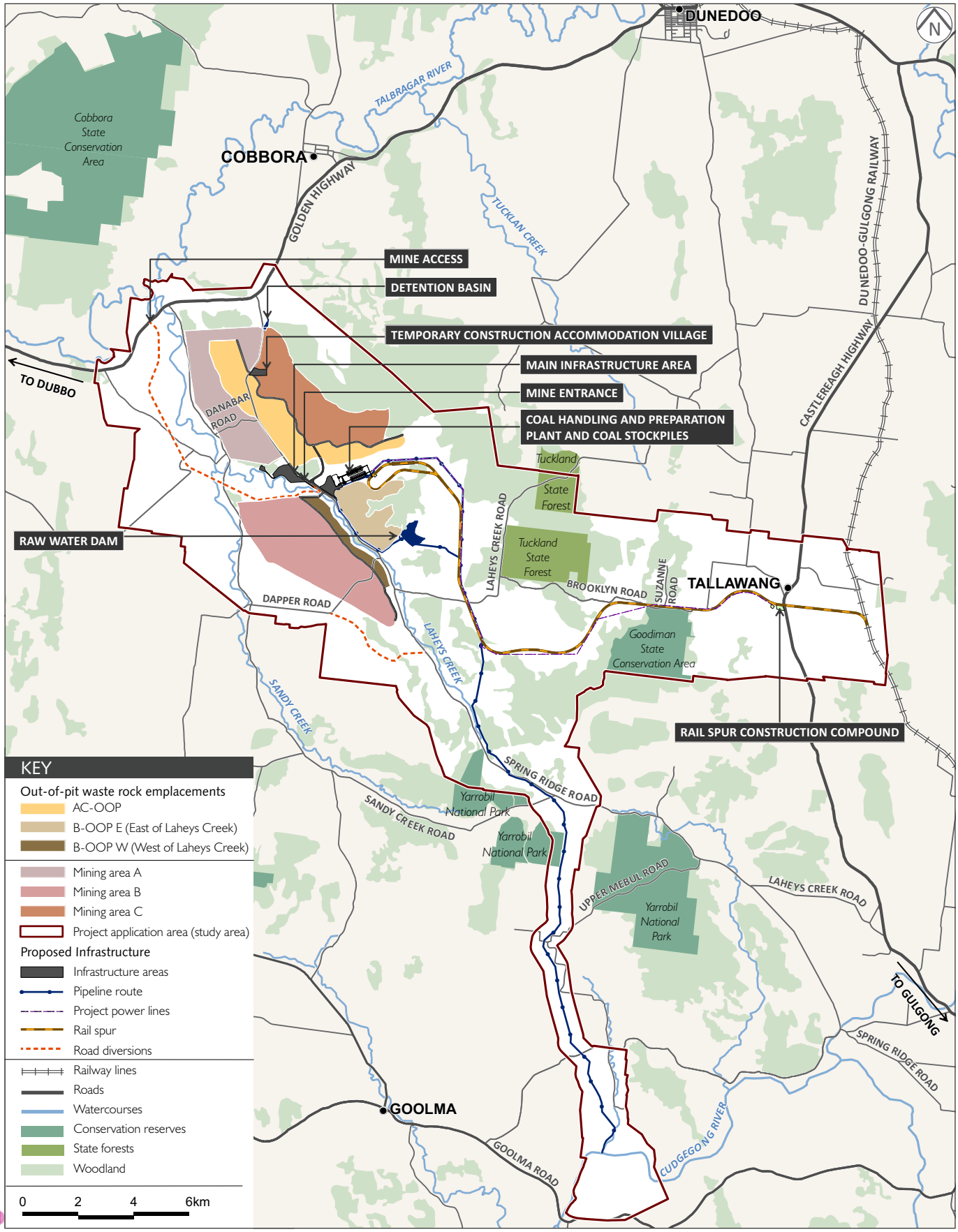
2.3.3 Train loading facility and rail spur

Coal will be transported by rail to the Project's customers, including Bayswater and Liddell power stations in the Upper Hunter Valley and Eraring, Vales Point and Munmorah power stations on Lake Macquarie on the NSW Central Coast.

Product coal will be loaded onto trains from an overhead train loading bin located on a rail spur balloon loop. Approximately five trains will be loaded each day. The rail spur will be approximately 28 km long and will join the Dunedoo-Gulgong rail line near Tallawang. A locomotive provisioning facility and a siding for fuel delivery may be located adjacent to the balloon loop.

2.3.4 Mine infrastructure area

The mine infrastructure area will be located adjacent to the mining areas. It will include workshops; hardstand and lay-down areas; bulk storage buildings; bulk fuel storage and a fuelling station; office buildings; an operations building and change-house; parking; an explosives magazine; and vehicle washdown bays.



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Conceptual Project Layout

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 2.2

2.3.5 Supporting infrastructure

i Access roads

The main access to the mine will be from the Golden Highway to the north of the operations, via a road diversion that will replace an existing section of Spring Ridge Road. There will be limited light vehicle access from the south via Spring Ridge Road.

Internal roads will connect the access road to the workshop, administration buildings and to the mine infrastructure area. Internal roads will also connect the various areas of the Project.

ii Water supply

The Project will require water primarily for the CHPP and for dust suppression. Water will be sourced by intercepting surface water and by pumping groundwater that enters the mine pits in accordance with the relevant permits and licences. Water will also be sourced from the Cudgegong River and pumped approximately 26 km to the primary raw water dam south-east of the mining area. Pre-existing high security water access licences have been purchased for the Project to allow up to 3.31 gigalitres (GL) of water to be extracted from the river.

iii Electricity supply

The Project will require approximately 20 megawatts (MW) of electrical power. The Project will be connected to the grid at a small switching yard adjacent to the Castlereagh Highway. A power line, generally running parallel to the rail spur, will deliver the electricity to a substation in the mine infrastructure area.

An 11 kV powerline will supply the Cudgegong River pump station from the existing grid approximately 2 km south of the pump station site.

2.3.6 Workforce and operating hours

The proposed mine construction workforce will average approximately 350 persons, peaking at approximately 550 persons over a 26 month period between the third quarter of 2013 to the second quarter of 2016.

The proposed mine operation workforce is estimated to be 300 persons during the first two years of full production in 2016 and 2017. This will increase steadily over the next ten years to reach a peak level of approximately 590 persons between 2027 and 2030.

Mine construction is expected to occur up to 12 hours per day. However, construction may occur up to 24 hours per day at times (eg during major concrete pours).

Mine operation will occur up to 24 hours per day, 7 days per week, 52 weeks per year.

2.4 Legislative framework

Director-General's requirements were issued on 23 December 2011 in accordance with section 75F of the EP&A Act. Relevant DGRs for the TEIA are shown in Table 2.2 with the section of the document where these are addressed.

Table 2.2 Director-General's requirements relevant to this ecological assessment

Type of requirement	Requirement	TEIA section that addresses DGR
General	A description of the existing environment, using sufficient baseline data	Chapter 4 and 5
	An assessment of the potential impacts of the Project, including any cumulative impacts, taking into consideration any relevant guidelines, policies, plans and statutory provisions	Section 6.3
	A description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the Project, including detailed contingency plans for managing any significant risks to the environment	Section 6.2
Key issue	Accurate estimates of any vegetation clearing associated with the Project	Table 6.5
	A detailed assessment of the potential impacts of the Project on any terrestrial and aquatic threatened species, populations, ecological communities or their habitats	Table 6.2 , Section 6.3.1
	A detailed description of the measures that would be implemented to avoid or mitigate impacts to biodiversity	Table 6.1, Section 6.1 and 6.2
	A comprehensive offset strategy to ensure the Project maintains or improves the biodiversity values of the region in the medium to long term (in accordance with NSW and Commonwealth policies)	Appendix C
	Consideration of how the proposal may impact upon lands covered by the *Brigalow and Nandewar Community Conservation Area Act 2005* (BNCCA Act); and the matters outlined in Attachment A (Commonwealth requirements)	Section 6.3

2.4.1 Legislation

i Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Commonwealth Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the Act as matters of national environmental significance (mNES). The EPBC Act focuses Commonwealth government interests on the protection of mNES, with the states and territories having responsibility for matters of state and local significance. Relevant objectives of the EPBC Act are to:

- provide for the protection of the environment, especially matters of NES;
- conserve Australian biodiversity;
- provide a streamlined national environmental assessment and approvals process; and
- promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources.

In general, the EPBC Act lists flora and fauna, and ecological communities that are deemed to be of national significance. The relevant matters of NES to which the EPBC Act applies for the Project are:

- listed threatened species and communities (section 18 & 18A); and
- listed migratory species (sections 20 & 20A).

These matters of NES are the subject of this assessment. The proposed Cobbora mine has been declared a controlled action under the EPBC Act due to the likelihood for significant impacts to matters of NES. As such, the Project requires approval by Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC).

Appendix D provides an overview of the potential impacts on ecological matters of NES, mitigation measures to reduce any potential impacts and measures to compensate for any remaining impacts that cannot be mitigated.

ii Threatened Species Conservation Act 1995

The NSW *Threatened Species Conservation Act 1995* (TSC Act) is administered by OEH. The Act aims to manage terrestrial threatened species, populations and ecological communities. The protection of threatened fish and marine vegetation is the responsibility of the NSW Department of Trade and Investment, Regional Infrastructure and Services (NSW Trade and Investment) under the NSW *Fisheries Management Act 1994* (FM Act).

The main objectives of the TSC Act are to:

- conserve biological diversity and promote sustainable development;
- prevent the extinction of native plants and animals;
- protect habitat that is critical to the survival of endangered species;
- eliminate or manage threats to biodiversity;
- properly assess the impact of development on threatened species; and
- encourage cooperative management in the conservation of threatened species.

The TSC Act lists terrestrial species, populations and ecological communities that are deemed by the NSW Scientific Committee (NSWSC) to be threatened.

The TSC Act, through Part 8A of the NPW Act, prohibits the harming, picking, possessing, buying or selling of individual threatened species. It contains a prohibition against the damage of their habitat and contains provisions to protect endangered populations and threatened ecological communities. Notwithstanding this, the TSC Act provides for a number of exceptions to these prohibitions. These include developments that are undertaken in accordance with approvals issued under the EP&A Act.

The potential impacts of the Project on threatened species, populations and ecological communities are considered in detail in section 6 of this TEIA.

iii Brigalow and Nandewar Community Conservation Area Act

In 2005, the local community of the Brigalow and Nandewar regions lobbied the NSW Government to protect forested land in the region. The NSW *Brigalow and Nandewar Community Conservation Area Act 2005* (BNCCA Act) was subsequently passed with the following objectives:

- to reserve forested land in the Brigalow and Nandewar area to create a Community Conservation Area that provides for permanent conservation of land, protection of areas of natural and cultural heritage significance to Aboriginal people and sustainable forestry, mining and other appropriate uses; and
- to give local communities a strong involvement in the management of that land.

Under Schedule 5 of the Act, State Forests (SF) formerly under the tenure of NSW Trade and Investment was vested with the Minister for National Parks and Wildlife, for the purposes of conservation and recreation. Lands surrounding the Project area to which this transfer applied were:

- Cobbora SF (now the Cobbora SCA and an area vested under the NPW Act);
- Curryall SF;
- Goonoo SF (now Goonoo SCA);
- Yarrobil SF (now Yarrobil NP); and
- Goodiman SF (now Goodiman SCA).

These areas are outside of the areas directly impacted by the Project.

2.4.2 Policies and guidelines

i Part 3A Draft Guidelines for Threatened Species Assessment

The NSW *Part 3A Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005) provides information to enable decision makers to ensure that developments:

- maintain or improve biodiversity values;
- conserve biological diversity values and promote ecologically sustainable development (ESD);
- protect areas of high conservation value;
- prevent the extinction of threatened species;
- protect the long-term viability of local populations of a species, population or ecological community; and
- protect aspects of the environment that are matters of national environmental significance.

This terrestrial ecology assessment has been undertaken in accordance with the Part 3A Guidelines (DEC and DPI, 2005).

ii DITR Biodiversity Management Handbook

The Commonwealth *Department of Industry, Tourism and Resources Biodiversity Management Handbook* (DITR, 2007) provides guidance for all stages of a mine's life from exploration, feasibility, design, construction, operation and closure. It outlines the key principles and procedures for assessing biodiversity values including:

- identifying primary, secondary or cumulative impacts on biodiversity values;
- minimising and managing these impacts;
- restoring conservation values; and
- managing conservation values on a sustainable basis.

Biodiversity values have been assessed in accordance with the handbook.

iii Threatened Species Assessment Guidelines

Threatened species impact assessment is conducted under the TSC Act for NSW listed species, populations and ecological communities. The assessment of significance (seven part test) under section 5A of the EP&A Act is used to ensure that the consideration is transparent for threatened species, populations and ecological communities, and their habitats (DECC, 2007a).

The Threatened Species Assessment Guideline provides assistance with interpreting and applying the factors of assessment. The aim of the guidelines is to help ensure that a consistent and systematic approach is taken when determining whether an action, development or activity is likely to significantly affect threatened species, populations or ecological communities, or their habitats either directly or indirectly.

These guidelines have been applied for species, populations and ecological communities when impacts are considered likely as a result of the Project. The assessments of significance within this terrestrial ecology impact assessment have been undertaken in accordance with these guidelines.

iv EPBC Act Policy Statement 1.2: Significant Impact Guidelines

The EPBC Act Policy 1.2: Significant Impact Guidelines (DEH, 2006a) provides assistance in determining if an action should be referred to SEWPaC for a decision by the Australian Government Environment Minister or whether assessment and approval is required under the EPBC Act. The policy covers all matters of NES including the following which are relevant to this assessment.

v Groundwater Dependent Ecosystems Policy

The Groundwater Dependent Ecosystems Policy (DLWC, 2004) was developed to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. The policy aims to encourage the ecologically sustainable management of the State's groundwater resources, so as to:

- slow and halt, or reverse any degradation of groundwater resources;
- ensure sustainability of groundwater dependent ecosystems;
- maintain the full range of beneficial uses of these resources; and

- maximise economic benefit to the region, state and nation.

Further detail on groundwater dependent ecosystems in the study area is provided in sections 3.9 and 4.4. Potential impacts to these ecosystems and application of the policy to management of these ecosystems are discussed in section 6.3.

vi State Environment Planning Policy No. 44: Koala Habitat Protection

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) defines Koala habitat as:

- potential Koala habitat - areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component; and

- core Koala habitat - an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

In accordance with section 15(a) of SEPP 44, this assessment has surveyed the study area so as to identify areas of potential koala habitat and core koala habitat. Section 5.2.3ib addresses the likelihood that Koalas or their habitat is present within the study area.

3 Methods

The following tasks were used in the TEIA to investigate biodiversity and the likely ecological impacts associated with the Project:

- literature and database review;
- terrestrial flora surveys;
- terrestrial fauna surveys; and
- impact assessment and mitigation.

The field investigations undertaken for the purposes of this study were conducted in accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). Information from the guidelines was complemented by threatened species profiles, and the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - working draft* (DEC, 2004). Where appropriate and available for the investigations, the SEWPaC threatened species survey guidelines were also used.

2009-2011 Baseline Survey undertaken by ERM (2012) assessed some parts of the current study area. Additional surveys were undertaken within the study area between 2011 and 2012. The 2011-2012 Survey methodologies were developed in line with the following guidelines:

- *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna. Amphibians*, (DECC, 2009);
- *Spot Assessment Technique*, (Phillips and Callaghan, 2011);
- *Survey Guidelines for Australia's Threatened Birds* (DEWHA, 2011a);
- *Survey Guidelines for Australia's Threatened Frogs* (DEWHA, 2011b);
- *Survey Guidelines for Australia's Threatened Mammals* (DEWHA, 2011c); and
- *Survey Guidelines for Australia's Threatened Reptiles* (DEWHA, 2011d).

3.1 Consultation

The following organisations and community groups were consulted during the ecological assessment:

- Dubbo OEH and Dubbo NSW National Parks and Wildlife Service (NPWS);
- Dubbo Department of Trade and Investment (DT&I);
- Central West CMA;
- SEWPaC;
- Dubbo Naturalists; and
- Cudgegong Naturalists (Mudgee).

Community groups and organisations were given a broad overview of the Project and were requested to provide local information with regard to threatened and common flora and fauna species.

3.2 Literature and database review

3.2.1 Database review

Scientific databases were consulted to determine the likelihood of threatened and non-threatened native species, communities and populations occurring within and adjacent to the study area (for an area with a radius of 30 km from the centre of the study area). Databases reviewed included:

- SEWPaC 2011, *Protected Matters Search Tool*, www.environment.nsw.gov.au/epbc/pmst/index.html, viewed October 2011;
- OEH 2010, *NSW Wildlife Atlas Database for threatened species of the Cobbora 1:100,000 map sheet,* requested September 2010;
- Department of Environment and Conservation (DEC) 2005, *Threatened species profiles for the Central Western CMA,* www.threatenedspecies.environment.nsw.gov.au, viewed October 2011;
- SEWPaC 2010, *Species Profiles and Threats (SPRAT) Database,* www.environment.gov.au/epbc, accessed September 2010;
- Birds Australia 2011, *Threatened birds of the Cobbora 1:100,000 map sheet,* www.birdata.com.au, viewed September 2011;
- The Royal Botanic Gardens and Domain Trust 2011, *PlantNET – the Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney,* http://plantnet.rbgsyd.nsw.gov.au, accessed September 2011; and
- Australian Government 2012, *Atlas of Living Australia,* www.ala.org.au, accessed February 2012.

A list of threatened species likely to occur in the study area was compiled based on the results of the database searches, literature review and consultation. Table 3.1 provides a list of these species, along with an overview of survey methods and optimal timing for the detection of the targeted threatened species in the study area. Following an initial scoping assessment in which the presence of suitable habitat was assessed, species deemed unlikely to occur were excluded from further analysis. Targeted surveys were aimed at species with the potential to occur within the locality and these are listed in Table 3.1 along with the survey timing and methods.

Table 3.1 Targeted threatened species survey requirements

Species	Status		Survey method	Survey timing requirements
	TSC Act	EPBC Act		
Plants				
Ausfeld's Wattle (*Acacia ausfeldii*)	V	-	Targeted threatened flora search	August, September, October (when flowering)
Homoranthus darwinioides	V	V	Targeted threatened flora search	Year round
Ingram's Zieria (*Zieria ingramii*)	E	E	Targeted threatened flora search	Year round
Philotheca ericifolia		V	Targeted threatened flora search	Spring (when flowering)
Pine Donkey Orchid (*Diuris tricolor*)	V	-	Targeted threatened flora search	Spring (when flowering)
Tylophora linearis	V	E	Targeted threatened flora search	Year round
Amphibians				
Sloane's Froglet (*Crinia sloanei*)	V	-	Auditory surveys, active search and spotlighting at water bodies, night driving	Autumn, Winter and Spring, after rain
Reptiles				
Pale-headed Snake (*Hoplocephalus bitorquatus*)	V	-	Spotlighting	Year round
Birds				
Australasian Bittern (*Botaurus poiciloptilus*)	E	-	Spotlighting	Year round
Barking Owl (*Ninox connivens*)	V	-	Call playback, spotlighting, stag watching, searches for pellets and owl wash	Year round
Black-breasted Buzzard (*Hamirostra melanosternon*)	V	-	Timed area search, targeted search	Year round
Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)	V	-	Timed area search, targeted search	Year round

Table 3.1 Targeted threatened species survey requirements

Species	Status		Survey method	Survey timing requirements
	TSC Act	EPBC Act		
Blue-billed Duck (*Oxyura australis*)	V	-	Timed area search, targeted search	Year round
Brolga (*Grus rubicunda*)	V	-	Timed area search, targeted search	Year round
Brown Treecreeper (*Climacteris picumnus victoriae*)	V	-	Timed area search, targeted search	Year round
Bush Stone-curlew (*Burhinus grallarius*)	E	-	Spotlighting	Year round
Diamond Firetail (*Stagonopleura guttata*)	V	-	Timed area search, targeted search	Year round
Flame Robin (*Petroica phoenicea*)	V	-	Timed area search, targeted search	Autumn and winter
Freckled Duck (*Stictonetta naevosa*)	V	-	Timed area search, targeted search	Year round
Gilbert's Whistler (*Pachycephala inornata*)	V	-	Timed area search, targeted search	Year round
Gang Gang Cockatoo (*Callocephalon fimbriatum*)	V	-	Timed area search, targeted search	Year round
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	V	-	Timed area search, targeted search	Year round
Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)	V	-	Timed area search, targeted search	Year round
Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*)	V	-	Timed area search, targeted search	Year round
Little Eagle (*Hieraaetus morphnoides*)	V	-	Timed area search, targeted search	Year round
Little Lorikeet (*Glossopsitta pusilla*)	V	-	Timed area search, targeted search	Year round
Malleefowl (*Leipoa ocellata*)	E	V	Timed area search, targeted search, search for mounds and tracks	Year round
Masked Owl (*Tyto novaehollandiae*)	V	-	Call playback, spotlighting, stag watching, searches for pellets and owl wash	Year round
Painted Honeyeater (*Grantiella picta*)	V	-	Timed area search, targeted search	Year round

Table 3.1 Targeted threatened species survey requirements

Species	Status		Survey method	Survey timing requirements
	TSC Act	EPBC Act		
Powerful Owl (*Ninox strenua*)	V	-	Call playback, spotlighting, stag watching, searches for pellets and owl wash	Year round
Regent Honeyeater (*Anthochaera phrygia*)	CE	E	Timed area search, targeted search	Late autumn to early spring
Scarlet Robin (*Petroica boodang*)	V	-	Timed area search, targeted search	Autumn and winter
Speckled Warbler (*Chthonicola saggitatus*)	V	-	Timed area search, targeted search	Year round
Spotted Harrier (*Circus assimilis*)	V	-	Timed area search, targeted search	Year round
Square-tailed Kite (*Lophoictinia isura*)	V	-	Timed area search, targeted search	Year round
Superb Parrot (*Polytelis swainsonii*)	V	V	Timed area search, targeted search	Winter
Swift Parrot (*Lathamus discolor*)	E	E	Timed area search, targeted search	Winter
Turquoise Parrot (*Neophema pulchella*)	V	-	Timed area search, targeted search	Year round
Varied Sittella (*Daphoenositta chrysoptera*)	V	-	Timed area search, targeted search	Year round
White-fronted Chat (*Epthianura albifrons*)	V	-	Timed area search, targeted search	Year round
Mammals				
Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)	V	-	Anabat detection, harp trapping	October to March
Eastern Cave Bat (*Vespadelus troughtoni*)	V	-	Anabat detection, harp trapping	October to March
Eastern Pygmy-possum (*Cercartetus nanus*)	V	-	Spotlighting, baited infrared camera, hair tubes	Year round
Koala (*Phascolarctos cinereus*)	V	V	Spotlighting, call playback, searches for scats and scratches	Year round
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	V	Anabat detection, harp trapping, searches for roosts in sandstone overhangs	October to March

Table 3.1 Targeted threatened species survey requirements

Species	Status		Survey method	Survey timing requirements
	TSC Act	EPBC Act		
Little Pied Bat (*Chalinolobus picatus*)	V	-	Anabat detection, harp trapping, searches for roosts in cliff crevices	October to March
Southern Long-eared Bat (*Nyctophilus corbeni*)	V	-	Harp trapping	October to March
Spotted-tailed Quoll (*Dasyurus maculatus*)	V	E	Spotlighting, IR cameras, searches for latrine sites in rocky outcrops	Year round
Squirrel Glider (*Petaurus norfolcensis*)	V	-	Spotlighting, call playback, hair tubes, searches for feeding marks and scratches, IR cameras	Year round
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V	-	Anabat detection, harp trapping	October to March

Notes: 1. TSC Act - Threatened Species Conservation Act 1995, EPBC Act - Environment Protection and Biodiversity Conservation Act 1999, V - vulnerable, E - endangered, CE - critically endangered

2. IR – infrared

3. Source for survey timing requirements: DECC, 2009; DEC, 2004, DEWHA 2011a-2011d

3.2.2 Literature review

Several databases, mapping projects, environmental assessment reports and relevant scientific literature were reviewed. In particular, the ERM baseline ecology report for the study area was reviewed to determine information gaps to be filled to ensure survey adequacy over the study area.

i Review of 2009-2011 Baseline Surveys (ERM 2012)

The 2009-2011 Baseline Surveys (ERM 2012) concentrated on the area surrounding Laheys and Sandy creeks and the surrounding agricultural areas. Design changes were made after the 2009-2011 Baseline Surveys were undertaken and this changed the disturbance areas.

Gap analysis was used to determine the adequacy of the 2009-2011 Baseline Surveys given the changes to the Project area. A review of survey effort and methods employed was also undertaken. The findings are summarised in Table 3.2. Adequacy was based on the required survey timing for target threatened species identified in Table 3.1 and within the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - working draft* (DEC, 2004).

The results of the 2009-2011 Baseline Surveys review were used to determine the requirements and locations for the 2011-2012 Surveys. This also assisted in determining additional survey methods required to cover all species identified within the database searches with the potential to occur within the study area.

Table 3.2 Summary of 2009-2011 baseline survey effort

Target group	Method	Dates survey completed	Survey adequacy*
Threatened flora	Targeted random meanders in suitable habitat	18-22 January 2010, 1-5 February 2010, 3-5 March 2010	All species would have been identifiable during the surveys.
Fauna habitat	Fauna habitat assessment and searches for signs	12-23 October 2009, 18-22 January 2010, 1-5 February 2010, 12-16 April 2010	Suitable survey effort for ERM study area.
Reptiles and amphibians	Nocturnal searches	October 2009	Nocturnal searches for Sloane's Froglet after rainfall and in winter not completed. Dedicated diurnal reptile surveys were not completed and no targeted nocturnal surveys for the Pale-headed Snake were undertaken.
Birds	Diurnal surveys	August and October 2009, January and April 2010, 23-25 August 2011	Surveys were conducted in winter targeting bird species following flowering events (eg Superb Parrot, Swift Parrot).
Bats	Anabat detection	October 2009	Bat species in the genus *Nyctophilus* cannot be positively identified using Anabat detection. Therefore harp trapping was required to determine the presence of the Southern Long-eared Bat and this was not completed.

Table 3.2 Summary of 2009-2011 baseline survey effort

Target group	Method	Dates survey completed	Survey adequacy*
Mammals	Ground hair tubes	October 2009	Arboreal trapping was not undertaken. The Squirrel Glider would not have been targeted using ground based hair tubes. However spotlighting surveys may have identified this species, but additional survey methods should also be used to target this species.
	IR camera surveys	October 2009	IR cameras targeted ground-dwelling carnivorous mammals. Arboreal trapping with suitable bait for the Squirrel Glider was not undertaken.
Birds and mammals	Nocturnal surveys	13–21 October 2009, 7-11 November 2009	Call broadcast was undertaken for birds, however no mammal call broadcast was undertaken
Other survey methods missing from the ERM methods			The Koala was not targeted within any surveys by ERM.

Notes 1. IR – infrared.

3.3 Detailed flora survey methods

3.3.1 Vegetation mapping review

A review of vegetation mapping and data was undertaken to provide information on the vegetation types known in the locality and in the region. Information sources included:

- *Cobbora Coal Project Terrestrial Ecology Baseline Report*, report to Cobbora Holding Company (ERM, 2012);
- *New South Wales Vegetation Classification and Assessment: Introduction of the Classification, Database, Assessment of Protected Areas and Threat Status of Plant Communities* (Benson, 2006);
- *New South Wales Vegetation Classification and Assessment: Part 2 Plant Communities of the NSW South-western Slope Bioregion and update of NSW Western Plains plant communities*, Version 2 of the NSWVCA database (Benson, 2008);
- *New South Wales Vegetation Classification and Assessment: Part 3 Plant communities in the NSW North Western Slopes and West-New England Region and Update of Western Plains and NSW South Western Slopes Bioregion* (Benson et al 2010);
- *Reconstructed and Extant Distribution of Native Vegetation in the Central West Catchment* (DEC, 2006a); and
- *Native Vegetation Map Report Series No. 2* (DIPNR, 2004).

3.3.2 Vegetation mapping

Vegetation mapping focussed on areas that had not previously been mapped during the 2009-2011 Baseline Surveys undertaken by ERM (2012). Fine scale vegetation mapping and assessment was undertaken within the Project impact area to produce a comprehensive vegetation map.

Vegetation types were assessed in the field using a combination of plot surveys and rapid assessment surveys. Vegetation type boundaries were mapped either on foot or from a vehicle using a global positioning satellite (GPS) receiver, whilst referencing aerial photographs and topographic maps. Field based assessments were followed by aerial photograph interpretation (API) and analysis using a geographic information system (GIS), to create a comprehensive vegetation map of the direct impact areas within the study area. Figure 3.1 shows the flora survey methods used.

Outside of the Project impact area, vegetation was mapped using aerial photograph interpretation, knowledge of the vegetation types, landscape formation, existing broad scale mapping (DIPNR, 2004 and DEC, 2006), with limited ground-truthing in key areas using plot-based and rapid assessments. This provided context for the local distribution and extent of vegetation types within the PAA.

Vegetation types identified within the study area were compared to the NSW Biometric Vegetation Types Database (DEC, 2008), vegetation types in the NSW Vegetation Information System (OEH, 2011a), vegetation classes and formations (Keith, 2004), vegetation types of the Central West CMA (DEC, 2006a) and vegetation community descriptions (Benson, 2008; Benson *et al,* 2010 and DIPNR, 2004). This comparison provided an appreciation of the extent and distribution of the vegetation types within the locality and within the region. This was used to determine the conservation significance of each vegetation type. Biometric vegetation types were assigned so that the study area could be assessed using the NSW Biobanking method to calculate offset requirements.

3.3.3 Vegetation plots

Vegetation plot surveys were undertaken to randomly sample each vegetation type within the potential disturbance area. Initial stratification of vegetation within impact areas was undertaken based on its position in the landscape and broad vegetation classification. Table 3.3 shows the stratification units identified, area of each unit, the number of required survey plots per stratification unit based on area (DEC, 2004) and the total number of plots surveyed in the study area between 2009 and 2012 (incorporating the 2009-2011 Baseline Surveys).

Table 3.3 Stratification units and number of survey plots

Stratification unit	Approximate area* (ha)	Number of plots required	Number of plots surveyed (2009-2012)
Ironbark/Cypress woodlands (hill slopes and foot slopes)	1,231	10	13
Box woodlands (flats and depressions)	80	3	12
Red Gum woodlands (flats and foot slopes)	191	3	5
Regrowth	365	5	5
Native pasture	967	10	10

*Notes: 1.*Hectares measured from GIS analysis of the study area*

All plots surveyed within the study area were 0.04 ha and most were surveyed using a 20 m by 20 m quadrat (as prescribed in the NSW standard (Sivertsen, 2009)). Where linear remnants or riparian communities were surveyed, plot layout was altered to avoid edge effects or ecotones with other vegetation types (eg using 10 m by 40 m plots). All flora species within plots were identified to species (or subspecies) and given a cover abundance score using a modified Braun-Blanquet method (see Table 3.4). Where a potential threatened species was recorded, a sample was collected and sent to the Royal Botanic Gardens Sydney for confirmation of identification. This was completed for a number of *Acacia* species in particular.

Table 3.4 Cover-abundance scores used in plot surveys

Score	Cover Abundance
1	Less than 5% cover and uncommon
2	Less than 5% cover and common
3	5-25%
4	25-50%
5	50-75%
6	75-100%

Notes: 1. Source: Wikum and Shanholtzer (1978)

2. The cover-abundance scores are a modified version of the Braun-Blanquet cover abundance scale

3.3.4 Grassland surveys

Grassland surveys were undertaken at 20 locations within the study area between 23 and 25 August 2011 and 17 and 20 October 2011. The purpose of the surveys was to determine if the study area contained any areas of Derived Native Grassland as described under the EPBC Act or the TSC Act.

Ten 20 m by 20 m quadrats were surveyed in grassy areas that were in association with remnant patches of Box-Gum woodlands, or that were considered to have potentially once supported Grey Box or Box-Gum Woodland communities. Flora species within each quadrat were recorded along with other details including locality description, cover abundance of each species, percentage cover of rocks, lichen and moss, bare ground and litter and tussock density and height. Additional notes on the general condition of the community and any signs of disturbances such as weeds or grazing were also taken.

Rapid assessments of grasslands were undertaken at 10 sites across the study area. The purpose of the rapid assessments was to eliminate areas of grassland that were, upon closer inspection, considered to be improved pasture, dominated by exotics, and thus not warranting a plot survey.

The locations of the grassland surveys and rapid assessments are shown on Figure 3.1.

Other specific information collected from survey plots included:

- broad classification of vegetation type (eg Grey Box Woodland);
- centre of plot (using GPS);
- position of plot in landscape, aspect and slope;
- presence of disturbances such as grazing or weeds;

- cover (%) of leaf litter, Cryptogams and logs (including length estimate);
- presence/absence of tree hollows or mistletoe;
- cover (%) of canopy species regeneration; and
- any other notable attributes of the plot or immediate surrounds.

3.3.5 Rapid assessments

Rapid assessments were undertaken at 14 locations across the study area in 2011-2012 (Figure 3.1). At each rapid assessment location, the dominant flora species within each stratum were recorded, photographs were taken and any other points of interest were noted. Vegetation type at rapid assessment points was classified by the dominant over storey species, and then by the other component species. Position in the landscape (eg slope, alluvial plain) was also used to assist in determining vegetation type.

3.4 Identification of threatened ecological communities

Vegetation plot data and rapid assessment data was reviewed against the State and Commonwealth descriptions of TECs known from the region to determine the presence of TECs within the study area.

3.5 Targeted flora species searches

Targeted searches for threatened flora (listed under the TSC Act and/or the EPBC Act) and rare species (Rare or Threatened Australian Plant (RoTAP) species (Briggs and Leigh, 1996)) were undertaken within suitable habitats of the study area (Figure 3.1). RoTAP species are plants that are presumed extinct, endangered, vulnerable or poorly known at the national level. The RoTAP list has no legal status but is a reference for the national conservation status of species.

Targeted flora species searches were undertaken using formal transect surveys and the random meander method. Transect surveys were walked by two ecologists, walking approximately 10 m apart. Survey effort was based on the vegetation type and the likely presence of suitable habitats. Random meanders were generally undertaken while mapping the vegetation types of the study area. The total survey effort for targeted flora surveys is provided in Table 3.5.

Where a rare or threatened species was recorded, a sample was taken and sent to the Royal Botanic Gardens Sydney for identification confirmation and the following data was collected:

- number of individuals;
- reproductive status of the population (eg flowering/fruiting);
- the locations of each individual using a GPS (where individuals were less than one metre apart, a single point was recorded and the number of plants at that point noted);
- habitat features present (eg rocky outcrops and associated flora species);
- aspect and/or degree of slope;
- vegetation type; and

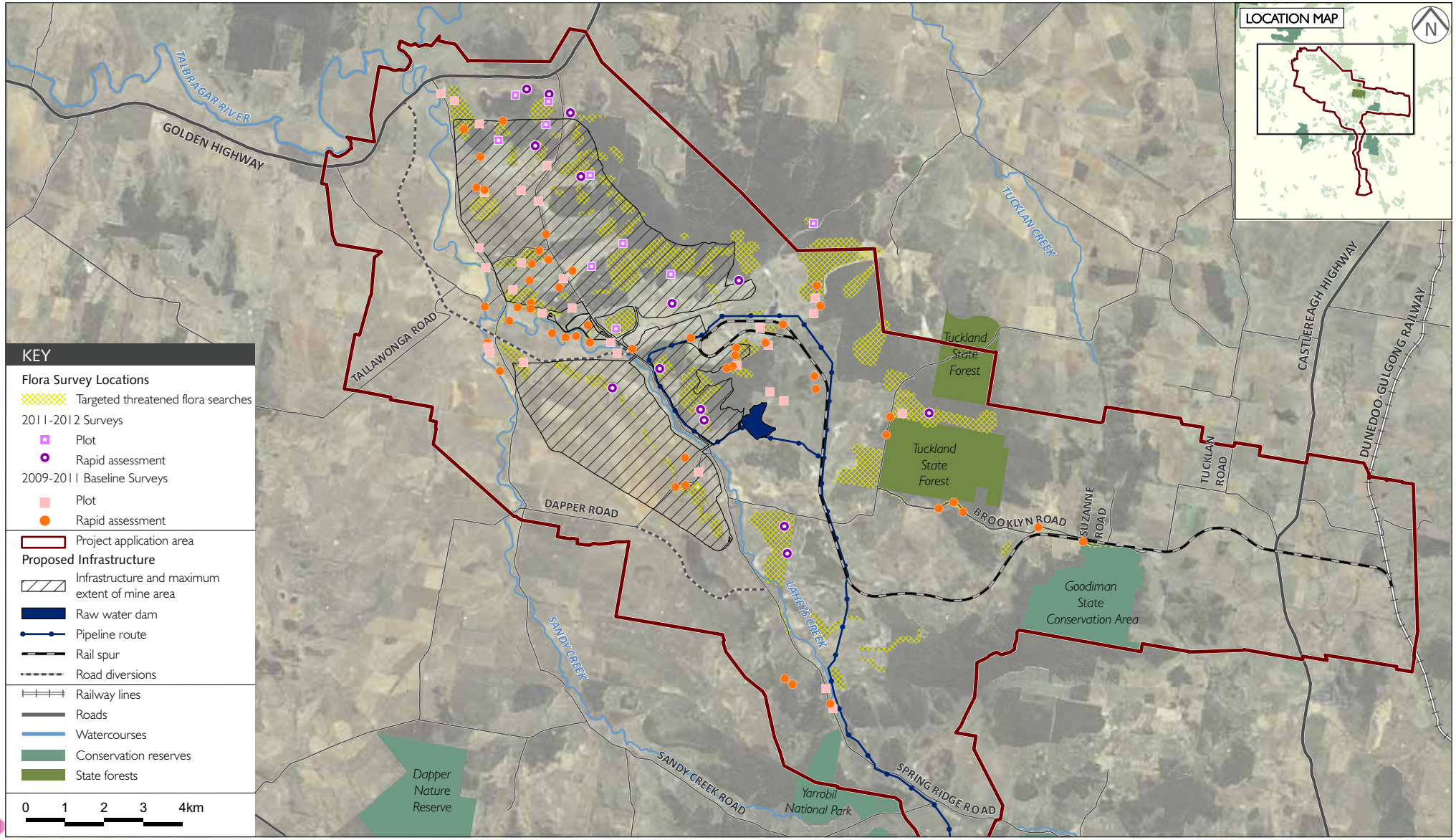
- threats (if any) and/or previous disturbances.

3.6 Vegetation survey effort

A summary of the survey effort for flora searches and vegetation surveys undertaken in the 2011-2012 Surveys is provided in Table 3.5.

Table 3.5 Flora survey effort

Survey method	2011-2012 Survey dates	Person hours or plots	Total survey effort for the study area (includes baseline survey)
Plot surveys	17-21 October 2011	10 plots	40 plots
Rapid assessments	27-29 September 2011 17-21 October 2011	14 plots	65 plots
Targeted threatened flora searches	17-21 October 2011 28 October - 2 November 2011	108 hours	201 hours



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EMM

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Flora Survey Sites

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 3.1

3.7 Detailed fauna survey methods

3.7.1 Fauna habitat assessment

An assessment of fauna habitat types and habitat condition was undertaken to determine appropriate locations for targeted sampling of fauna species. The presence of specific habitat features was noted including the presence of:

- hollow-bearing trees, including stags;
- bush rock and rocky outcrops;
- logs and other artificial cover (eg discarded metal roofing etc);
- wetlands, streams, rivers, dams and other water bodies;
- nests, roosts, burrows and dens;
- glider feeding scars and Koala (*Phascolarctos cinereus*) feed trees;
- chewed She-oak (*Allocasuarina* spp.) cones;
- areas that could act as movement corridors for plant or animal species;
- winter-flowering eucalypts;
- permanent soaks and seepages; and
- scats.

Figure 3.2 and Figure 3.3 show the locations and the types of fauna surveys undertaken.

3.7.2 Survey conditions

The 2011-2012 Surveys were undertaken over spring and summer from 2011 to 2012 after a wet winter and spring (Table 3.6). Rainfall and warm temperatures resulted in significant flowering events during the survey period. This may have also altered seasonal migration patterns for some species, particularly birds, due to the presence of abundant foraging resources both inside and outside the study area.

Table 3.6 Weather conditions during 2011-2012 Surveys for fauna

Season and year	Dates	Temperature	Rainfall	Fauna surveys
Spring 2011	17-21 October	Min 6.4°C Max 28.8°C	0 mm	Reptiles, birds, hair tubes, bat call detection, harp traps, opportunistic, habitat
	7-11 November	Min 9.4°C Max 34.8°C	2.3 mm on 7 November 8.8 mm on 9 November 0.7 mm on 10 November	Reptiles, amphibians, birds, hair tubes, IR cameras, opportunistic, habitat
Summer 2011	12-16 December	Min 11.4°C Max 26.7°C	22.7 mm on 12 December 4.0 mm on 13 December	Reptiles, amphibians, birds, IR cameras, opportunistic, habitat
	16-20 January	-	-	Nocturnal, opportunistic

Notes: 1.Data from Dunedoo weather station (BOM 2011a).

3.7.3 Reptiles and amphibians

i Active searches

Reptile and amphibian survey methods were selected that identified targeted threatened species and their habitat, and that adequately sampled the entire study area for common herpetofauna (reptiles and frogs). Preliminary assessments of the study area were undertaken to identify the most suitable sites in which to concentrate survey effort and increase the chances of detection of threatened reptile and amphibian species. Active searches of the identified areas were conducted in suitable habitats including under rocks, logs and other items of ground cover or shelter (Figure 3.2). Identification of species was made in the field and taxonomy was as per Wilson and Swan (2010). Photographs and measurements were taken of species that could not be confirmed in the field, for later identification.

ii Nocturnal searches

Suitable habitats for targeted nocturnal species were identified during daytime surveys. Transects of these areas were undertaken at night (Figure 3.2). Road surveys were conducted when driving between study areas, particularly after or during rain (Figure 3.2). Roads were slowly driven to search for reptiles and amphibians.

Searches for amphibians, particularly rare and threatened species were carried out from early spring 2011 through to summer 2012. All appropriate amphibian habitats within the study area were searched. This included searches along riparian corridors, farm dams, and areas of ephemeral inundation such as low-lying paddocks near watercourses. Calling frogs were located and identified where appropriate with all handling procedures conforming to NPWS Protocol 6 (NPWS, 2008) to minimise the risk of spread of chytrid disease in frog communities. Frogs were not handled unless necessary for identification purposes, and gloves were used in cases where frogs had to be handled.

Tadpole traps were placed at several water bodies to determine amphibian species that were breeding within the study area. In addition, eggs and tadpoles were identified during the nocturnal surveys, using a net where required. Boots, nets and tadpole traps were washed and disinfected between study areas with different water influences.

3.7.4 Birds

i Diurnal birds

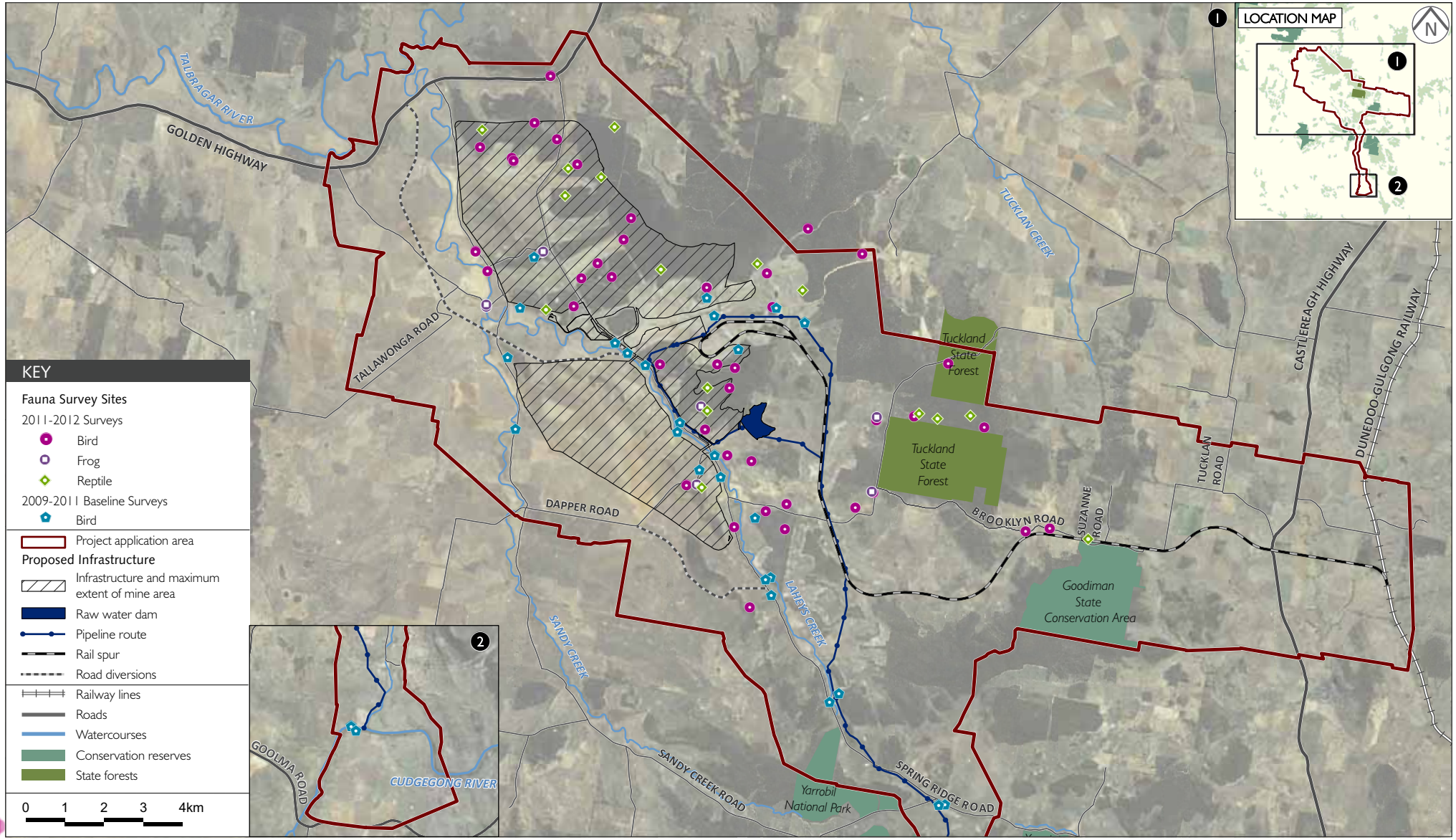
Timed searches of 20 minutes duration were used to survey diurnal (day active) birds. Species accumulation curves were used and surveys extended until no new birds were identified. Timed searches were extended to one person hour at sites where new species continued to be encountered.

The presence and abundance of all birds observed in the study area during the timed searches were recorded. Birds were identified either visually, with the aid of binoculars or by call identification. Surveys commenced in the early morning, within an hour of sunrise when bird activity is greatest (Bibbly, Burgess and Hill, 1992). Survey locations are shown on Figure 3.2.

ii Nocturnal birds

Nocturnal bird spotlighting surveys commenced at sunset (to capture species emerging from roost sites and hollows) during favourable weather (ie outside times of extreme wind and rain during the survey period (Figure 3.2). Call playback for threatened owl species was also conducted. For ethical reasons, call playback was discontinued if an owl species was called in on more than two nights. If more than one area was surveyed for nocturnal birds on the same night, the surveys were located a minimum of 1 km apart to reduce the likelihood of the same birds being surveyed in multiple samples.

In addition to nocturnal spotlight surveys, searches for any evidence of owls (eg pellets, wash on trees and used hollows) were undertaken during searches for signs of fauna.



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Reptile, Amphibian and Bird Survey Sites

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 3.2

3.7.5 Bats

A combination of methods was used to sample bat species diversity and abundance in the study area. Call detection (Anabat), roost surveys and harp trapping methods were used to detect insectivorous bats and spotlighting was undertaken to target flying-foxes.

i Anabat detection

Echolocation calls of microchiropteran bats were recorded within representative habitat in the study area. Calls were recorded over the entire night using an electronic storage device (ZCAIM) via Anabat II and/or SD1 bat detectors for subsequent computer analysis. Detectors were located adjacent to harp traps where possible (or nearby rock outcropping) and were placed in a total of nine areas for two nights in each location (Figure 3.3).

Anabat sonograms were identified using Anabat or Analook for Windows (Corben, 2011). The Australian Bat Society's (ABS) *Standards for Reporting Bat Detector Surveys* (ABS, 2001) have been adopted in the preparation of this report. Sonograms were identified by direct comparison with the personal reference library of Glenn Hoye (Fly by Night Bat Consultancy) who has an extensive local reference library of calls from Ulan (approximately 30 km to the east of the PAA).

ii Harp traps

Harp traps were placed at nine locations over four nights (Figure 3.3). Traps were placed in suitable flyways throughout the study area to ensure that all major habitats were sampled. Individuals captured were identified to species level, together with other measurements and observations including age (canine wear), gender, sexual condition, weight, forearm length and ear length for Long-eared Bats (*Nyctophilus* spp.) as this is a character used to distinguish species.

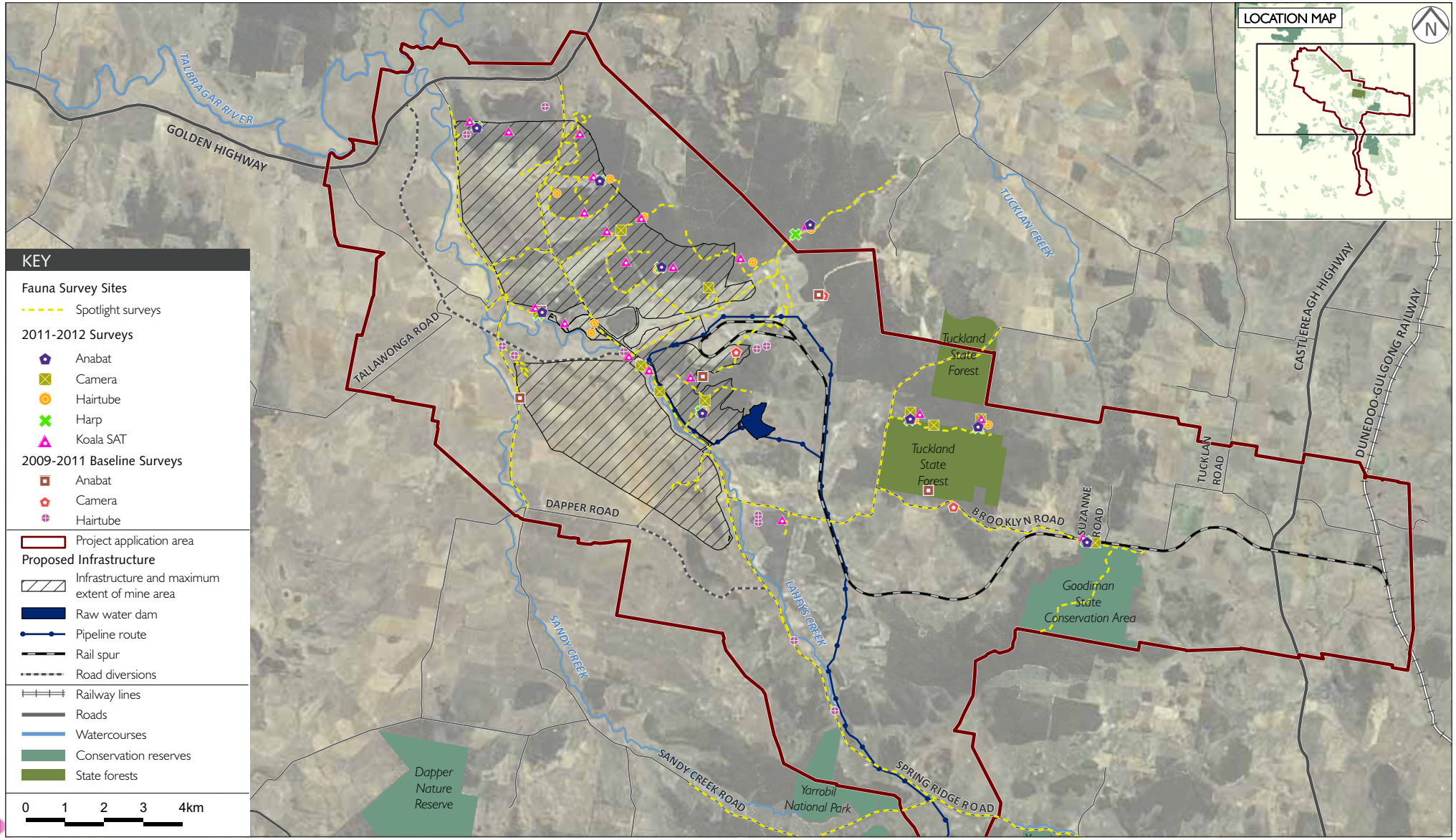
iii Roost surveys

Surveys targeting cave dwelling bat species were undertaken in rocky outcrops and cliff faces. Where such habitat features were located in proximity to a trapping site, Anabat II detectors were placed within suitable roosting areas to target such species.

3.7.6 Mammals

i Trapping

Elliot and cage trapping were not undertaken as the mammal species targeted by surveys were considered to be detectable using other methods including hair sampling, scat analysis, infrared cameras, spotlighting and call playback (see section 3.7.7).



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EMM

Cobbora Holding Company Pty Limited

Mammal Survey Sites

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 3.3

ii Hair sampling

Hair tubes were placed in locations with continuous tracts of vegetation, focusing on the impact area (Figure 3.3). A combination of large and small, ground and arboreal (1.5-2 m above ground level) hair tubes were placed within the study area. Each transect contained 14 hair tubes, with a mixture of ground and arboreal, large and small tubes. Ground hair tubes were positioned in bushes, small trees or within dense groundcover and identified fauna runways. Arboreal hair tubes were placed within trees, on the high side of the trunk with nails. Hair tubes were left for at least 14 consecutive nights in accordance with EPBC survey requirements for targeted mammal species (DEWHA, 2011c).

Bait in arboreal tubes consisted of rolled oats, peanut butter and honey. A honey/water mixture was sprayed up the tree trunk (approximately 2-4 m above the ground) to attract animals to the tubes. Bait within the ground-based hair tubes consisted of either the typical bait mix (as above) or a mixture of sardines, tuna and/or truffle oil and flour to target marsupial predators (DEWHA, 2011c) and omnivores. Hair samples were sent to Georgeanna Story (ScatsAbout) for analysis.

iii Spotlighting and call broadcasting

Spotlight searches were carried out for threatened nocturnal mammal species within the study area. Calls of nocturnal mammal species (Squirrel Glider (*Petaurus norfolcensis*) and Koala) were broadcast during the spotlighting to elicit responses. Opportunistic sightings of terrestrial mammal fauna were also recorded. Nocturnal surveys were conducted over a total of 14 nights. Where possible, nights with rainfall and greater moon influence were avoided as they are known to affect spotlight success (DEC, 2004).

iv Tracks, scats and signs

Opportunistic records of tracks, scats and signs (that indicate mammalian use of an area) were noted while completing other survey tasks. These tracks, scats and signs can sometimes lead to the identification of taxa to the species level and are therefore important presence indicators. Any predator scats identified were analysed for prey species remains by Georgeanna Story (ScatsAbout).

v Koala survey

Koalas in a socially stable breeding population are known to repeatedly feed on a small number of trees (home range trees). As such, high activity areas can be determined based on the location and distribution of faecal pellets in suitable habitat. The spot assessment technique (SAT) (Phillips and Callaghan, 2011) was used to identify the presence and activity level of Koalas in the study area. This technique required checking the basal areas around trees adjacent to a known habitat tree to determine habitat use. Known Koala habitat trees include:

- a tree of any species beneath which one or more Koala faecal pellets have been observed;
- a tree in which a Koala has been sighted; or
- any other tree known or considered likely to be an important tree for Koalas in a particular area (Phillips and Callaghan, 2011).

Potential feed trees present within the study area include River Red Gum (*Eucalyptus camaldulensis*), White Box (*E. albens*), Blakely's Red Gum (*E. blakelyi*), Fuzzy Box (*E. conica*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Dwyer's Red Gum (*E. dwyeri*) Narrow-leaved Stringybark (*E. sparsifolia*) and Red Stringybark (*E. macrorhyncha)* (DECC, 2008b and SEPP 44).

Locations within the study area, containing these tree species were searched for signs of Koala use to determine presence and/or activity levels. A total of 20 person hours was spent searching for habitat signs, specifically Koala pellets, over the survey period.

Within the surveyed vegetation plots, the number of Koala feed trees was recorded. In accordance with SEPP 44, areas were identified as potential Koala habitat where feed trees identified within Schedule 2 of the SEPP comprised more than 15% of the total number of trees in the upper or lower strata of the tree component. Habitat assessments were also undertaken for Koalas in these locations.

vi Infrared camera survey

Three motion-sensitive infrared (IR) cameras were placed for two nights at six sites during November 2011. A typical bait mixture was used with sardines, targeting ground-based carnivores and omnivores. Cameras were positioned in identified fauna runways, often in gullies or in areas where water was available. An additional five cameras were deployed for four nights in December 2011, with bait consisting of a sponge soaked in honey and truffle oil, placed on habitat trees opposite the camera location.

3.7.7 Fauna survey effort

Table 3.7 provides a summary of the fauna survey effort undertaken for the 2011-2012 Surveys.

Table 3.7 Summary of fauna survey effort

Target group	Method	Dates of 2011-2012 Surveys
All	Fauna habitat assessment and searches for signs	28 October to 2 November 2011, 7 to 11 November 2011, 12 to 16 December 2011
Reptiles and amphibians	Active searches	7 to 11 November 2011, 12 to 16 December 2011
	Nocturnal searches	7 to 11 November 2011, 28 October to 2 November 2011, 12 to 16 December 2011
Birds	Diurnal surveys	7 to 11 November 2011, 12 to 16 December 2011
Bats	Anabat detection	17 to 21 October 2011
	Harp trapping	17 to 21 October 2011
Mammals	Arboreal and ground-based hair tubes	17 October to 11 November 2011, 7 to 30 November 2011
	Koala SPOT	7 to 11 November 2011, 12 to 16 December 2011
	IR camera surveys	7 to 11 November 2011, 12 to 16 December 2011
Birds and mammals	Nocturnal surveys	28 October to 2 November 2011, 12 to 16 December 2011

3.8 Summary of flora and fauna survey effort

An independent desktop assessment of the proposed assessment methods was undertaken by Alison Hunt & Associates Pty Ltd. A number of recommendations were made and these were incorporated into the methods to ensure adequacy of surveys.

A summary of all survey methods, survey effort (ie number of hours spent surveying and number of plots surveyed) and survey timing for the Project is provided in Table 3.8. The table describes the total survey effort undertaken within the study area which includes both the 2009-2011 Baseline Surveys and 2011-2012 Surveys.

Table 3.8 Summary of all biodiversity surveys within the study area

Taxa group	Survey method	Total survey effort	Survey timing
Flora	Preliminary vegetation surveys	24 person hours	Winter and Spring 2009
	Plot surveys	30 plots	Spring 2009 and 2011
	Rapid vegetation assessments	57 points	Spring 2009 and 2011
	Targeted threatened flora searches	201 person hours	Summer-Autumn 2010, Spring-Summer 2011
Fauna General	Habitat assessments and searches for signs	Over 450 person hours	Spring 2009, Summer-Autumn 2010, Spring-Summer 2011
Reptiles	Active search	96 person hours	Summer 2011
	Nocturnal search	114 person hours	Summer 2011
Birds	Timed diurnal search	69 search areas (20-60 minutes per search)	Winter and Spring 2009, Summer and Autumn 2010, Winter and Summer 2011
Microchiropteran bats	Anabat detection	39 detector nights	Spring 2009 and 2011
	Harp trapping	18 trap nights	Spring 2011
Non-flying mammals	Arboreal hair tubes	1,600 trap nights	Spring-Summer 2011
	Ground hair tubes	2,707 trap nights	Spring 2009, Summer 2011
	Koala spot assessment	20 person hours at 20 plots	Summer 2011
	Infrared camera surveys	41 days and nights at 15 locations	Spring 2009, Summer 2011
Nocturnal birds and mammals	Call broadcasting and spotlighting	16 locations on 29 occasions	Spring and Summer 2009, Spring and Summer 2011

Notes: 1. Vegetation mapping was carried out between Spring 2009 and Summer 2011. Surveys were carried out across different seasons to increase the detection rates of flowering plants.

3.8.1 Survey limitations

i General limitations

The survey effort, design and timing targets the threatened species considered likely to occur within the study area, while also providing baseline information on the flora and fauna present. It was not possible to detect every species that may reside or visit the study area, particularly those that are cryptic, migratory or have inactive stages in their lifecycle. For those species of conservation significance which were not detected, the likelihood of occurrence in the study area was based on the presence of suitable habitat and known nearby recent records (see Appendix A). If habitat was present for such species along with recent nearby records, it was assumed that such species occurred in low densities.

ii Fauna

Survey effort for threatened fauna (Table 3.8) generally met or exceeded applicable guidelines. However, mammal surveys did not include live trapping as recommended for the Squirrel Glider and Eastern Pygmy Possum (*Cercartetus nanus*). Survey methods were used that are considered suitable alternatives to live trapping for the threatened mammal species targeted. Such methods included stag watching, spotlighting, call playback, infrared cameras, and hair tubes. Recent surveys in nearby conservation areas used similar methods without live trapping and recorded the target species (NPWS, 2000). The NPWS (2000) study found that spotlight searches were the most productive, in terms of mammal species observed.

iii Flora

Vegetation surveys and threatened flora searches were undertaken using Sivertsen (2009) *Native Vegetation Interim Type Standard* and DEC (2004) *Draft Threatened Biodiversity Survey and Assessment: Guidelines.* The number of plots surveyed complied with requirements according to site stratification (DEC, 2004).

Every effort was made to accurately record vegetation type boundaries using GPS and aerial photographs. However, some imprecision may occur in boundary locations where vegetation types merge, as in general, vegetation boundaries do not occur as straight lines as represented on mapping.

In analysing the vegetation types recorded within the study area, it was noted that many types were not accurately described in the available vegetation databases. In particular, the Biobanking database (DECC, 2008a) did not provide accurate descriptors for many of the vegetation types recorded within the study area. However, for the purposes of calculating offsets and impacts, it was necessary to prescribe a type of 'best fit'.

3.8.2 Naming conventions

Naming conventions for each group targeted are shown in Table 3.9. While the nomenclature for many groups is relatively straightforward (ie flora, birds), some species of bats are currently undergoing major taxonomic revisions. For example, the formerly named Greater Long-eared Bat (*Nyctophilus timoriensis*), as recognised by OEH, was redescribed by Parnaby (2009) into five species with distinct distributions. The species present in the study area is called the Southern Long-eared Bat (*Nyctophilus corbeni*), which is recognised by SEWPaC. Nomenclature for this species within the report is consistent with the SEWPaC descriptions for this threatened species.

Table 3.9 Naming conventions by group

Group	Nomenclature adopted
Flora	Harden (1980) and PlantNET (RBGDT, 2012)
Reptiles and amphibians	Cogger (2000)
Birds	Morcombe (2000)
Bats	Threatened species, populations and communities of NSW (DEC, 2005) and Churchill (1998) (with the exception of *N.corbeni* as discussed above which is based on Parnaby (2008))
Mammals	Menkhorst and Knight (2004)

3.9 Groundwater dependent ecosystems identification

Groundwater dependent ecosystems (GDEs) have the potential to be impacted by groundwater drawdown. The baseline surveys identified the occurrence of GDEs within the study area using photographs taken by Parsons Brinkerhoff (PB), topographic maps and vegetation data (ERM, 2012). Potential GDEs were identified where springs or other signs of surface water/groundwater connectivity were recorded or predicted based on groundwater modelling. This included areas with groundwater derived stream flow, River Red Gum woodland on creek banks, or wetland areas containing water and/or Cumbungi (*Typha domingensis*).

PB (2012) completed a detailed assessment of the groundwater systems of the study area. As part of the assessment, PB completed a long term (21 day) pump test at two locations (GW5 and GW7) to determine connectivity between the regional Permo-Triassic aquifer and the alluvium aquifers within the study area. Hydrographs were plotted to show changes to the alluvial aquifers from pumping of the regional aquifer. Groundwater modelling was undertaken for the Project.

Results from the pump test, hydrographs and groundwater modelling were used to determine potential groundwater availability to terrestrial ecosystems. PB supplied GIS layers identifying the locations within the study area where the water table occurs between 0-3 m below and 3-5 m below the surface. These were overlain on vegetation mapping to gain an understanding of the locations where the water table surface is within the root zone and therefore potentially available to terrestrial vegetation. Predicted drawdown of groundwater within the alluvium was also provided in GIS format for various stages through the mine life, which was used to determine possible impacts on potential GDEs.

4 Results

4.1 Desktop and database review

4.1.1 Literature review

Several databases, mapping projects, environmental assessment reports and relevant scientific literature were reviewed. A summary of the main documents reviewed and outcomes of the review is provided in the following sections.

i 2009-2011 baseline survey report for the proposed Cobbora Coal Project

A 2009-2011 Baseline Survey of the terrestrial flora and fauna was undertaken by ERM (2012) within the study area for the original concept of the Project. The survey aimed to identify and describe the existing environment, vegetation communities and fauna habitats present with a view to identifying threatened species, populations and communities.

Since undertaking surveys within the ERM study area, there have been considerable design changes to the Project. This has included the removal of an additional water pipeline to Ulan Coal Mine to the east of the study area, and the relocation of the pits to avoid impacts to the riparian systems of the locality.

Three threatened ecological communities (TEC) were identified within the ERM study area:

- Box-Gum Grassy Woodland;
- Fuzzy Box Woodland; and
- Inland Grey Box Grassy Tall Woodland.

The potential for derived native grasslands which form part of the Grey Box Woodland and Box-Gum Woodland TECs, to be represented in grassland areas was assessed by ERM (2012). The survey found that the low diversity of native grasses and forbs made these areas inconsistent with the TSC Act and/or EPBC Act listed communities.

Four threatened flora species were identified within the ERM study area:

- Ausfeld's Wattle (*Acacia ausfeldii*);
- *Homoranthus darwinioides*;
- Ingram's Zieria (*Zieria ingramii*); and
- *Tylophora linearis*.

Several threatened fauna species were identified within the study area:

- Barking Owl (*Ninox connivens*);
- Blue-billed Duck (*Oxyura australis*);
- Brown Treecreeper (*Climacteris picumnus picumnus*);
- Diamond Firetail (*Stagonopeura guttata*);
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*);

- Glossy Black-Cockatoo (*Calyptorhynchus lathami*);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*);
- Hooded Robin (*Melanodryas cucullata*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Little Pied Bat (*Chalinolobus picatus*);
- Powerful Owl (*Ninox strenua*);
- Speckled Warbler (*Pyrrholaemus sagittatus*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- White-fronted Chat (*Epthianura albifrons*); and
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*).

ii Extinction processes of a transitional agricultural landscape system

Bauer and Goldney (2000) reviewed the cumulative and long-term effects of European land management on vertebrate diversity in the Central Western Region (CWR) of New South Wales. They were able to compare land use history with fauna distribution records in space and time. Their analysis suggested that the region has experienced a large decline in mammal diversity when compared with other vertebrate groups, although these have also experienced declines.

The history of agricultural land use suggests that a complex interaction of many factors may be responsible for the decline of various species. They argued that there are complex links between anthropogenic and natural events and the patterns of vertebrate decline, as revealed through an analysis of historic records, land degradation, the nature and extent of vegetation clearing, rabbit and sheep eruptions, the development of pastoral and wheat industries, the dispersal history of cats and foxes, and drought events in the region (Bauer and Goldney, 2000).

Based on the evidence presented, Bauer and Goldney argue that the CWR is an ecological transition region. This in part stems from the change in landform from tablelands to plains the decreasing rainfall that is experienced along an east-west gradient and the very significant cumulative human impacts across this landscape since European settlement.

This document provides a historical perspective of land use within the region. It also provides information relating to the reasons for the current diversity, or lack thereof, of vertebrates within the study area and surrounds.

iii Status of Vertebrate Fauna and their Habitat in the Central West Catchment

The *Status of Vertebrate Fauna and their Habitat in the Central West Catchment* report (Goldney *et al,* 2007) aimed to develop a comprehensive list of vertebrate species occurring across the Central West Catchment (CWC) and the distribution, relative abundance, habitat requirements and conservation status of those species. Each 1:100,000 mapsheet for the catchment was assessed for the status of vertebrate species and their habitat. This was then used to determine conservation priorities and management actions for species and habitat (Goldney *et al*, 2007).

The CWC includes the catchments of the Macquarie, Cudgegong, Bogan and Castlereagh Rivers, covering an area of 92,000 km^2, and encompassing parts of the Central Tablelands, the Central Western Slopes and the Central Western Plains.

A total of 551 native vertebrate species, made up of 16 fish, 36 amphibians, 113 reptiles, 318 birds and 68 mammals have been recorded within the CWC. Fourteen broad habitat types based on structural attributes of the mapped vegetation classification and topography were developed for the area. In general, the map sheets confined to the eastern half of the CWC had a higher diversity of vertebrate fauna species. The Project is located within the eastern half of the CWC (Figure 2.1).

iv New South Wales Vegetation Classification and Assessment: Part 3

The *NSW Vegetation Classification and Assessment: Part 3* paper was the fourth in a series of reports covering the Brigalow Belt South (BBS) and Nandewar (NAN) bioregions and the western half of the New England Tablelands Bioregion (NET), an area of 9.3 million ha being 11.6% of NSW.

The paper found that a feature of the BBS and NAN bioregions is the array of ironbark and bloodwood dominated shrubby woodlands on sandstone and acid volcanic substrates, which extend from Dubbo to Queensland. Large expanses of basalt-derived soils were found to support grassy box woodland and native grasslands. Wetlands occurred on sodic soils near Yetman and in large clay gilgais in the Pilliga region. Sedge lands were found to be rare and occupy impeded creeks. Areas of deep sand contained She-oak (*Allocasuarina* spp.), eucalypt mallee and Urn Heath (*Melaleuca uncinata)*. Grassy box woodlands occupied lower elevations with lower rainfall and higher temperatures (Benson *et al,* 2010).

Approximately 60% of the woody native vegetation in the BBS and NAN bioregions is estimated to have been cleared resulting in large areas of 'derived' native grasslands. As of June 2010, 7% of the area was in 136 protected areas and 127 of the 315 plant communities were assessed as being adequately protected in reserves.

Using the New South Wales vegetation assessment and classification (NSWVCA) database threat criteria, 15 plant communities within the study area were assessed as being Critically Endangered, 59 Endangered, 60 Vulnerable, 99 Near Threatened and 82 Least Concern (Benson *et al,* 2010). Current threats identified included expanding dryland and irrigated cropping on alluvial plains, floodplains and gently undulating topography at lower elevations; over-grazing of steep hills; altered water tables and flooding regimes; localised mining; and the spread of exotic species, notably Coolatai Grass (*Hyparrhenia hirta*) (Benson *et al,* 2010).

v Reconstructed and Extant Distribution of Native Vegetation in the Central West Catchment

Reconstructed and Extant Distribution of Native Vegetation in the Central West Catchment (DEC, 2006a) describes the development of vegetation mapping datasets for the Central West CMA. Two key outputs of the report were a catchment-wide pre-clearing vegetation map and a map depicting existing vegetation coverage. Seventy-five broad vegetation types (BVTs) were identified from the existing data. Each BVT was described in terms of dominant species, variation in structure, commonly associated native and introduced species, its relationship with soils and landform, and distribution (DEC, 2006a).

The report estimated that around 38% of the Central West CMA is currently vegetated to some degree and 62% has been cleared. Further statistics were calculated to help prioritise BVTs in terms of conservation status. It was found that there are an estimated 14 BVTs with less than 1,000 ha of their extent remaining, 20 with less than 30% remaining, 31 with between 30% and 70% remaining, and 10 with more than 70% of their extent existing today (DEC, 2006a).

An indication of the catchment-wide representation of each BVT in conservation reserves was also provided. Twenty-one BVTs are not reserved at all within the Central West CMA, and only 12 have more than 15% of their area in conservation reserves. The results presented provide a conservative view of the level of clearing and vegetation degradation within native vegetation (DEC, 2006a).

Condition and habitat value of the existing vegetation was not considered during the study and was said to vary greatly across the region. The report also states that substantial areas of native vegetation have been highly modified and/or degraded by land use, weed invasion and altered ecological processes such as changed flooding and fire regimes. Grasslands, shrublands and wetlands, in particular, may not be accurately represented by the Projects mapping due to methodological biases in previous studies (DEC, 2006a).

The report states that maps created by the study are intended for use as a regional planning resource by the Central West CMA and are not appropriate for individual property planning purposes. The appropriate scale for use of the final map is recommended at 1:250,000, due to the methodologies employed and varying scales of the constituent datasets (DEC, 2006a).

vi Brigalow Belt South Regional Assessment – Preliminary fauna survey of Pilliga and Goonoo Forests

Preliminary surveys were undertaken of Pilliga and Goonoo Forests for the purposes of drawing together and building on the existing knowledge base for the area, and to identify requirements for future surveys (NPWS, 2000). Nine threatened species were detected in Goonoo SF and adjacent Coolbaggie NR. These were the Glossy Black-cockatoo, Turquoise Parrot (*Neophema pulchella*), Barking Owl, Masked Owl (*Tyto novaehollandiae*), Malleefowl (*Leipoa ocellata*), Square-tailed Kite (*Lophoictinia isura*), Eastern Pygmy-possum (*Cercartetus nanus*), Squirrel Glider (*Petaurus norfolcensis*) and the Southern Long-eared Bat (*Nyctophilus corbeni* syn. *timoriensis)*. An additional species, the Australasian Bittern (*Botaurus poiciloptilus*), was detected opportunistically outside the study boundary on the Castlereagh River near Mendooran (NPWS, 2000).

Narrow-leaf Ironbark Forest was recorded as one of the dominant vegetation communities in Goonoo State Forest. Threatened fauna species found in this community included the Barking Owl, Masked Owl, Turquoise Parrot, Glossy Black-Cockatoo, Koala, Squirrel Glider and Southern Long-eared Bat.

Blue-leaved Ironbark (*E. nubila*) forest was found to contain Glossy Black-Cockatoo, Barking Owl, Malleefowl, Eastern Pygmy Possum and Southern Long-eared Bat. Blakely's Red Gum/Rough-barked Apple (*E.blakelyi/ Angophora floribunda*) woodlands supported seven threatened species including Turquoise Parrot, Koala, Squirrel Glider, Pilliga Mouse, Eastern Pygmy Possum, Southern Long-eared Bat and Yellow-bellied Sheathtail Bat. The Glossy Black-Cockatoo, Malleefowl, and the Pilliga Mouse (*Pseudomys pilligaensis*) were recorded within Heath/Scrubland/Mallee (NPWS, 2000).

The vegetation types recorded within Goonoo SF (now Goonoo SCA) are also present in the study area. Therefore the recorded species are indicative of the species likely to occur within the PAA.

vii Community data search and biodiversity survey of the Brigalow Belt South

In response to a strong community desire to provide input into the Brigalow Belt South (BBS) western regional assessment, funding was provided for local community groups to conduct biological surveys and to retrieve local biological and ecological information held by some groups. This project was undertaken by local community environment organisations with considerable knowledge of their local environment and expertise in gathering biological and ecological information (Paull, 2002).

Bird data from 39 sites, reptile data from eight sites, mammals data from 95 sites and plant data from a further 22 sites were entered into agency biotic databases and used for targeted analyses. Two of these projects just provided species lists without specific locations. This study identified about 1,000 species of plants and 150 species of vertebrate animal (Paull, 2002).

Twenty-four threatened species listed in NSW were detected during the surveys, including two endangered species, the Malleefowl and the Bush Stone Curlew (*Burhinus grallarius*). One Rare or Threatened Australian Plant (RoTAP) listed species was also recorded (Paull, 2002).

Of relevance to the current report, studies included:

- Goonoo SF (now Goonoo SCA) survey data. This data were gathered in 1998 during a community biodiversity survey organised by the National Parks Association of NSW. This survey yielded valuable information on the floristics, birds and reptiles of the area;

- Bird and Plant Survey of Cobbora SF (now Cobbora SCA and surrounding land vested under the NPW Act). Systematic bird and plant surveys were conducted in this state forest by the Orange Field Naturalists during March 2002;

- Plant survey of Yarrobil (now Yarrobil NP), Goodiman (now Goodiman SCA) and Tuckland SF. Twelve systematic plant surveys were conducted in these three state forests during March 2002. These were undertaken on behalf of the Mudgee and District Environment Group; and

- Glossy Black-Cockatoo survey data for Goonoo SF. These data has been taken from targeted surveys in the Goonoo forest since 1994 by the Dubbo Field Naturalists (Paull, 2002).

Vegetation within the Cobbora SF is dominated by Mugga Ironbark (*E. sideroxylon*) and Tumbledown Red Gum (*E. dealbata*). Goonoo State Conservation Area is dominated by Narrow-leaf (*E. crebra*) and Blue-leaf Ironbark (*E. nubila*). Both these vegetation types occur within the study area.

viii Moolarben Coal Project Stage 2 Ecological Assessment

The *Moolarben Coal Project Stage 2 Ecological Assessment* (Ecovision Consulting, 2008) for an underground and open cut coal mine comprised detailed flora and fauna surveys and impact assessment. The study area for the assessment is approximately 40 km to the south-east of the Project so recorded species are indicative of the species and communities that could occur within the Project study area.

The surveys identified the presence of the threatened *Eucalyptus scoparia* and *Pomaderris queenslandica,* as well as Box Gum Woodland endangered ecological community (EEC) within the survey areas. Threatened fauna species identified included:

- Birds: Black-chinned Honeyeater (*Melithreptus gularis gularis*), Brown Treecreeper, Diamond Firetail, Gang-gang Cockatoo (*Callocephalon fimbriatum*), Glossy Black-Cockatoo, Grey-crowned Babbler, Hooded Robin, Painted Honeyeater (*Grantiella picta*), Powerful Owl, Speckled Warbler and Square-tailed Kite; and

- Bats: Eastern Bentwing Bat, Southern Long-eared Bat, Large-eared Pied Bat and Little Pied Bat (Ecovision Consulting, 2008).

ix Ulan Coal Mine Continued Operations Environmental Assessment

The *Ulan Coal Mine Continued Operations Environmental Assessment* (Umwelt, 2009) provided the environmental assessment under Part 3A of the EP&A Act for the proposed open cut extension area for the Ulan Coal Mine. The site is approximately 35 km to the east of the Project so recorded species are indicative of the species and communities that could occur within the Project study area.

Umwelt completed a detailed survey of the proposed extension area. The site occurs in proximity to three bioregional boundaries and therefore has a diverse range of flora and fauna assemblages, with a mixture of coastal and inland influences. The study identified the following biodiversity values within the site:

- thirty seven vegetation communities including Box Gum Woodland EEC;
- Five threatened flora species; Ausfeld's Wattle, Pine Donkey Orchid (*Diuris tricolor*), *Eucalyptus cannonii,* Hoary Sunray (*Leucochrysum albicans* var.*tricolor*) and *Homoranthus darwinioides*;
- Threatened fauna species:
    - Birds: Barking Owl, Black-breasted Buzzard (*Hamirostra meanosternon*), Black-chinned Honeyeater, Blue-billed Duck, Brown Treecreeper, Bush Stone-curlew (*Burhinus grallarius*), Diamond Firetail, Flame Robin (*Petroica phoenicia*), Gang-gang Cockatoo, Glossy Black-Cockatoo, Grey-crowned Babbler, Hooded Robin, Little Lorikeet (*Glossopsitta pusilla*), Magpie Goose (*Anseranas semipalmata*), Painted Honeyeater, Powerful Owl, Regent Honeyeater (*Anthochaera phrygia*), Speckled Warbler, Square-tailed Kite (*Lophoictinia isura*), Scarlet Robin (*Petroica boodang*), Spotted Harrier (*Circus assimilis*), Swift Parrot (*Lathamus discolor*), Turquoise Parrot and Varied Sittella;
    - Mammals: Koala, Brush-tailed Rock-wallaby (*Petrogale penicillata*) and Squirrel Glider; and
    - Bats: Eastern Bentwing-bat, Eastern Cave Bat (*Vespadelus troughtoni*), Southern Long-eared Bat, Large-eared Pied Bat, Large-footed Myotis (*Myotis macropus*) and Little Pied Bat (Umwelt, 2009).

4.2 Vegetation mapping

4.2.1 Previous mapping review

Vegetation assessment and mapping projects that provided background data for the Project are detailed in Table 4.1. Of these, only ERM (2012) provided accurate, site-specific vegetation data and GIS layers.

Table 4.1 Vegetation mapping projects relevant to the study area

Project	Data obtained	Use in current project
ERM (2012)	Vegetation mapping and GIS layers Species lists from plot surveys and rapid assessments	Vegetation mapping and data incorporated into EMM mapping and vegetation type assessments
Benson (2008)	Vegetation type descriptions for the South Western Slopes Bioregion	Vegetation type classifications
Benson *et al.* (2010)	Vegetation type descriptions for the Brigalow Belt South Bioregion	Vegetation type classifications
DEC (2006a)	Broad Vegetation Type (BVT) descriptions for the Central West CMA	Vegetation type classifications
DIPNR (2004)	Broad scale vegetation map of the study area	Preparation for field mapping within the study area, vegetation type classification for broad scale map
Biometric Vegetation Types (DEC, 2008)	Vegetation types by CMA region	Vegetation of the study area assigned to Biometric type to assist in offset calculations

4.2.2 Vegetation types of the study area

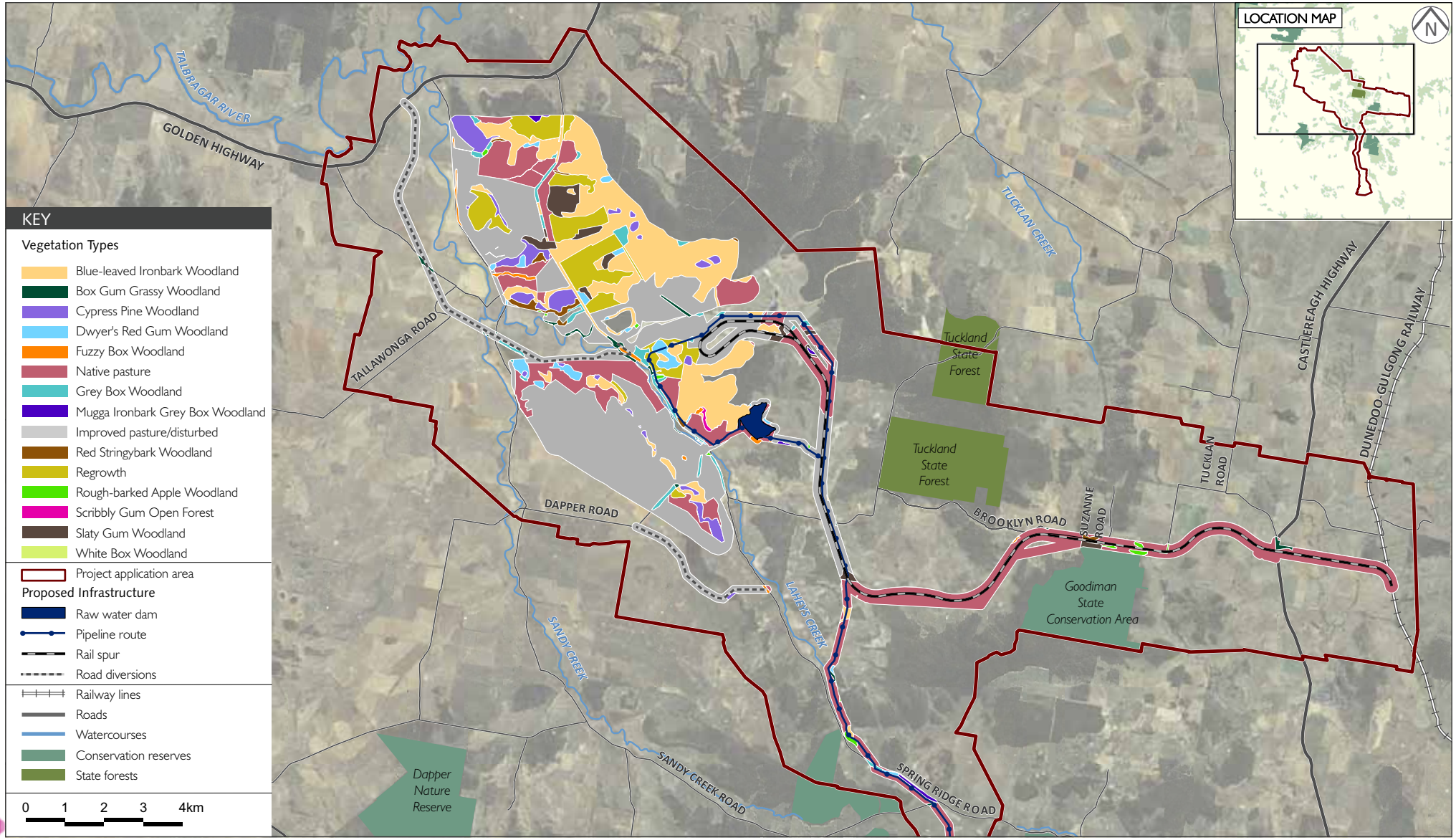
Overviews of each of the vegetation types within the study area are provided within the following section. It provides profiles of the vegetation types recorded in the study area. A vegetation map showing the spatial distribution of the vegetation types across the impact area is provided as Figure 4.1.

The condition of each of the woodland vegetation types was compared with the CMA benchmark data and all remnants were assigned a moderate/good condition rating. A discussion of the conservation status of the recorded vegetation types is provided in Section 4.5.4. The following table (Table 4.2) summarises the abundance of each vegetation type identified within the PAA. Blue-leaved Ironbark Woodland was the most abundant vegetation type within the PAA, accounting for approximately 50% of all vegetation. Scribbly Gum Open Forest was the least abundant vegetation type, with only 5 ha recorded in the PAA (Table 4.2). The vegetation type assessment against databases for each of the vegetation types is provided in Table 4.3.

Table 4.2 Vegetation types across the PAA

Vegetation type	TEC	Area within PAA (ha)*	Area to be impacted by the Project (ha)
Blakely's Red Gum Woodland	Box Gum Woodland	62	0
Blue-leaved Ironbark Woodland		5,230	1,018
Box Gum Grassy Woodland	Box Gum Woodland	815	7
Cypress Pine Woodland		488	191
Dwyer's Red Gum Woodland		129	83
Fuzzy Box Woodland	Fuzzy Box Woodland	129	13
Grey Box Woodland	Grey Box Woodland	660	54
Mugga Ironbark Grey Box Woodland		55	1
Mugga Ironbark Woodland		81	0
Narrow-leaved Stringybark Woodland		22	0
Red Stringybark Woodland		888	22
Regrowth		813	365
Rough-barked Apple Woodland	Box Gum Woodland	226	5
Scribbly Gum Open Forest		5	5
Slaty Gum Woodland		874	103
Tumbledown Gum Woodland		123	0
White Box Woodland	Box Gum Woodland	206	0
Native Pasture in low condition		3,000	967
Improved Pasture /disturbed		7,000	1,866
Total		**20,804**	**4,700**

Notes: 1. Based on previous broad scale mapping (DEC, 2006 and DIPNR, 2004), aerial photograph interpretation with limited ground-truthing outside the impact area.*



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Vegetation Types within the Impact Area

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 4.1

i Dominant vegetation types

a. Cypress Pine Woodland

Cypress Pine Woodland was dominated by Black Cypress Pine (*Callitris endlicheri*), with a cover abundance of greater than 70%. This vegetation type occurred on low rises with rocky substrate, typically on the mid to upper slope. Associated overstorey species included Dwyer's Red Gum (*E. dyweri*), *Allocasuarina* sp., ironbarks (*E. nubila, E. crebra* and *E. sideroxylon*) and Red Stringybark (*E. macroryhncha*), which were all recorded as scattered individuals within the community. Cypress Pine Woodland was characterised by a low cover abundance of forbs (typically less than 5%) consisting of species such as Slender Rice Flower (*Pimelea linifolia*). It was also characterised by low percent shrub cover, usually dominated by Common Fringe-myrtle (*Calytrix tetragona*) (height of 1.2 m and cover of 15% or less).

The Cypress Pine canopy reached to 20 m in height with emergent Ironbarks reaching to 30 m. There was usually a dense leaf litter present, formed from the Cypress Pine, with an abundance of small rock, lichen and woody debris. Regeneration was either absent or sparse. This community graded into the Ironbark/Stringybark communities on hill slopes, or into box communities on the lower elevation parts of the study area. Disturbances recorded within the Cypress Pine Woodland included grazing by domestic and feral animals. Exotic flora species were not common.

Cypress Pine Woodland was most closely aligned to CW107 *Black Cypress Pine - Narrow-leaved Stringybark heathy woodland of the southern Brigalow Belt South Bioregion* (DECC, 2008a). Approximately 50% of CW107 has been cleared within the CMA (DECC, 2008a). Areas of Cypress Pine are visible in aerial imagery outside of the impact area and within nearby conservation areas (Yarrobil NP, Goodiman SCA and Cobbora SCA). Given its common occurrence within the study area it is likely that Cypress Pine Woodland is not currently under threat within the region.

b. Box Gum Grassy Woodland

Box Gum Grassy Woodland was characterised by Yellow Box with Blakely's Red Gum and a grassy understorey. It occurred along roadsides, in low-lying parts of the study area and along drainage lines and depressions (see Figure 4.1). Other associated canopy species included Grey Box (*E. microcarpa*), Fuzzy Box (*E. conica*) and Rough-barked Apple (*Angophora floribunda)* with the canopy reaching 30 m in height. There were no areas of Box Gum Grassy Woodland derived native grassland identified within the study area.

Dominant grass species recorded included Wallaby Grasses (*Austrodanthonia* sp.), Speargrasses *(Austrostipa* sp.) and Three-awn Grasses (*Aristida* sp.). Forbs present included *Calotis* sp., *Wahlenbergia* sp., *Dichondra* sp. and the creepers *Glyicne* sp. and *Desmodium* sp. Regeneration of the canopy species was present in areas where grazing had been excluded, such as along Spring Ridge Road.

Box Gum Grassy Woodland graded into Fuzzy Box Woodland, Grey Box Woodland and Rough-barked Apple Woodland. Disturbances present included domestic animal grazing, weed invasion and feral animal grazing. In some areas, such as along Spring Ridge Road, remnants of Box Gum Grassy Woodland are considered to have been relatively resistant to weed invasion, given their location in the landscape and the linear nature of remnant stands.

Box Gum Grassy Woodland of the study area was most closely aligned to CW112 *Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion*. This vegetation type has been cleared to 95% of its pre-European extent within the CMA (DECC, 2008a) with an estimated 1,112 ha in conservation reserves (OEH, 2012). However, as the community has not been fully mapped across its extent (OEH, 2012), the area of community within the CMA is likely to increase as further mapping projects are undertaken.

This vegetation type qualifies as White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community under the TSC Act and White Box Yellow Box Blakeley's Red Gum Grassy Woodland and Derived Native Grasslands critically endangered ecological community under the EPBC Act. Box Gum Grassy Woodland is also an 'over-cleared' vegetation type within the CMA. Over-cleared vegetation types are defined in the Biometric Operational Manual (DECCW 2011) as those vegetation types where greater than 70% of that vegetation type has been cleared from the CMA.

c. Blue-leaved Ironbark Woodland

Blue-leaved Ironbark Woodland in the study area was dominated by Blue-leaved Ironbark (*Eucalyptus nubila*), typically with a small tree layer of Black Cypress Pine. Red Stringybark, Dwyer's Red Gum or Slaty Gum (*E. dawsonii*) were also common. Blue-leaved Ironbark Woodland typically occurred on rocky substrates on gentle slopes. She-oaks (*Allocasuarina* sp.) were locally common in some areas. Where ironbarks occurred with a small tree layer of Cypress Pine, there was low ground cover and low diversity; where they occurred on lower foot slopes, the ground cover became grassy and there was an increase in species diversity.

Blue-leaved Ironbark Woodland graded into Stringybark communities on steeper hillslopes, or into Slaty Gum or box communities on the lower elevation parts of the study area. This vegetation type was extensive within the study area (see Figure 4.1).

The understorey of the Blue-leaved Ironbark Woodland of the study area was characterised by the dominant shrub Common Fringe Myrtle, with Sifton Bush, Hoary Guinea Flower (*Hibberita obtusifolia)*, Forest Goodenia (*Goodenia hederacea)* and Purple Burr-daisy (*Calotis cuneifolia),* all commonly occurring small shrubs. There was usually greater than five grass species present, with Red anther Wallaby Grass (*Joycea pallida*) being recorded in six out of seven plots. Disturbances recorded within this community include logging and grazing by domestic and feral animals. Exotic flora species were not common within this vegetation type.

CW115 *Blue-leaved Ironbark woodland on sandy uplands and slopes of the Darling Riverine Plains Bioregion* is the closest association of the community in the study area within the Biometric vegetation types database. Approximately 30% of CW115 has been cleared from the CMA (DECC, 2008a). It is estimated that over 38,000 ha of vegetation aligning with this community occurs within conservation areas (OEH, 2012).

d. Grey Box Woodland

Grey Box Woodland typically occurred as monotypic stands of Grey Box trees up to 25 m high. Other occasional canopy species included Fuzzy Box and Blakely's Red Gum (*E. blakelyi*). When it occurred in low-lying areas, the Grey Box Woodland graded into other box woodland communities, including Box Gum Grassy Woodland and Fuzzy Box Woodland. It also occurred at the foot slopes of the Blue-leaved Ironbark Woodland community. Small Grey Box Woodland remnants, for example those recorded to the west of Spring Ridge Road, had been subject to high levels of disturbance such as grazing (cattle and sheep), sheep camps and exotic species invasion. There were no areas of Grey Box Woodland derived native grassland identified within the study area.

Grey Box Woodland was characterised by a grassy understorey with a sparse to absent shrub cover. Species recorded included Cough Bush (*Cassinia laevis*) and Sifton Bush. There was usually a dense leaf litter present, with low cover of rock, mosses and lichen. Regeneration was recorded in remnants not impacted by grazing.

Grey Box Woodland within the study area was most closely aligned to CW145 *Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions* (DECC, 2008a). Approximately 95% of this community has been cleared within the Central West CMA (DECC, 2008a), with just 30 ha of the community within reserves (OEH, 2012). However, this is likely to be an underestimation, as more land has been set aside for the purposes of conservation since the time of the field assessments.

This vegetation type qualifies as Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions endangered ecological community under the TSC Act and Grey Box Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia endangered ecological community under the EPBC Act. It is also an over-cleared vegetation type within the CMA (see DECCW, 2011).

e. Fuzzy Box Woodland

Fuzzy Box Woodland was recorded along Spring Ridge Road (northern section) and along Sandy Creek Road (predominantly the northern section) and as small scattered remnants in other areas. Fuzzy Box Woodland has been heavily impacted by weed invasion and along Sandy Creek Road it has been impacted by sheep grazing and sheep camps. The vegetation remnants along Sandy Creek Road are much narrower than those along Spring Ridge Road and this has also increased their susceptibility to degradation through edge effects. Most of the trees within the community are mature with abundant hollows.

Fuzzy Box Woodland occurred as a grassy woodland up to 20 m high dominated by Fuzzy Box canopy, with Yellow Box or Grey Box trees also present. Understorey shrubs were sparse or absent, with the dominant ground cover species being grasses (one plot recorded 11 species of grass). Slender Bamboo Grass (*Austrostipa verticillata)* was noted as a commonly associated species. Other grasses recorded included Three-awn Grass, Weeping Meadow Grass *(Microlaena stipoides)* and Wallaby Grasses.

Fuzzy Box Woodland was most closely aligned to CW138 *Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion* (DECC, 2008a). Approximately 95% of this community has been cleared within the Central West CMA and it is considered to be critically endangered within the catchment (DECC, 2008), with an estimated 77 ha within conservation reserves (OEH, 2012). However, this is likely to be an underestimation, as more land has been set aside for the purposes of conservation since the time of assessment.

This vegetation type qualifies as Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions endangered ecological community under the TSC Act. It is also an over-cleared vegetation type within the CMA (see DECCW, 2011).

f. Red Stringybark Woodland

Red Stringybark Woodland occurred as a grassy/shrubby woodland up to 20 m high dominated by Red Stringybark, with Ironbarks, Black Cypress Pine and red gums (Dwyer's and Slaty) also occurring at varying densities. In some areas, shrub cover was absent. Where shrubs occurred, Sifton Bush dominated. The common ground cover species recorded were Mat Rushes (*Lomandra longifolia, L. filiformis*) Hoary Guinea Flower and Thyme Spurge (*Phyllanthus hirtellus)*.

Red Stringybark Woodland was recorded on mid to upper slopes, usually with rocky outcropping. It was also recorded in saddles in the landscape, between Cypress Pine and ironbark communities. Disturbances present included agricultural and feral animal (goats, rabbits) grazing.

This vegetation type was most closely aligned with CW177 *Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion* (DECC, 2008a). CW177 has been cleared over 85% of its pre-European extent within the CMA (DECC, 2008a). It is also identified as an over-cleared vegetation type within the Biometric vegetation type database (DECW 2008a). Given its common occurrence within the study area, it is likely that Red Stringybark Woodland occurs in conservation areas of the locality (eg Yarrobil NP, Goodiman SCA and Cobbora SCA).

g. Slaty Gum Woodland

Slaty Gum Woodland typically occurred as monotypic stands of tall Slaty Gum trees (up to 25 m in height). Other canopy species rarely occurred within this community. Slaty Gum Woodland was common in the study area on foot slopes adjacent to ironbark or stringybark communities. In some instances where this vegetation type occurred within a matrix of other communities or graded into Ironbark communities, it was mapped as Slaty Gum Woodland but exhibited characteristics of Ironbark communities. For example, some Slaty Gum Woodland remnants mapped within the study area contained a shrub layer that included She-oak, a species not characteristic of the Slaty Gum community.

Where Slaty Gum Woodland occurred as a monotypic stand of Slaty Gum trees, this vegetation type was characterised by a very sparse ground cover of forbs and grasses consisting of species such as Purple Burr-daisy, Three-Awn Grass, Wallaby Grass and Speargrass. Shrub cover was generally sparse to absent, but where it occurred it consisted of *Acacia* and C*assinia* species. There was usually a dense leaf litter present, with sparse layer of small rocks, lichen and woody debris. Regeneration was generally absent.

There was only one community dominated by Slaty Gum listed within the Biometric database; CW191 *Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion* (DECC, 2008a). Approximately 65% of this community has been cleared in the Central West CMA (DECC, 2008a).

h. Dwyer's Red Gum Woodland

Dwyer's Red Gum Woodland was recorded as small remnants predominantly in flat, sandy areas to the east of Spring Ridge Road (See Figure 4.1). In this area Dwyer's Red Gum Woodland commonly occurred as a mallee type community, with a high cover of small shrubs including Sifton Bush and Violet Kunzea (*Kunzea parvifolia*). Grasses and grass-like plants were also relatively diverse when compared to other vegetation types within the study area. It was not clear whether this community was a naturally occurring mallee/heath type community, or whether it was a successional stage of a mature Red Gum Woodland.

The vegetation type most closely aligned to the type recorded was CW133 *Dwyer's Red Gum - Currawang grassy mid-high woodland of central NSW.* The estimated extent of clearance for the community within the Central West CMA (CW 133) is 65% (DECC, 2008a).

i. Grasslands

Grasslands of the study area were surveyed and mapped by ERM (2012). Two types of grassland were identified: Native Pasture and Improved Pasture.

Native Pasture of the study area was dominated by Spear Grasses (*Austrostipa* spp.) and Three-Awn Grass (*Aristida* spp.). Both genera are fairly resistant to high levels of grazing, a dominant land use in these areas. Native pasture areas were not representative of vegetation communities that would have occurred prior to clearing and agricultural activities, and were not considered to be consistent with the definition of any derived native grassland listed under the TSC Act or the EPBC Act (ERM, 2012). This was determined through analyses of data collected in the field. Native pasture areas were considered to be in low condition with few native forbs and often containing weed species.

Improved Pasture was dominated by exotic species and had been 'improved' through seed-sewing and fertiliser application.

j. Regrowth

'Regrowth' was recorded in areas that had been cleared and grazed in the recent past. Coloniser species (predominantly Sifton Bush) were dominant in regrowth areas, indicating that the areas were at an early successional stage. This also explained the low species diversity observed.

Regrowth was not able to be classified as a particular vegetation type, given the absence of diagnostic species. However, given that regrowth areas were recorded adjacent to Red Gum and Ironbark communities, they would most likely regenerate to these common vegetation types. For the purposes of Biobanking, the regrowth areas were classified as Blue-leaved Ironbark Woodland.

ii Lesser vegetation types

A number of lesser vegetation types were recorded within the study area. These were uncommon or occurred in very small patches across the study area. Vegetation type assessments for these are provided in Table 4.3.

Other areas of the proposed mine footprint not described in this section, were not considered to represent native vegetation as these were dominated by exotic and/or pasture species and areas which had been cropped previously (Figure 4.1). These areas are considered 'disturbed' and are not included in vegetation impact calculations.

a. Mugga Ironbark Woodland

Mugga Ironbark Woodland was characterised by the dominant canopy species Mugga Ironbark (*E. sideroxylon*), with Blakely's Red Gum also occurring. Mugga Ironbark was a common species across the study area, but did not dominate in most areas. Mugga Ironbark Woodland was most closely aligned to CW156 *Mugga Ironbark - Inland Grey Box shrubby woodland of the Brigalow Belt South Bioregion.* Within the Central West CMA this vegetation type has been cleared up to 50% (DECC, 2008a).

b. Narrow-leaved Stringybark Woodland

Narrow-leaved Stringybark Woodland occurred infrequently at the top of rocky outcrops, grading into other stringybark and ironbark communities (see Figure 4.1).

Narrow-leaved Stringybark Woodland was most closely aligned to CW107 *Black Cypress Pine - Narrow-leaved Stringybark heathy woodland of the southern Brigalow Belt South Bioregion.* Approximately 50% of CW107 has been cleared within the CMA (DECC, 2008a).

c. Mugga Ironbark Grey Box Woodland

Mugga Ironbark Grey Box Woodland occurred as small remnants grading into other ironbark or box communities. It was characterised by Mugga Ironbark and Grey Box as co-dominants, with a shrubby understorey. Species recorded included White Cypress Pine (*Callitris glaucophylla*), *Melaleuca erubsecens,* Sifton Bush and Cough Bush.

Mugga Ironbark Grey Box Woodland was most closely aligned to CW155 Mugga Ironbark - Inland Grey Box - pine tall woodland of the NSW South Western Slopes Bioregion. Within the Central West CMA, 50% of this community has been cleared (DECC, 2008a).

d. Rough-barked Apple Woodland

Rough-barked Apple Woodland occurred frequently across the study area, but in very small patches, either along drainage depressions or at the foot slopes of ironbark/stringybark communities. This vegetation type typically occurred as monotypic stands of Rough-barked Apple trees, often in grazed areas, being impacted by cattle, sheep, sheep camps and weed invasion. Rough-barked Apple trees observed within the study area were usually mature, with little to no regeneration occurring, and commonly were paddock trees surrounded by cultivated and improved pasture.

The community was most closely aligned to CW111 *Blakely's Red Gum - Rough-Barked Apple flats woodland of the NSW western slopes* (VCAID 281). CW111 has been cleared over approximately 75% of its area within the CMA (DECC, 2008a) and is therefore considered to be an over-cleared vegetation type within the Central West CMA (see DECCW, 2011).

This vegetation type qualifies as White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community under the TSC Act and White Box Yellow Box Blakeley's Red Gum Grassy Woodland and Derived Native Grasslands critically endangered ecological community under the EPBC Act.

e. Blakely's Red Gum Woodland

Blakely's Red Gum Woodland was recorded in small patches as stands of Blakely's Red Gum with a grassy/shrubby understorey. Species recorded included *Melaleuca erubescens*, Seven Dwarfs Grevillea (*Grevillea floribunda*), Sifton Bush and Cough Bush. This vegetation type was recorded within, or adjacent to, ironbark and stringybark communities, commonly in drainage depressions.

The community was most closely aligned to CW111 *Blakely's Red Gum - Rough-Barked Apple flats woodland of the NSW western slopes*. CW111 has been cleared over approximately 75% of its area within the CMA (DECC, 2008a) and is therefore considered to be an over-cleared vegetation type within the Central West CMA (see DECCW, 2011).

While this vegetation appears to be shrubby in some areas, using a precautionary approach, it is considered to qualify as White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community under the TSC Act and White Box Yellow Box Blakeley's Red Gum Grassy Woodland and Derived Native Grasslands critically endangered ecological community under the EPBC Act.

f. Scribbly Gum Open Forest

Scribbly Gum Open Forest was recorded as one small remnant (approximately 5 ha), all of which will be removed by the Project. This vegetation type was uncommon within the study area, with Inland Scribbly Gum (*E. rossii*) only being recorded within this remnant. Scribbly Gum Open Forest was recorded on a rocky sandstone hilllslope with Red Stringybark as a scattered subdominant.

There was no accurate vegetation type description for the Scribbly Gum of the study area within the Biometric Vegetation Types database. The most closely aligned community was CW176 *Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion*. This community has been cleared over approximately 85% of its extent in the CMA (DECC, 2008a) and consequently this vegetation type is considered to be over-cleared within the CMA (see DECCW, 2011).

g. Tumbledown Gum Woodland

Tumbledown Gum Woodland was recorded as four small remnants in the south of the study area. This vegetation type was recorded on low rises where it graded into Mugga Ironbark Woodland and Red Stringybark Woodland.

It was most closely aligned to CW202 *Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes*. Approximately 75% of this community has been cleared from the Central West CMA and consequently this vegetation type is considered to be an over-cleared vegetation type within the CMA (see DECCW, 20011).

h. White Box Woodland

White Box Woodland was recorded along Spring Ridge Road where it graded into ironbark woodland and other box communities. It was dominated by White Box (*E. albens*) with a small tree layer of Black Cypress Pine.

White Box Woodland of the study area was most closely aligned to CW213 *White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW*. Within the Central West CMA it is considered to have been 90% cleared (DECC, 2008a) and consequently this vegetation type is considered to be over cleared within the CMA (see DECCW, 20011).

This vegetation type qualifies as White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community under the TSC Act and White Box Yellow Box Blakeley's Red Gum Grassy Woodland and Derived Native Grasslands critically endangered ecological community under the EPBC Act.

4.2.3 Vegetation type assessment

Vegetation types identified within the study area were classified according to the NSW Biometric Vegetation Types Database (DEC, 2008) and other available vegetation databases and mapping projects to determine their extent, distribution and conservation significance. The results of the vegetation type assessment are provided in Table 4.3. The table provides a list of vegetation types identified within the study area, along with the most closely aligned vegetation types from the available databases and mapping projects.

The OEH Vegetation Information System (VIS) is currently being updated and there are a number of existing classifications for the region. In the following table, Biometric vegetation types (BVTs) are vegetation types used by the CMA's for mapping. The BVTs are being integrated into the VIS.

The NSW plant community type (PCT) classification provides a community-level classification for NSW vegetation type mapping, and includes integration of the BVTs. The PCTs will form the amalgamated types across NSW and will be used in regulatory tools (eg BioBanking Credit Calculator) in the future. The updated VIS Classification database (version 2) integrates the management of PCTs with the NSW Vegetation Classification and Assessment (VCA) classification (of Benson *et al* 2010), BioMetric Vegetation Type classification and BioMetric Vegetation Condition Benchmarks database.

Table 4.3 Vegetation type assessment against databases

Project Vegetation Type	Keith Class	Biometric vegetation type	VCA	BVT	PCT ID
Dominant vegetation types					
Cypress Pine Woodland	Western Slopes Dry Sclerophyll Forests	CW 107 Black Cypress Pine - Narrow-leaved Stringybark heathy woodland of the southern Brigalow Belt South Bioregion	VCAID 309 Black Cypress Pine - Red Stringybark - red gum - box low open forest on siliceous rocky outcrops in the NSW South Western Slopes Bioregion	BVT15 Pine Woodland	673 (CW107), 309 (VCAID 309)
Box Gum Grassy Woodland	Western Slopes Grassy Woodland	CW112 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	VCAID277 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	BVT70 Yellow Box woodland on flats and alluvial terraces of the slopes	277
Blue-leaved Ironbark Woodland	Western Slopes Dry Sclerophyll Forests	CW115 Blue-leaved Ironbark woodland on sandy uplands and slopes of the Darling Riverine Plains Bioregion	VCAID 467 (CW241) Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo)	BVT10 Broad-leaved Ironbark open-forest	467
Grey Box Woodland	Floodplain Transition Woodlands	CW145 Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	VCAID76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	BVT74 Inland Grey Box Woodland	76
Fuzzy Box Woodland	Western Slopes Grassy Woodlands	CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion	VCAID201 Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	BVT69 Fuzzy Box woodland on flats and alluvial terraces	201
Red Stringybark Woodland	Upper Riverina Dry Sclerophyll Forests	CW177 Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion	VCAID331 (CW292) Red Stringybark woodland on hillslopes, northern NSW South Western Slopes Bioregion	BVT12 Red Stringybark and/or Ironbark open-forest	1095 (CW177), 331 (CW292)
Slaty Gum Woodland	Southern Tableland Dry Sclerophyll Forests	CW191 Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion	VCAID (0)	BVT82 Slaty Box Woodland	1177

Table 4.3 Vegetation type assessment against databases

Project Vegetation Type	Keith Class	Biometric vegetation type	VCA	BVT	PCT ID
Rough-barked Apple Woodland	Western Slopes Grassy Woodlands	CW111 Blakely's Red Gum - Rough-Barked Apple flats woodland of the NSW western slopes	VCAID281 Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	None	281
Scribbly Gum Open Forest	Upper Riverina Dry Sclerophyll Forests	CW176 Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	VCAID477 (CW260) Inland Scribbly Gum - Red Stringybark - Black Cypress Pine - Red Ironbark open forest on sandstone hills in the southern Brigalow Belt South Bioregion and northern NSW South Western Slopes Bioregion	BVT6 Inland Scribbly Gum Woodland	477 (CW260),
Dwyer's Red Gum Woodland	Inland Rocky Hill Woodlands	CW133 Dwyer's Red Gum - Currawang grassy mid-high woodland of central NSW	VCAID471 (CW255) Dwyer's Red Gum - Black Cypress Pine - ironbark low woodland on sandstone hillcrests in the Dubbo - Gilgandra region, south-western Brigalow Belt South Bioregion	BVT49 Dry woodland on rocky hills	471
Narrow-leaved Stringybark Woodland	Western Slopes Dry Sclerophyll Forests	CW107 Black Cypress Pine - Narrow-leaved Stringybark heathy woodland of the southern Brigalow Belt South Bioregion	VCAID478 (CW282) Red Ironbark-Black Cypress Pine-stringybark-Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong-Mendooran region, southern Brigalow Belt South Bioregion	None	478
White Box Woodland	Western Slopes Grassy Woodlands	CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW	VCAID412 (CW319) White Box- Black Cypress Pine shrubby hill woodland in the east Pilliga-Mendooran-Gulgong regions, mainly Brigalow Belt South Bioregion	BVT77 White Box - White Cypress Pine woodland	267 (CW213), 412 (CW319)
Mugga Ironbark Grey Box Woodland	Western Slopes Dry Sclerophyll Forests	CW155 Mugga Ironbark - Inland Grey Box - pine tall woodland of the NSW South Western Slopes Bioregion	VCAID217 Mugga Ironbark-Western Grey Box-cypress pine tall woodland on foot slopes of low hills in the NSW South Western Slopes Bioregion	BVT13 Mugga Ironbark Woodland on hills	217

Table 4.3 Vegetation type assessment against databases

Project Vegetation Type	Keith Class	Biometric vegetation type	VCA	BVT	PCT ID
Lesser vegetation types					
Mugga Ironbark Woodland	Western Slopes Dry Sclerophyll Forests	CW156 Mugga Ironbark - Inland Grey Box shrubby woodland of the Brigalow Belt South Bioregion	VCAID403 (CW271) Dapper Mugga Ironbark - Western Grey Box - Blakely's Red Gum- Black Cypress Pine grass shrub hill woodland (southern Brigalow Belt South Bioregion)	BVT13 Mugga Ironbark Woodland on hills	403
Tumbledown Gum Woodland	Western Slopes Dry Sclerophyll Forests	CW202 Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes	VCAID461 (CW331) Tumbledown Gum Woodland on hills in the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion	None	461
Blakely's Red Gum Woodland	Western Slopes Grassy Woodland	CW112 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	VCAID 278 Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	None	278

Notes: 1. Source: Keith, 2004; DECC, 2008a; Benson et al, 2010; DEC, 2006a, OEH, 2011a.

2. CW = Central West, VCA = Vegetation Classification and Assessment Database (OEH, 2012), VIS = Vegetation Information System (OEH, 2011a), PCT = Plant Community Type Classification from VIS (OEH, 2011a), BVT = Regional Vegetation Class.

4.3 Flora

A total of 257 flora species were recorded within the study area during the 2011-2012 Surveys. Of the species recorded, 18% were exotic. In general, exotic species were not common with almost half of the weed species recorded exclusive to one rapid assessment plot, in a linear remnant adjacent to an area that had been cropped and grazed.

Native ground cover and small shrub species recorded within the study area were generally common to all areas and there were no species that could be identified as being specific to any one vegetation type, or diagnostic of a vegetation type. The most frequently occurring native species (16 out of 19 assessment plots) was Mulga Fern (*Cheilanthes sieberi*), which is common in open woodland and on rocky crevices and hillsides in the region.

Table 4.4 lists the four most frequently occurring native species, along with a count of the number of times the species was recorded in plots. It also lists the four most frequently recorded exotic species in the study area. A complete flora species list is provided in Appendix E.

Table 4.4 Most frequently recorded native and exotic species recorded in the study area

Common Name	Scientific Name	Number of times recorded (percent of plots)
Native species		
Mulga Fern	*Cheilanthes sieberi* ssp. *sieberi*	16 (84%)
Purple Burr-daisy	*Calotis cuneifolia*	13 (68%)
Forest Goodenia	*Goodenia hederacea* ssp. *hederacea*	13 (68%)
-	*Gonocarpus tetragynus*	12 (63%)
Exotic species		
Fleabane	*Conyza albida*	4 (21%)
Catsear	*Hypochaeris radicata*	4 (21%)
Scarlet Pimpernel	*Anagallis arvensis*	3 (16%)
-	*Sonchus asper*	3 (16%)

4.3.1 Noxious Weeds

The following exotic species recorded within the study area are listed as noxious weeds in the local control area:

- St John's Wort (*Hypericum perforatum*);
- African Boxthorn (*Lycium ferocissimum*);
- Common Prickly Pear (*Opuntia stricta*); and
- Blackberry (*Rubus fruticosus* sp. *aggreagata*).

All of the above species are Class 4 weeds within the local control area. Under the NSW *Noxious Weeds Act 1993* landowners have a legal obligation to manage the growth of a Class 4 weed, in a manner that reduces its numbers, spread and incidence, and continuously inhibits its reproduction.

Blackberry is also listed as a weed of national significance (WoNS). WoNS have been identified because of their invasiveness, impacts on primary production and the environment, potential for spread and socioeconomic impacts. Individual landowners and managers are ultimately responsible for managing WoNS, while state and territory governments are responsible for overall legislation and administration.

4.4 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have species composition and natural ecological processes dependent on groundwater (DLWC, 2004). Four main types of GDEs have been recognised in NSW:

- terrestrial vegetation;
- base flows in streams;
- aquifer and cave ecosystems; and
- wetlands.

Groundwater modelling has identified the presence of two types of terrestrial vegetation that may depend upon groundwater resources. The first are rain fed springs at the intersection of the basalt hilltops in the south of the study area or on the northern side of the Talbragar River (PB, 2012) (Figure 4.2). All identified rain-fed spring locations and associated ecosystems occur outside the impact area (Figure 4.2).

The second type is riparian vegetation where shallow alluvial aquifers have been identified. Riparian zones within the study area occur on sandy loams characterised by Fuzzy Box, Blakely's Red Gum and Rough-barked Apple. These species are not typically known for groundwater dependency compared to species such as the River Red Gum (*Eucalyptus camaldulensis*), a rare species within the study area.

In these riparian areas, a shallow alluvial aquifer is present which may be used by riparian vegetation as a water source, particularly in dry periods. There appears to be some connection of the semi-permanent pools along Sandy Creek, Laheys Creek and the Talbragar River with these shallow alluvial aquifers. However, isotopic analysis has identified that water within these aquifers is likely to be derived from rainwater infiltration rather than older groundwater within the regional groundwater systems (PB, 2012).

The alluvial groundwater depth is currently less than 3 m in some areas and therefore within the typical root zone of eucalypts (Pallardy and Kozlowski, 2008) (Figure 4.2). Table 4.5 shows the area of vegetation that is within this shallow groundwater zone (where the alluvial aquifer is within 0-3 m of the surface).

Murray *et al* (2003) define GDEs as requiring the input of groundwater to maintain their current composition and functioning. Removal of groundwater from these ecosystems or a change in the timing, quantity, quality or distribution of groundwater may influence GDEs. Such changes could include altering the availability of water for transpiration by vegetation and the recruitment of seedlings into the adult population.

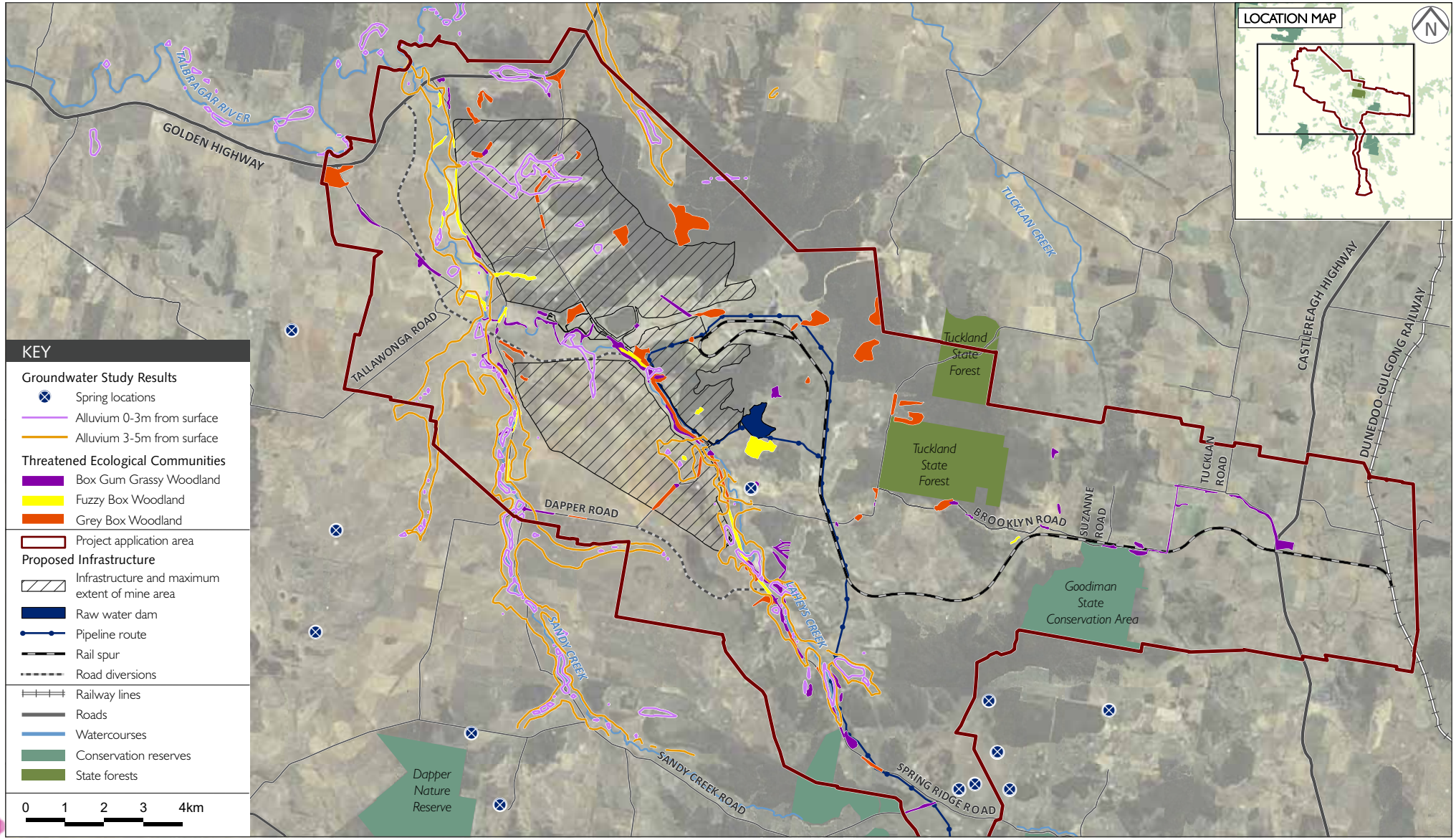
Table 4.5 Vegetation where the alluvium is within 3 m of the surface according to groundwater modelling

Vegetation community	TEC	Area (ha) within groundwater availability zone
Regrowth	-	1.0
Grey Box Woodland	Inland Grey Box Woodland (EPBC Act and TSC Act)	1.0
Fuzzy Box Woodland	Fuzzy Box Woodland (TSC Act)	0.4
Box Gum Grassy Woodland	Box Gum Woodland (EPBC Act and TSC Act)	0.1
Rough-barked Apple Woodland	Box Gum Woodland (EPBC Act and TSC Act)	1.4
Blakely's Red Gum	Box Gum Woodland (EPBC Act and TSC Act)	0.6
Total		**4.5**

Notes 1.Source: PB, 2012

A total of 4.5 ha of terrestrial woodland occurs within this zone, however as a range of vegetation types were recorded, no apparent correlation with vegetation type and groundwater availability is apparent (Figure 4.2). Most of these communities are listed as TECs, as these are associated with the alluvial floodplains (Table 4.5). As groundwater is 3-5 m or deeper for the majority of the riparian zone, and therefore likely to be outside the typical rooting depth of the eucalypts present, these systems are likely to be more reliant on flood events for ecosystem processes than this groundwater. Therefore groundwater use by terrestrial woodland is likely to be opportunistic rather than dependent.

Groundwater within the alluvium, where it is present along parts of Sandy Creek and Laheys Creek and the Talbragar River, may supply deeper pools with water in drier periods. Such areas may provide drought refuge for terrestrial fauna species when rain-fed water resources become dry. However, a number of farm dams within the study area are also likely to provide drought refuge for terrestrial fauna, and it is unlikely they would rely solely on the creeks within the study area.



Source: PB (2012)

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Groundwater Availability within the Study Area

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 4.2

4.5 Fauna

Fauna diversity of the study area is relatively high, particularly within the vegetated areas in the eastern part of the study area and within the remnant habitats along the creek lines and roads when compared to regional studies. A total of 217 native fauna species were recorded. The smaller roadside remnants dominated by box woodlands contained a number of threatened and regionally significant fauna species.

4.5.1 Broad habitat types

Assessment of the fauna habitats available within the study area was undertaken for the five broad habitat types identified in the study area (Figure 4.3):

- box woodlands on floodplains;
- ironbark/stringybark woodlands on slopes and ridgelines;
- red gum woodlands on flats and lower slopes;
- cypress woodlands on ridge tops; and
- grassland and regrowth communities on grazed flats.

The following sections describe the fauna habitat resources that each of these vegetation types provides, and the fauna species predicted to use these areas.

i Box woodlands

This habitat type occurs in the lower lying parts of the study area, usually in association with creeks or drainage lines (Figure 4.3). The canopy species of this habitat type include Inland Grey Box, Fuzzy Box, Yellow Box and Blakely's Red Gum.

Box Woodlands provide shelter and breeding opportunities for hollow dependent mammals, reptiles, amphibians and birds with the highest recorded number of tree hollows per hectare (124 hollows, see Figure 4.4). Fallen timber was also abundant in this habitat type, with many large, hollow fallen logs recorded. Fallen timber provides foraging habitat opportunities for insectivorous birds such as the Brown Treecreeper and shelter opportunities for reptiles such as the Blue-tongued Lizard (*Tiliqua scincoides*) (both species recorded within the study area).

Box woodlands in the study area were typically characterised by an understorey of tussock grasses, which provides habitat opportunities for granivorous and ground-feeding birds including the Superb Parrot and Speckled Warbler, and reptiles such as the Eastern Brown Snake (*Pseudonaja textilis*).

Box woodlands usually occur on sandy or alluvial soils, providing shelter habitat for burrowing frogs such as the Ornate Burrowing Frog (*Limnodynastes ornatus*) and the Eastern Banjo Frog (*Limnodynastes dumerilii*).

ii Ironbark/stringybark woodlands

Ironbark/stringybark woodlands occured on gentle midslopes to steep upper slopes (Figure 4.3). Canopy species include Blue-leaved Ironbark, Narrow-leaved Ironbark, Mugga Ironbark, Red Stringybark and Narrow-leaved Stringybark.

Stringybark woodlands of the study area usually contained large rocky sandstone or granite outcrops, while those dominated by Ironbark contained sandstone or lateritic outcropping. These rocky outcrops contain overhangs and crevices which provide shelter and potential breeding opportunities for cave-roosting microbats such as the Large-eared Pied Bat and Eastern Bentwing Bat and for the Swamp Wallaby (*Wallabia bicolor*), Common Wombat (*Vombatus ursinus*) and the Thick-tailed Gecko (*Underwoodisaurus millei*) which were all recorded within these rocky habitats.

Ironbark woodlands contained the winter-flowering species, Mugga Ironbark, which is an important resource for flower and nectar-dependent birds including honeyeaters (*Lichenostomus fuscus, L. leutocis and L .penicillatus)* and mammals including the Sugar Glider (*Petaurus breviceps*).

Ironbark/stringybark woodlands of the study area contained an average of 52 hollows per hectare (Figure 4.4), providing shelter habitat for hollow-dependent fauna, including the Barking Owl and Powerful Owl. Fallen timber was abundant in this habitat type, and would provide shelter opportunities for reptiles including the Bearded Dragon (*Pogona vitticeps*).

iii Red Gum Woodlands

Red gum woodlands occurred on flat topography at the foot of gentle and steep slopes of the study area (Figure 4.3). The canopy comprises Slaty Gum, Tumbledown Red Gum or Dwyer's Red Gum.

Red gum woodlands of the study area made up a smaller area of the study area and provided less available resources for hollow-dependent fauna in comparison with other broad vegetation types, with only 21 hollows per hectare recorded on average.

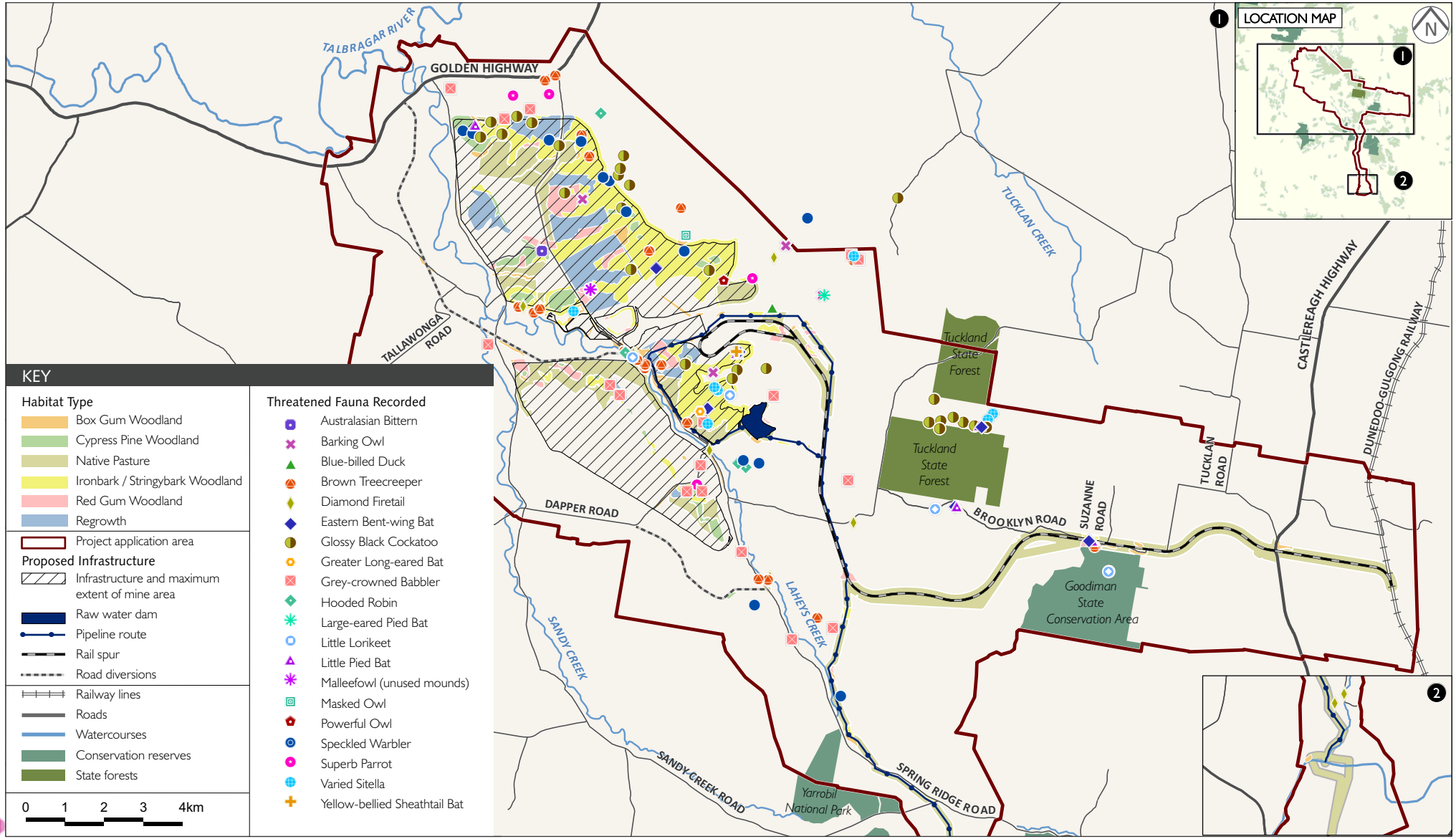
The grassy understorey of this woodland type would provide habitat for granivorous birds including the Hooded Robin and Diamond Firetail. Cones of Black She-Oak (*Allocasurina littoralis*) and *A. gymnathera*, chewed by the Glossy Black-Cockatoo, were found in Red Gum Woodlands where they intergraded with Ironbark Woodlands that contained these species in the shrub stratum.

Red gum woodlands provide foraging opportunities for the Eastern Bentwing Bat and Little Pied Bat, which were recorded in this habitat type.

iv Cypress woodlands

Cypress woodlands occur on gentle midslopes to steep upper slopes of the study area (Figure 4.3). They are dominated by Black Cypress Pine with occasional Bull-oak and Blue-leaved Ironbark. Cypress woodlands provide limited shelter opportunities for hollow-dependent fauna such as birds, mammals, and reptiles as they generally do not form hollows, and trees are predominantly juvenile in age.

This habitat type provides good resting habitat for macropods, with several diurnal resting areas and a large volume of scat observed. Cypress woodlands also provide foraging opportunities for the Speckled Warbler, Grey-crowned Babbler, Diamond Firetail and Glossy Black-Cockatoo, all of which were observed in this broad habitat type.



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Broad Fauna Habitats within the Study Area and Threatened Fauna Records

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 4.3

v Grassland and regrowth communities

Grasslands were a dominant feature within the study area landscape. Regrowth was recorded in areas that had been cleared previously for grazing purposes (Figure 4.3). Regrowth was characterised by a low, dense vegetation structure and was dominated by Sifton Bush, with occasional emergent Wattles (*Acacia* spp.), *Allocasuarina* spp., eucalypt saplings and grasses. Grassland and regrowth areas provide foraging habitat for grazing and browsing macropods such as the Eastern Grey Kangaroo (*Macropus giganteus*), Wallaroo (*M. robustus*) and Red-necked Wallaby (*M. rufogriseus*). Frequent observations of these species and their runways were made in this habitat. Glossy Black-Cockatoos were observed foraging where regrowth contained She Oaks (*Allocasuarina* spp.). These areas also provide prime foraging areas for raptors and owls.

4.5.2 Habitat resources

The following sections provide a description of the resources available to fauna for foraging, shelter and breeding within the study area.

i Water resources

Water resources within the study area include dams, creeks and drainage depressions. Two large artificial dams occur to the east of out of mine pit B. A number of smaller dams also occur throughout the study area.

Water persists within the larger dams and some of the deeper sections of creek during dry periods, providing significant water resources to fauna within the locality. The importance of these water sources was noted during the dry conditions of the 2009 surveys, when a number of wetland and migratory bird species, such as the threatened Blue-billed Duck, were recorded within the study area.

ii Tree hollows

The distribution of hollow-bearing trees depends on tree species composition, tree age, site conditions, competition, tree health and past management activities. Hollows occur at varying densities. Undisturbed woodlands typically contain 7-17 hollow-bearing trees per hectare (NSWSC, 2007b). Hollow density for box woodlands, ironbark/stringybark woodlands and red gum woodlands generally met or exceeded this average figure, indicating that in these vegetation communities, large non-viable timber containing hollows within the study area remains undisturbed.

There is considerable spatial variation in the density of hollow-bearing trees throughout the study area. However, hollow abundance was the greatest along the roadside of Spring Ridge Road, along Laheys Creek and Sandy Creek within the box-dominated woodlands (Figure 4.4).

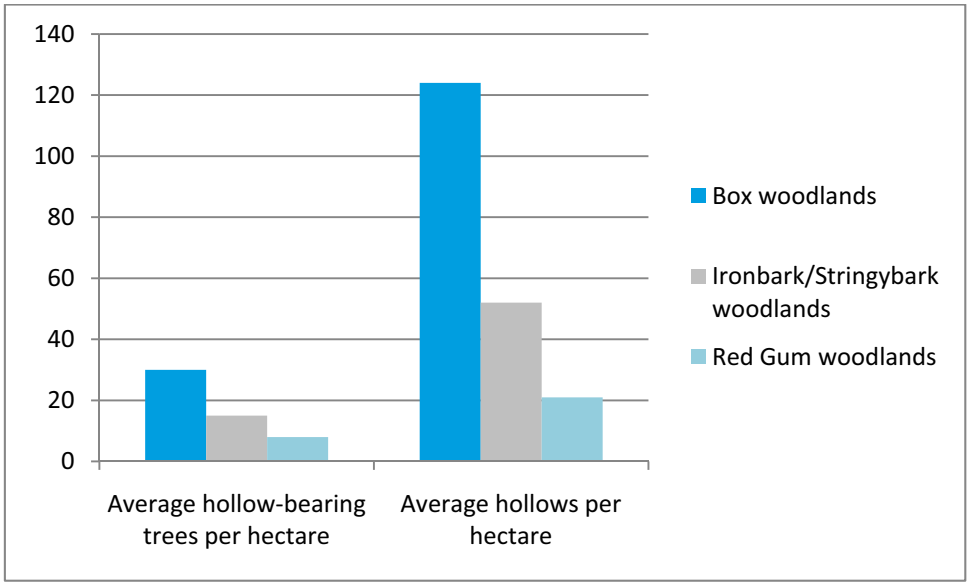


Figure 4.4 Average tree hollow density within the broad habitats of the study area

Ironbark/stringybark woodlands had approximately half the available hollows of box woodlands. Hollows were also observed to be smaller in ironbark/stringybark woodlands. The hollow density in red gum woodlands was lower than these two communities at an average of 21 per hectare, with hollows completely absent from cypress woodland and regrowth habitat types. A number of large hollows were recorded in Slaty Gum and Ironbark trees in the eastern parts of the PAA. These hollows would provide potential nesting habitat for large birds such as the Powerful Owl and the Glossy Black-Cockatoo.

iii Fallen timber

The value to fauna of dead fallen wood or coarse woody debris (CWD) in Australian forest ecosystems is well established. Reptiles use logs for shelter, to lay eggs and as basking sites, while mammals may use logs for shelter or for nesting and some bird species have shown reliance on CWD (Grigg *et al,* 2007).

Due to the logging history within the remnant native vegetation, CWD is abundant within the study area. CWD provides shelter and resources for a range of invertebrate species, providing foraging resources within the study area for insectivorous birds such as Hooded Robins, mammals such as the Short-beaked Echidna (*Tachyglossus aculeatus*) and Yellow-footed Antechinus (*Antechinus flavipes*), and reptiles such as the Copper-tailed Skink (*Ctenotus taeniolatus*) and the Eastern Blue-tongue Lizard.

iv Flowering trees and shrubs

The study area contains a number of flowering trees and shrubs, providing foraging opportunities for a range of invertebrate and vertebrate fauna. Flowering resources are available onsite for most seasons, with a peak in the spring-summer period when the study area receives most of its rainfall.

Winter flowering resources including Inland Grey Box, Mugga Ironbark, Red Stringybark and White Box occur throughout the site. Rainfall and drought events can influence flowering periods. During the spring/summer survey (2011) which was conducted after rainfall, most eucalypts onsite were in flower, including those usually flowering in winter (see photograph inset).

Mistletoes are abundant within the eucalypts of the study area. These have been shown to be important for many species of birds, mainly honeyeaters, which feed at mistletoe flowers with some species feeding exclusively at mistletoe for periods of the year (Reid, 1986). Mistletoe plants generally produce abundant flowers annually whilst many of their eucalypt hosts are irregular suppliers of nectar and are therefore an important year-round nectar source for fauna. In addition to the nectar, the berries are also an important food source for fauna species, with 33 bird species recorded feeding on mistletoe berries (Reid, 1986).

v Woody fruits and seeds

A number of woody fruits and seeds occur within the study area, providing foraging resources for a number of fauna species. This includes specialist seed feeders such as the Glossy Black-Cockatoo, which feeds mainly on the seeds of She-oaks. Four species of She-oak were recorded within the PAA Buloke, Black She-oak, *Allocasuarina diminuta* and *A. gymnanthera*, and evidence of foraging was observed throughout the patches of She-oak (chewed cones) (see photograph inset).

The flowering eucalypts also provide significant seed resources for a range of parrot species within the study area. The presence of migratory and opportunistic parrot species such as the Superb Parrot and the Little Lorikeet recorded after the significant flowering event in spring 2011 to summer 2012 indicates the importance of seed resources both locally and regionally for parrot species.

The study area contains a number of wattle species and other seeding shrub species, which provide significant seed resources for fauna. In addition, the native grass seeds provide abundant resources for ground foragers such as the Diamond Firetail, which was recorded within this broad habitat type.

vi Rocky outcrops and bush rock

Outcropping occurs throughout the study area, providing small caves and crevices which are valuable shelter and nesting sites, particularly for birds and bats (see photograph inset). These also provide shelter from extreme environmental events, such as fire. Several cave-roosting bat species were recorded in the vicinity of these habitat features including the Little Pied Bat and the Eastern Bent-wing Bat. These areas also appeared to be frequented as shelter sites for the Common Wombat and Eastern Grey Kangaroo.

Bush rock was also abundant throughout the study area, particularly associated with outcropping and hill slopes. Bush rock provides important sources, including shelter, foraging and nesting sites for fauna species. These areas provided habitat for a range of species, particularly geckos such as the Thick-tailed Gecko and more common Lesueur's Velvet Gecko (*Oedura lesueurii*).

4.5.3 Amphibians

Amphibian diversity within the study area was high for the region, with a total of 17 species recorded. In comparison, over 50% of the Central West CMA map sheets had greater than 10 amphibian species recorded and the total frog species recorded for the Cobbora map sheet was between eight and 11 species (DEC, 2006b). Amphibian diversity was much greater in the 2011-2012 Surveys, which were conducted during and after a significant period of rain, when compared with the baseline surveys. Frogs were abundant within the many farm dams within the study area, and less abundant within the riparian zones. The presence of eggs and tadpoles within the still waters of the farm dams suggest that dams may be preferred for breeding. It may also be a result of the frequent flash flooding within the creeks as a result of heavy rain during the survey period.

During recent regional surveys at Goonoo State Conservation Area, the most common frog species encountered were Broad-palmed Frog (*Litoria latopalmata*) and Peron's Tree Frog (*Litoria peronii*). The Ornate Burrowing Frog (*Limnodynastes ornatus*) and Northern Banjo Frog (*Limnodynastes terraereginae*) were recorded widely across the area. The survey of the study area identified Peron's Tree Frog and Rocket Frog (*Litoria nasuta*) as the most common species. Frogs recorded in only one or two sites within the study area included Bibron's Toadlet (*Psuedophryne bibroni*), Desert Tree Frog (*Litoria rubella*) and Eastern Sign-bearing Froglet (*Crinia parinsignifera*).

4.5.4 Reptiles

The study area contains substantial areas of rocky outcrops and slopes, fallen timber and woodland areas, providing habitat for a range of reptile species. In general, reptile diversity was moderate for the region, with a total of 25 reptile species recorded within the study area. In comparison, over 50% of the 1:100,000 map sheets within the Central West Catchment contain records of 26 or more species, with the Cobbora map sheet recording between 32 and 41 reptile species (DEC, 2006b).

Reptile activity at the site was considered to be low, with only a few individuals of most species recorded. However, the Eastern Bearded Dragon was commonly observed basking on the study area roads, and the Garden Skink (*Lampropholis delicata*) and Copper-tailed Skink were frequently recorded in leaf litter in woodland areas.

4.5.5 Birds

The 2009-2011 Baseline Surveys recorded a total of 109 bird species. On average, 12 species were recorded at each bird survey site. The highest diversity was 20 species recorded within roadside Grey Box communities (ERM, 2012).

During the 2011-2012 Surveys, 28 bird species on average were recorded at each of the survey sites. Two sites, the first within Grey Box Woodland near Tuckland State Forest and the second at one of the large dams had the highest diversity, recording 41 bird species each. Several bird groups were only recorded during the 2011-2012 Surveys. This included species of wood swallow, egret, cuckoo, raven, songlark and cormorant, Emu (*Dromaius novaehollandiae*) and Superb Parrot. This is potentially attributed to the flower and water resources available within the study area as a result of significant rainfall prior to and during the 2011-2012 Surveys.

A total of 168 bird species have been recorded during the surveys of the study area. This represents 67% of species known to occur within the Dubbo area (Hosking *et al,* 2010) and 77% of the species recorded within the Cobbora 1:100,000 map sheet by Birds Australia (2010). Thus, bird diversity within the study area is relatively high.

i Raptors

Raptor diversity within the study area was considered to be moderate for the region, with seven diurnal and seven nocturnal birds of prey recorded. In comparison, the Dubbo Field Naturalists have recorded 17 diurnal raptors and nine nocturnal raptors within the region (Hosking *et al*, 2010).

The Black-shouldered Kite (*Elanus axillaris*) was the most common raptor recorded. Barn Owls and Tawny Frogmouths were often recorded during the nocturnal road surveys, particularly when frogs were abundant on the road. Barn Owl, Brown Goshawk (*Accipter fasciatus*) and the Barking Owl are considered to be uncommon residents in the region (Hosking *et al,* 2010). The White-throated Nightjar (*Eurostopodus mystacalis*) (recorded within the study area) is considered to be rare within the Dubbo area; however this may be as a result of under-reporting (Hosking *et al*, 2010).

ii Woodland birds

Woodland birds identified within the study area were typical of those found on the eastern side of the Great Dividing Range, and those most often recorded in the Piliga to the west of the site. As such, the study area is considered to represent a transitional zone for woodland bird species. Habitat resources for woodland species are abundant with a number of fruiting and flowering shrubs and trees, coarse woody debris, insects and nesting habitat.

The most commonly recorded woodland bird species, which were also utilising open areas where grass seeds were abundant, and the ecotones between these two habitats, were the Eastern Rosella (*Platycercus eximius*), Galah (*Cacatua roseicapilla*), Australian Magpie (*Gymnorhina tibicen*), Striated Pardalote (*Pardalotus striatus*), Noisy Friarbird (*Philemon corniculatus*), White-throated Treecreeper (*Cormobates leucophaeus*), Sacred Kingfisher (*Todiramphus sanctus*) and the Rufous Whistler (*Pachycephala rufiventris*). This is similar to those species recorded in the woodland habitats of the nearby Goonoo Conservation Area study (NPWS, 2000).

iii Water birds

Several large dams, smaller farm dams, soaks and creeks within the study area provide abundant habitat for water birds. Species common to the larger dams of the study area included Australian Wood Duck (*Chenonetta jubata*), Pacific Black Duck (*Anas superciliosa*), Pied Cormorant (*Phalacrocorax varius*) and Grey Teal (*Anas gracilis*). Several migratory water bird species were recorded within the large dams of the study area. These are discussed further in Section 5.3.5.

4.5.6 Non-flying mammals

A total of 21 mammal species (excluding bats) were recorded. Almost half of these are pest species.

Macropods were diverse and numerous around the site, as was evident from sightings and the presence of scats. A total of four macropod species were identified, of which the Eastern Grey Kangaroo, Swamp Wallaby and Red-necked Wallaby were the most commonly sighted. The Wallaroo (*Macropus robustus*), was observed less frequently. Areas of woodland adjacent to agricultural areas provide abundant resources for grazing and browsing macropod species. The woodland areas provide sheltering habitat, with a number of resting sites observed during the surveys.

Other common ground-dwelling mammals within the study area included the Common Wombat (*Vombatus urinsus*) and Short-beaked Echidna (*Tachyglossus aculeatus*). Commonly recorded arboreal mammals included the Yellow-footed Antechinus, Brushtail Possum, with occasional sightings of Ringtail Possum (*Pseudocheirus peregrinus*) and Sugar Glider (*Petaurus breviceps*).

4.5.7 Bats

Few microbat species were captured within harp traps which may have been due to the open structure of the woodland within the study area (Table 4.6). However, bat activity levels and species diversity recorded using an Anabat detector were high at 3,534 identifiable passes, yielding an accurate representation of local bat species and activity levels. Bat species and the habitat in which they were trapped or detected are shown in Table 4.6.

Table 4.6 Bat species recorded within the study area and their habitats

Common name	Scientific name	Habitat type recorded	Dominant roost habit
Large-eared Pied Bat*	*Chalinolobus dwyeri*	Ironbark/stringybark woodland	Cave
Gould's Wattled Bat	*Chalinolobus gouldlii*	Red gum woodland, ironbark/stringybark woodland, box woodland	Tree hollow
Chocolate Wattled Bat	*Chalinolobus morio*	Red gum woodland, ironbark/stringybark woodland, box woodland	Tree hollow
Little Pied Bat*^	*Chalinolobus picatus*	Red gum woodland	Cave
Eastern Bentwing Bat*	*Miniopterus schreibersii ocenensis*	Ironbark/stringybark woodland	Cave
Southern Freetail Bat	*Mormopterus* sp. 3	Ironbark/stringybark woodland, Red Gum Woodland	Tree hollow
Inland Freetail Bat	*Mormopterus* sp. 4	Ironbark/stringybark woodland, Red Gum Woodland	Tree hollow
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	Ironbark/stringybark woodland, Red Gum Woodland	Tree hollow
Gould's Long-eared Bat	*Nyctophilus gouldi*	Ironbark/stringybark woodland, Red Gum Woodland	Tree hollow
Southern Long-eared Bat*	*Nyctophilus corbeni*	Ironbark/stringybark woodland, Red Gum Woodland	Tree hollow
Yellow-bellied Sheathtail Bat*	*Saccolaimus flaviventris*	Red gum woodland	Tree hollow
Inland Broadnosed Bat	*Scotorepens balstoni*	Ironbark/stringybark woodland	Tree hollow
Little Broadnosed Bat	*Scotorepens greyii*	Ironbark/stringybark woodland, red gum woodland	Tree hollow
Eastern Broadnosed Bat	*Scotorepens orion*	Ironbark/stringybark woodland, red gum woodland	Tree hollow
White-striped Freetail Bat	*Tadarida australis*	Red gum woodland, ironbark/stringybark woodland, box woodland	Tree hollow
Little Forest Bat	*Vespadelus vulturnus*	Red gum woodland, ironbark/stringybark woodland, box woodland	Tree hollow

Notes: *1. *threatened species discussed further in Section 5.3.4.*

2. ^highest identification level was probable, while all others were confidently identified.

Bats recorded across a range of habitat types within the study area include Gould's Wattled Bat, Chocolate Wattled Bat, Inland Freetail Bat, Lesser Long-eared Bat, Gould's Long-eared Bat, White-striped Freetail Bat and Little Forest Bat (Table 4.6).

In nearby Goonoo State Conservation Area and the Pilliga Nature Reserve, the most common and widespread bats detected by harp-trapping were Little Forest Bat, Gould's Wattled Bat, Southern Long-eared Bat, Lesser Long-eared Bat, Gould's Long-eared Bat, Inland Broad-nosed Bat and the Little Broad-nosed Bat (NPWS, 2000). This suite of species is comparable to the most common bat species recorded in the study area with the exception of the Southern Long-eared Bat which was recorded on only one occasion and the Little Pied Bat was also rarely recorded by NPWS (2000). The most frequently captured bats across the study area were the Little Forest Bat and Lesser Long-eared Bat.

A variety of habitats is available within the study area for both forest and cave-dwelling bats. Roosting habitat is available for forest-dwelling bats where hollows, fissures and cracks occur within live or dead trees, and under peeling bark. Foraging habitat opportunities are present for insectivorous bat species within the study area including tree trunks and canopy for gleaning bats, and the tree canopy or over pasture for aerial pursuit foragers (Table 4.6).

Roosting habitat opportunities are also available for cave-dwelling bat species (Table 4.6) in the form of small cracks and fissures in rocky outcrops and cliff faces. It is considered that given the simple nature of small caves and crevices, that it would not constitute maternity roost habitat for those species that have specific requirements (ie limestone caves for Eastern Bent-wing Bat (Churchill, 2008). However, it is possible that small colonies of the Large-eared Pied Bat breed within the area (Glenn Hoye pers comm, 2012; Michael Pennay pers comm, 2012).

4.5.8 Pest species

Several pest fauna species were recorded during the surveys. Evidence of feral Pigs (*Sus scrofa*) was recorded in a number of locations with scats and diggings common, particularly within the large tracts of remnant vegetation in the eastern part of the study area. Feral Goats (*Capra hirsus*) also appear to be a problem in the steeper country to the east of the proposed mine. The European Red Fox (*Vulpes vulpes*) was sighted in a number of locations throughout the study area. House Mouse (*Mus musculus*) hair was identified from a number of Fox scats and Black Rats (*Rattus rattus*) were observed.

Some small flocks of Common Starlings (*Sturnus vulgaris*), European Goldfinch (*Carduelis carduelis*) and House Sparrows (*Passer domesticus*) were recorded, mainly in the agricultural areas in the western part of the study area.

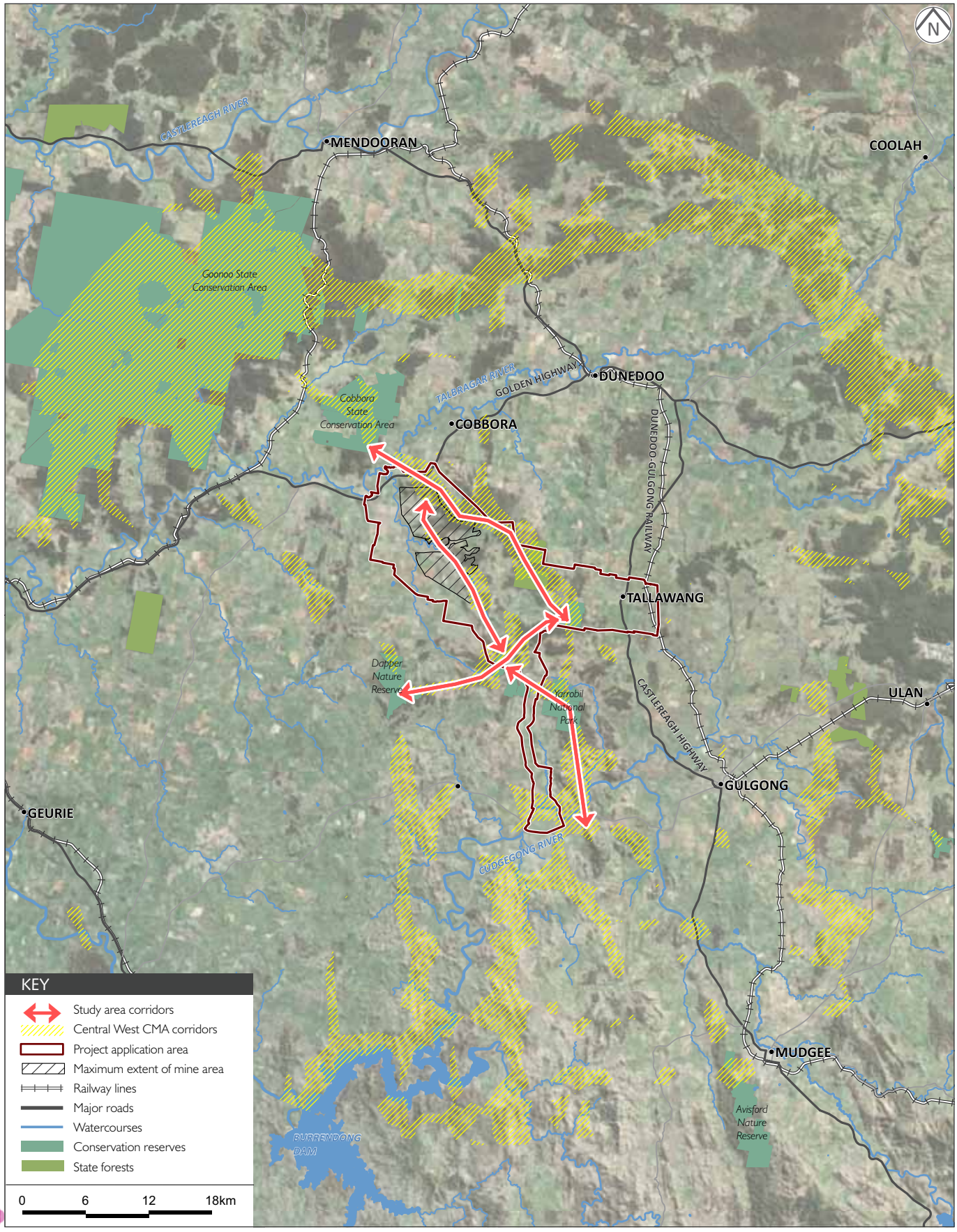
Pest species appear to be having an impact on the habitat condition and fauna species of the study area. The abundance of pest species is similar to that reported within the Goonoo SCA surveys where House Mice, feral pigs, feral goats and the European Red Fox were the most common species recorded.

4.5.9 Habitat linkages

Regional corridors have been mapped by the Central West CMA as part of the catchment action plan (CAP). A regional corridor extends from the north-eastern part of the study area along the eastern side through Cobbora SCA to Goonoo SCA to the north along the ridgelines to Lake Burrendong (Figure 4.5). It is possible that the study area and its surrounds also represent a stepping stone and refuge area for species between the two large protected areas of Goonoo SCA to the west and Goulburn River NP to the east.

The main local habitat corridors within the study area occur north to south, with one minor corridor from east to west to the south of the proposed mine area. These corridors link the large patch of remnant vegetation in the east of the study area with Tuckland SF, Goodiman SCA and Yarrobil NP (Figure 5.6). This link is not entirely vegetated, with agricultural paddocks and fences for fauna to manoeuvre over the length of the corridor.

A second narrow corridor occurs along the length of Spring Ridge Road (Figure 4.5). This roadside corridor contains significant fauna habitat features such as large hollow-bearing trees and water resources along Laheys Creek.



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Corridors and Habitat Linkages of the PAA and Surrounds

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 4.5

5 Conservation significance

5.1 Database search results

5.1.1 Threatened ecological communities

Eleven TECs have the potential to occur within the Central West CMA (see Table 5.1). The following three TECs have been recorded previously within the study area:

- Box-Gum Woodland;
- Fuzzy Box Woodland; and
- Grey Box Woodland.

5.1.2 Recorded threatened species

A total of 66 threatened species have been recorded previously, or are predicted to occur within the area covered by the Cobbora 1:100,000 mapsheet or within 30 km of the study area:

- fifteen plant species;
- two amphibian species;
- one reptile species;
- thirty-five bird species; and
- thirteen mammal species.

A list of threatened species likely to occur in the study area was compiled based on the results of the literature review, database searches and consultation. This was used to develop the field methods for threatened flora and fauna (Table 3.1).

5.1.3 Predicted to occur

Predictive modelling indicates that 13 flora, 18 fauna, 12 migratory and five TECs listed under the EPBC Act as matters of National Environmental Significance have the potential to occur within the locality of the study area.

5.1.4 Threatened populations

There are no threatened populations of flora or fauna known to occur in the study area.

Table 5.1 Threatened ecological communities known to occur within the Central West CMA and identified within the SPRAT search

Threatened ecological community	Status		Potential for occurrence
	TSC Act	EPBC Act	
Artesian Springs Ecological Community	EEC	EEC	Low
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	EEC	EEC	Low
Coolibah-Black Box woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions	EEC	-	Low
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	EEC	-	High
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	EEC	EEC	High
Mt Canobolas Xanthoparmelia Lichen Community	EEC	-	Low
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	EEC	EEC	Low
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	-	CEEC	High
Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)	-	EEC	Low
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions	EEC	-	Low
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions	EEC	-	Low
White Box Yellow Box Blakely's Red Gum Woodland	EEC	CEEC	High

Notes *1. Source: DEC, 2005.*

2. TSC Act – Threatened Species Conservation Act 1995, EPBC Act – Environment Protection and Biodiversity Conservation Act 1999, EEC – endangered ecological community, CEEC, critically endangered ecological community.

5.2 Threatened ecological communities

Vegetation types identified within the study area were compared to listings of TECs under the EPBC Act and TSC Act. A comparison was undertaken with published TEC species lists, habitat descriptions and distributions, and published identification guidelines. Three TECs were identified within the study area:

- Box Gum Grassy Woodland (incorporating the Box Gum Grassy Woodland, Blakely's Red Gum Woodland and Rough-barked Apple Woodland vegetation types), listed as *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community* under the EPBC Act and *White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community* under the TSC Act;

- Inland Grey Box Woodland (comprising the mapped Grey Box Woodland vegetation type) listed as *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia endangered ecological community* under the EPBC Act and *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions endangered ecological community* under the TSC Act; and

- Fuzzy Box Woodland (comprising the Fuzzy Box Woodland type) listed as *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions endangered ecological community* under the TSC Act.

These communities are discussed in the following sections. Figure 5.1 shows the location of TECs within the study area.

One other listed TEC was considered likely to occur within the study area, *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland*, was not recorded onsite.

5.2.1 Box Gum Woodland

Box Gum Woodland is listed as endangered under the TSC Act and is referred to by the NSW Scientific Committee as *White Box Yellow Box Blakely's Red Gum Woodland*. The community is listed as critically endangered under the EPBC Act and is referred to by the Commonwealth Threatened Species Scientific Committee (TSSC) as *White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands*.

i NSW listing

a. Criteria

White Box Yellow Box Blakely's Red Gum Woodland (hereafter referred to as Box Gum Woodland) is listed as an EEC under the NSW TSC Act. It is found on relatively fertile soils on the tablelands and western slopes of NSW (DEC, 2002). Box Gum Woodland contains one or more of the following characteristic species in varying proportions and/or combinations: White Box, Yellow Box or Blakely's Red Gum. Grass and herbaceous species generally characterise the ground layer. In some locations, trees may be absent as a result of past clearing and at these locations only an understorey may be present. Shrubs are generally sparse or absent, though they may be locally common (NSWSC, 2008).

Disturbed remnants are considered to form part of the community, including those where either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration.

b. Vegetation communities across the study area

Using the NSW criteria for Box Gum Woodland and DECCW (2010), the following vegetation types mapped within the study area were considered to represent the Box Gum Woodland endangered ecological community:

- Box Gum Woodland (815 ha);
- Blakely's Red Gum Woodland (62 ha);
- White Box Woodland (206 ha); and
- Rough-barked Apple Woodland (226 ha).

The total area of Box Gum Woodland EEC mapped within the study area is 1,309 ha. General condition of Box Gum Woodland remnants within the study area varied with position in the landscape and vegetation type. In general, the remnants along roadsides, which were dominated by Yellow Box with Blakely's Red Gum (and referred to as the 'Box Gum Grassy Woodland' vegetation type), were relatively diverse, with grassy understorey dominated by native species. Exotic species were present but not considered to have impacted these remnants to a high degree. Narrow and linear remnants that had been subject to grazing, and where remnants were adjacent to improved pasture, contained more exotic species. These were also less diverse with respect to native species and had a higher cover of bare ground.

Blakely's Red Gum Woodland within the study area had a more shrubby/tussock understorey and had not been subject to a high level of clearing or disturbance. It occurred predominantly on drainage lines within Ironbark communities. It is possible that these remnants may be considered too shrubby for the listed community, however using a precautionary approach were considered to constitute the TEC.

White Box Woodland areas occurred as monocultures and integrades with Grey Box Woodland. These were mainly in the southern part of the PAA along the roadsides.

Rough-barked Apple Woodland generally occurred on the edges of grazing land, or along drainage lines or low-lying areas within grazed lands. Typically the ground cover and understorey had been heavily impacted by sheep or cattle. Rough-barked Apple Woodland was aligned to CW111 *Blakely's Red Gum - Rough-Barked Apple flats woodland of the NSW western slopes* (DECC, 2008a) and VCAID281 *Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion.* Therefore it was assumed that Blakely's Red Gum and/or Yellow Box would have once formed one of the dominant tree species within this community.

No areas of mapped grassland were considered to represent derived native grassland communities under the TSC Act-listed Box Gum Woodland community definition.

ii Commonwealth listing

a. Criteria

White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (hereafter referred to as Box Gum Woodland) is listed as a critically endangered ecological community under the EPBC Act. The community as listed under the EPBC Act is slightly different to the community listed under the TSC Act.

Under the EPBC Act, Box Gum Woodland is characterised by an understorey of tussock grasses, herbs and shrubs and dominated by White Box, Yellow Box or Blakely's Red Gum. The tree-cover is generally discontinuous and consists of trees of medium height with clearly separated canopies (TSSC, 2006). The listed community occurs in areas where rainfall is between 400 and 1,200 mm per annum, on moderate to highly fertile soils at altitudes of 170 m to 1,200 m (TSSC, 2006).

To qualify as the community under the EPBC Act, patches of woodland must fulfil certain criteria. The criteria includes:

- the most common overstorey species either White Box, Yellow Box or Blakely's Red Gum currently or previously;
- a predominantly native understorey;

- patch size greater than 0.1 ha; and
- 12 or more native understorey species present (excluding grasses) with at least one important species OR a patch size greater than 2 ha (SEWPaC, 2011b).

b. Vegetation communities across the study area

Following assessment using the NSW criteria, the four identified indicative vegetation types were assessed under EPBC criteria to see if remnants qualified as the community under the EPBC Act. Where assessed, most remnants achieved the EPBC criteria. Where 12 native understorey species (excluding grasses), a judgment was made as to whether this criterion was likely to be achieved during optimal survey conditions. Where this criterion was not achieved, the patch size and number of trees was also used to determine the occurrence of the community. Consequently, all areas dominated by the characteristic tree species Yellow Box and/or Blakely's Red Gum, were found to constitute the threatened Box Gum Woodland community under the EPBC Act.

It is likely that some of the smaller Rough-barked Apple Woodland remnants would not qualify as the community under the EPBC Act, particularly where they occurred within grazing land. However, not all of these could be ground-verified and in the absence of survey data, a conservative approach was taken and the remnants were considered to be representative of the community.

No areas of mapped grassland were considered to represent derived native grassland communities under the EPBC Act-listed Box Gum Woodland community definition.

5.2.2 Grey Box Woodland

Grey Box Woodland is listed as endangered under the TSC Act and is referred to by the NSW Scientific Committee as *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions*. The community is listed as endangered under the EPBC Act and is referred to by the Commonwealth Threatened Species Scientific Committee as *Grey Box Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia*.

i NSW listing

a. Criteria

Inland Grey Box Woodland TEC (hereafter referred to as Grey Box Woodland) includes those woodlands where Inland Grey Box is the dominant characteristic tree species, often found in association with Bimbil Box (*Eucalyptus populnea* subsp. *bimbil*), White Cypress-pine, Kurrajong, Buloke or Yellow Box and sometimes with White Box. Shrubs are typically sparse or absent, but can be diverse and locally common. A variable ground layer of grass and herbaceous species is present at most sites, while at severely disturbed sites the ground layer may be absent. The community generally occurs as an open woodland 15-25 m tall but in some locations the overstorey may be absent as a result of past clearing or thinning, leaving only an understorey (NSWSC, 2011a).

b. Vegetation communities across the study area

One vegetation type mapped within the study area was considered to represent the NSW-listed TEC; Grey Box Woodland. No areas of mapped grassland were considered to represent derived native grassland communities under the TSC Act-listed Grey Box Woodland community definition.

ii Commonwealth listing

a. Criteria

Under the EPBC Act Grey Box Woodland is described as woodland to open forest, with a canopy dominated by Grey Box, a moderately dense to sparse shrub layer and a ground layer of perennial and annual native forbs and graminoids. Other tree species are often present and may be co-dominant with Grey Box at some sites. The community includes patches of derived grassland, where the tree canopy and mid-layer has been removed to less than 10% crown cover, but the native ground layer remains largely intact (TSSC, 2010). The EPBC Act prescribes condition thresholds for the community including:

- minimum patch size is 0.5 ha;
- canopy layer contains Grey Box as the dominant or co-dominant tree species; and
- vegetative cover of non-grass weed species in the ground layer is less than 30% at any time of the year (TSSC, 2010).

Additional criteria are also provided for degraded patches including:

- small woodland patches (0.5 to 2 ha in area) with tree crown cover greater than 10%;
- larger woodland patches with a well developed canopy (2 ha or more in area); and
- patches where the canopy is less developed or absent (derived grassland) (TSSC, 2010).

b. Vegetation communities across the study area

Using the EPBC condition thresholds and listing advice, all remnants mapped as Grey Box Woodland within the study area were considered to constitute the Grey Box Woodland EEC under the EPBC Act.

The total area of NSW and Commonwealth-listed Grey Box Woodland EEC mapped within the study area is 660 ha. The condition of Grey Box Woodland remnants varied with location and the associated landscape in the study area. In general, stands of the woodland to the west of Spring Ridge Road had been heavily impacted by grazing, had little to no native understorey, very few native forbs and low diversity of native grasses (which were typically *Austrostipa* species). Where Grey Box Woodland occurred within a matrix of other vegetation types it had been subject to less disturbance and displayed greater diversity of ground cover species, although shrubs were still sparse to absent.

No areas of mapped grassland were considered to represent derived native grassland communities under the EPBC Act-listed Grey Box Woodland community definition.

5.2.3 Fuzzy Box Woodland

Fuzzy Box Woodland is listed as endangered under the TSC Act and is referred to by the NSWSC as *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions*. The community is not listed under the EPBC Act.

i NSW listing

a. Criteria

Fuzzy Box Woodland occurs as a woodland or open forest dominated by Fuzzy Box, often with Inland Grey Box, Yellow Box or Kurrajong. Buloke (*Allocasuarina luehmannii*) is common in places (OEH, 2011d). Shrubs are generally sparse and the ground cover is usually moderately dense, comprising native forbs, prostrate shrubs and native grasses.

The community occurs on alluvial or colluvial soils on prior streams and abandoned channels or slight depressions on the undulating plains or flats of the western slopes of the Great Dividing Range. Fuzzy Box Woodland often occurs upslope from River Red Gum communities, just above frequently inundated areas on the floodplain (NSWSC, 2011b).

b. Vegetation communities across the study area

One vegetation type mapped within the study area was considered to represent the EEC; Fuzzy Box Woodland.

Fuzzy Box Woodland in the study area was mapped across 129 ha (Figure 5.1). In general, stands were recorded along roadsides where they had been impacted by weed invasion. To the west of Spring Ridge Road they had also been heavily impacted by grazing. Most remnants occurred as monotypic stands of Fuzzy Box, with scattered occurrences of other canopy species including Yellow Box and Grey Box. The majority of canopy trees were mature with abundant hollows, providing habitat for native fauna.

5.3 Significant flora

5.3.1 Threatened flora species

Four threatened flora species were recorded within the study area. Table lists these species and their respective conservation status under the TSC Act and EPBC Act, and their RoTAP status. No other threatened or RoTAP flora species were recorded within the study area. The following section provides information on the habitat requirements of these threatened flora species, a description of their habitats and distribution within the study area, life history and current threats.

Table 5.2 Threatened flora species recorded in the study area

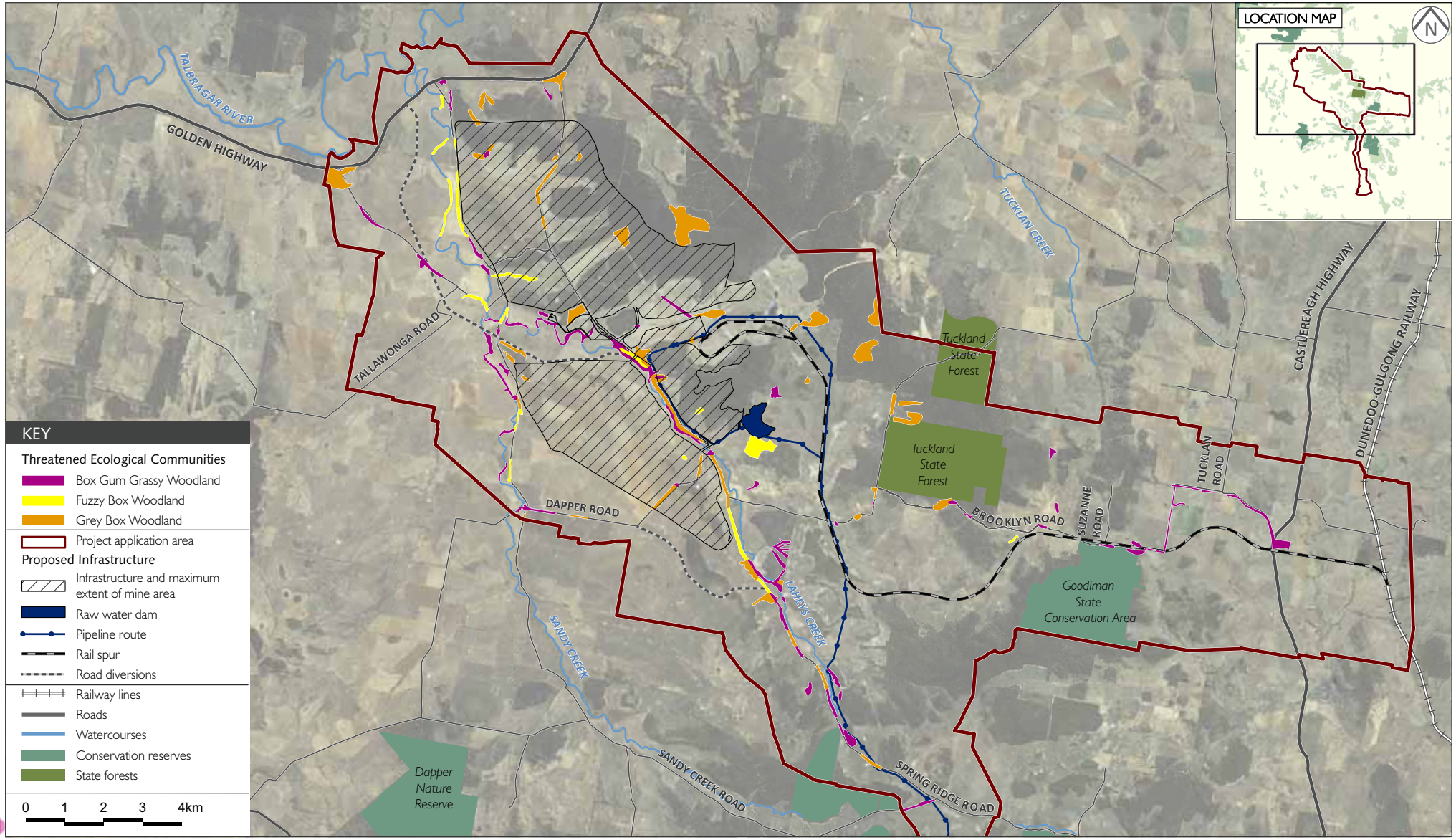
Common name	Species name	Status		
		TSC Act	EPBC Act	RoTAP
Ausfeld's Wattle	*Acacia ausfeldii*	V	-	3RCa
Ingram's Zieria	*Zieria ingramii*	E	E	2V
-	*Homoranthus darwinioides*	V	V	3VCa
-	*Tylophora linearis*	V	E	3E

Notes: *1. TSC Act (NSW)- Threatened Species Conservation Act 1995, EPBC Act (Cth) – Environment Protection and Biodiversity Conservation Act 1999. CE – critically endangered, E – endangered, V- vulnerable.*

2. 3RCa = Range more than 100 km but in small populations, Rare but with no current identifiable threat, Species is known to occur within a proclaimed reserve, Species is considered to be adequately reserved. 1000 or more plants occur within a proclaimed reserve.

3. 2V = Restricted distribution - range extending over less than 100 km, Vulnerable - at risk over a longer period (20-50 years).

4. 3E = Range more than 100 km but in small populations, Endangered - at serious risk in the short term (one or two decades).



Integrated Design Solutions | 030518 Cobbora Coal Project - Ecology F5.1 Rev G - 17 September 2012

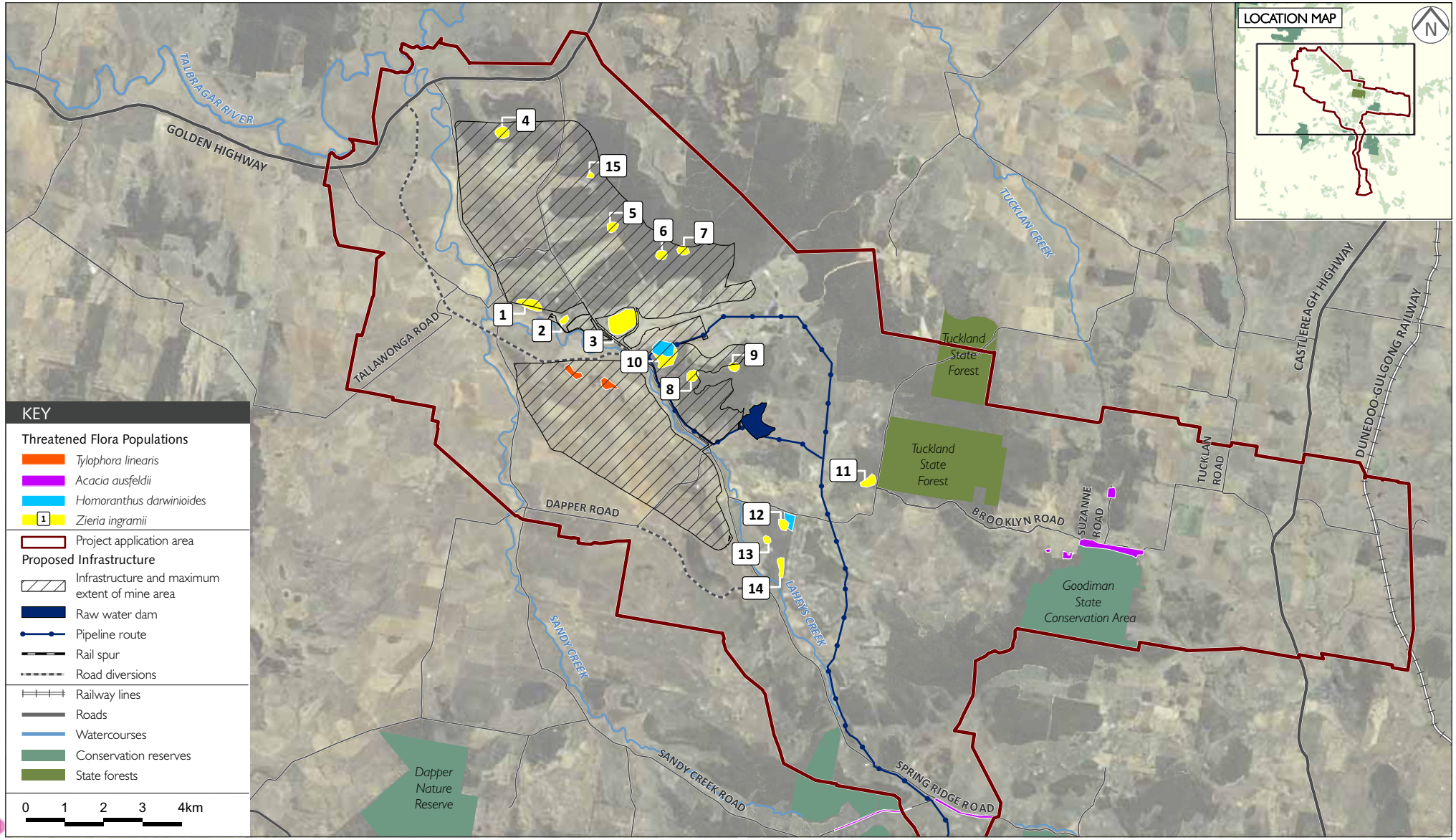
EMM

Cobbora Holding Company Pty Limited

Threatened Ecological Communities

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 5.1



Integrated Design Solutions | 030518 Cobbora Coal Project - Ecology F5-2 Rev F - 17 September 2012

EMM

Cobbora Holding Company Pty Limited

Threatened Flora Populations Recorded

Cobbora Coal Project - Terrestrial Ecology Assessment

Figure 5.2

i Ausfeld's Wattle

Ausfeld's Wattle occurs in NSW and Victoria. In NSW it is found in the Mudgee-Ulan-Gulgong area, predominantly in the northern part of the NSW South Western Slopes bioregion, with some occurrences in the adjoining bioregions of Brigalow Belt South and the Sydney Basin. In the Mudgee-Ulan area (in the region of the study area), Ausfeld's Wattle is mostly found on flat ground in remnant roadside patches of woodland with White Box, Blakely's Red Gum and native Cypress Pines with an understorey dominated by *Cassinia* sp. and grasses. The largest populations occur to the north-west of Gulgong in Tuckland State Forest and the recently declared Yarrobil National Park and Goodiman State Conservation Area (NSWSC, 2007a).

In the study area, Ausfeld's Wattle was recorded along roadsides, along Brooklyn Road in Goodiman State Conservation Area within Blue-leaved Ironbark and Slaty Gum Woodland, and along Spring Ridge Road and Sandy Creek Road in Mugga Ironbark Grey Box Woodland. A large sub-population was recorded in regrowth vegetation, where it was the dominant species, adjacent to Goodiman SCA. The sub-population in this area was estimated at 55,000 individuals, based on 10 m by 10 m plots recording 100 plants. It is estimated that 56,000 plants occur within the study area.

Approximately half of the remaining populations of this species are located within an agricultural landscape on road verges, while others occur on private pastoral land (NSWSC, 2007a). Threats to the species identified by the NSW Scientific Committee (2007a) include roadside disturbance, weed invasion, grazing and small-scale clearing, which are considered likely to result in continuing decline in populations, and hence the species overall in NSW.

ii Ingram's Zieria

Ingram's Zieria is a small aromatic shrub that grows between 40 cm and 60 cm but may reach up to 1 m in height. Plants are usually slender and spindly but occasionally may be bushy and can develop into a medium-sized shrub. Branches are ridged and slightly hairy with opposite and trifoliolate leaves that appear whorled along the branches.

Prior to surveys being undertaken within the study area, Ingram's Zieria had only been recorded at two other locations; the Goonoo and Cobbora SCAs, where it was recorded on gentle slopes or near the crests of low rises, in undulating terrain on northerly, westerly or southerly aspects (DEC, 2007a). Plants were recorded on light sandy soils described as red-brown to yellow-brown sandy or clay loams, overlying sedimentary rock, which may be outcropping. It has been suggested that particular elements of the soil, such as organic carbon, phosphorous or aluminium levels, may determine where it occurs (DEC, 2007a).

Ingram's Zieria typically occurs in *Eucalyptus-Callitris* woodland or open forest communities containing Black Cypress Pine and Blue-leaved Ironbark and a shrubby to heathy understorey (DEC, 2007a). In Goonoo SCA, Dwyer's Red Gum appears to be a predictor of the species and it has also been noted that it is rare to find Ingram's Zieria without another species of the Rutaceae family present (DEC, 2007a).

DEC (2007) state that other species that have been recorded at most sites include *Allocasuarina diminuta/ Allocasuarina gymnanthera, Acacia triptera* and *Calytrix tetragona.* However, the current assessment found that such species were common across the Blue-leaved Ironbark vegetation type as a whole, and were not particular to areas where Ingram's Zieria was recorded.

In the study area, Ingram's Zieria has been recorded on gentle slopes, and relatively flat topography (Figure 5.2). The species does not appear to prefer a certain aspect, being recorded on slopes of all aspects. It was most commonly recorded in Blue-leaved Ironbark Woodland or Red Stringybark Woodland (Figure 5.2). A population was also recorded within Dwyer's Red Gum Woodland. In Blue-leaved Ironbark Woodland, it sometimes occurred at disturbed track edges in close proximity to fallen timber, which appeared to be affording individual plants a certain degree of protection. This may be an artefact of previous grazing regimes.

A total of 1,255 individual plants in 15 sub-populations were recorded within the study area. Table 5.3 provides a description of the local population within the study area.

Table 5.3 Ingram's Zieria local population in the study area

Population	Number of Individuals	Description of sub-population	Vegetation community
1	48	On a gentle south-west facing slope in an area of open woodland.	Boundary between Red Stringybark Woodland and Cypress Pine Woodland
2	28	On a gentle west facing slope in an area of open woodland at the base of a small hill. Within a grassy understorey with areas of bare ground.	Red Stringybark Woodland
3	340	Located on a small grassy hill surrounded by paddocks. Small rock outcrops occur throughout with the plants generally below these areas on flatter ground. The sub-population ranges from north-facing slopes to south-east facing slopes and flat ground. Open woodland with a high percentage of bare ground. Individuals had set seed in November 2011 in this area.	Blue-leaved Ironbark Woodland and Dwyer's Red Gum Woodland
4	179	A large percentage of bare ground with young plants and a large number of seedlings. The plants occurred in an area of low canopy cover which was dominated by Sifton Bush with scattered fallen timber and surrounded by open Blue-leaved Ironbark Woodland. The sub-population was on a gentle north-facing slope. The sub-population was a mixture of older plants and seedlings.	Blue-leaved Ironbark Woodland
5	63	On a north-facing slope and on the top of the slope in red earth with large and smaller rocks. Occurred within areas where there was a high percentage of fallen timber and bare ground.	Blue-leaved Ironbark Woodland
6	1	On a ridge top in open ironbark forest. This area was recorded during the baseline surveys and the specimens were not able to be located within the 2011-2012 surveys despite targeted searches in the area.	Blue-leaved Ironbark Woodland

Table 5.3 Ingram's Zieria local population in the study area

Population	Number of Individuals	Description of sub-population	Vegetation community
7	2	On a ridge top in open ironbark forest. This area was recorded during the baseline surveys but the specimens were not able to be located within the 2011-2012 surveys despite targeted searches in the area.	Blue-leaved Ironbark Woodland
8	25	On a small rise on a north-facing slope in open woodland with abundant rocky areas and bare ground.	Blue-leaved Ironbark Woodland
9	24	In area where there was a large amount of fallen timber (dead *Allocasuarina* spp.) on a north-facing slope. It occurred on the edge of a track in an area with an open canopy. The sub-population contained some older plants and seedlings.	Blue-leaved Ironbark Woodland
10	431	Sub-population began in Red Gum Woodland which graded into Ironbark Woodland. Made up of very young plants with many seedlings present. Plants occurred in an area of low shrubs and open canopy. Some plants were flowering and setting seed in January and August 2012.	Dwyer's Red Gum Woodland and Regrowth
11	18	On an eastern-facing slope in open woodland.	Blue-leaved Ironbark Woodland and Cypress Pine Woodland
12	70	On a relatively flat area to north-facing gentle slope. Adjacent to a population of *Homoranthus darwinioides*. It occurs in a rocky area where there is a low percent canopy cover and a high proportion of open ground. The sub-population contained some older plants and seedlings.	Blue-leaved Ironbark Woodland and Cypress Pine Woodland
13	25	Plants were predominantly located on the midslope with some plants recorded at the base of gentle slopes.	Blue-leaved Ironbark Woodland
14	23	Plants recorded on the upper parts of south to south east facing slopes. The sub-population contained some older plants and seedlings in open woodland with a low sparse shrub layer and scattered grass tussocks.	Blue-leaved Ironbark Woodland
15	8	On a rocky rise in an open area adjacent to a track, this sub-population contained mainly smaller individuals in open forest and where there was some fallen timber.	Blue-leaved Ironbark Woodland
Total	**1,255**		

iii *Homoranthus darwinioides*

Homoranthus darwinioides is found on sandy soil on sandstone outcrops and sloping ridges. Vegetation associations where the species has been recorded include *Eucalyptus-Callitris* woodland, consisting of Narrow-leaved Ironbark, Blue-leaved Ironbark, Dwyer's Red Gum and Inland Scribbly Gum. *H. darwinioides* is known from several populations in Goulburn River National Park and two populations in Goonoo State Conservation Area in NSW (TSSC, 2008a).

The main identified threats to *H. darwinioides* are:

- localised extinction due to stochastic events;
- feral animals, in particular rabbits, and feral goats;
- stock impacts from grazing and trampling;
- erosion of sandstone habitat; and
- inappropriate fire regimes (TSSC, 2008a).

A population of *H. darwinioides* was recorded in the study area, occurring as two sub-populations (Figure 5.2). One sub-population was recorded as 227 individuals in Dwyer's Red Gum Woodland, Blue-leaved Ironbark Woodland and surrounding regrowth. *H. darwinioides* was most abundant where the canopy was sparse. In the regrowth areas, it occurred as large solitary plants on open ground amongst dense patches of Sifton Bush. The sub-population occurs on a light brown sandy loam with loose sandstone rocks at the surface.

Sub-population two was estimated at greater than 200 individuals (using counts from this study, Irvin and Bartus (2007) and ERM (2012)). This sub-population is located in Blue-leaved Ironbark Woodland. The dominant shrub species was Common Fringe-myrtle. Other species recorded included Silver-leaved Ironbark (*E. melanophloia*), Black Cypress Pine, *Allocasuarina gymanthera, Acacia triptera, Philotheca ciliata, Lomandra filiformis filiformis* and *Platysace linearifolia*. Bare ground in the area was approximately 15%, with canopy cover estimated at 20%, and there was abundant lichen cover on the ground.

iv *Tylophora linearis*

Tylophlora linearis is an herbaceous climber with a clear latex that grows to about 2 m long (TSSC, 2008b). It has been recorded in dry scrub, open forest and woodlands associated with Broombrush (*Melaleuca uncinata*), Blue-leaved Ironbark, Mugga Ironbark, White Box, Black Cypress Pine, White-Cypress Pine, Buloke, Hakea Wattle (*Acacia hakeoides*) and Streaked Wattle (*A. lineata*).

T. linearis has rarely been collected and is known from eight localities in the Dubbo area and Mt Crow in NSW. The species is conserved within Goobang National Park, Eura State Forest, Goonoo State Conservation Area, Pilliga West State Forest and Coolbaggie Nature Reserve (TSSC, 2008b). The main threats to *T. linearis* include forestry activities, disturbances such as grazing and fire and invasion of habitat by introduced weeds such as Lantana (*Lantana camara*) (TSSC, 2008b).

In the study area, nine individual *T. linearis* were recorded during the baseline survey. Six individuals were recorded in Blue-leaved Ironbark and three were recorded in Red Gum Woodland (Figure 5.2). The individuals were recorded growing amongst *Lepidosperma* species, where they appeared to be protected from cattle grazing (ERM, 2012). This is a cryptic species that could be easily overlooked during surveys.

5.4 Significant fauna species

Seventeen threatened birds and five threatened microbats listed under the schedules of the TSC Act and/or EPBC Act have been recorded within the study area (Figure 4.3). In addition, three species of birds listed soely as migratory under the EPBC Act have been recorded (Table 5.4).

Recorded threatened species and their respective habitats in the study area are discussed in the following sections. In addition to the species recorded onsite, potential habitat occurs for a number of listed threatened species.

Table 5.4 Threatened and migratory fauna species recorded within the study area

		Status	
Common name	**Scientific name**	**TSC Act**	**EPBC Act**
Birds			
Australasian Bittern	*Botaurus poiciloptilus*	E	E
Barking Owl	*Ninox connivens*	V	-
Blue-billed Duck	*Oxyura australis*	V	Mi
Brown Treecreeper	*Climacteris picumnus victoriae*	V	-
Cattle Egret	*Ardea ibis*	-	Mi
Diamond Firetail	*Stagnopleura guttata*	V	-
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V	-
Great Egret	*Ardea alba*	-	Mi
Grey-crowned Babbler	*Pomatostomus temporalis*	V	-
Hooded Robin	*Melanodryas cucullata*	V	-
Little Lorikeet	*Glossopsitta pusilla*	V	-
Malleefowl (disused nests)	*Leipoa ocellata*	E	E, Mi
Masked Owl	*Tyto novaehollandiae*	V	-
Powerful Owl	*Ninox strenua*	V	-
Rainbow Bee-eater	*Merops ornatus*	-	Mi
Speckled Warbler	*Chthonicola saggitata*	V	-
Superb Parrot	*Polytelis swainsonii*	V	V
Turquoise Parrot	*Neophema pulchella*	V	-
Varied Sittella	*Daphoensitta chrystoptera*	V	-
White-fronted Chat	*Epthianura albifrons*	V	-

Table 5.4 Threatened and migratory fauna species recorded within the study area

Common name	Scientific name	Status	
		TSC Act	EPBC Act
Bats			
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*	V	-
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V
Little Pied Bat	*Chalinolobus picatus*	V	-
Southern Long-eared Bat	*Nyctophilus corbeni (syn. timoriensis)*	V	V
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	V	-

Notes: 1. TSC Act–Threatened Species Conservation Act 1995, EPBC Act –Environment Protection and Biodiversity Conservation Act 1999, Mi-migratory, V-vulnerable, E-endangered.

5.4.1 Threatened reptiles and amphibians

There was no amphibian or reptile species listed under the EPBC Act or TSC Act recorded within the study area.

Potential habitat is present for Sloane's Froglet (*Crinia sloanei*) in grassland, swamps and farm dams in the study area and for the Pale-headed Snake (*Hoplocephalus bitorquatus*) along creeks (ie Laheys Creek) containing large trees with hollows.

5.4.2 Threatened birds

A number of woodland birds which are listed as threatened in NSW under the TSC Act were recorded frequently within the study area (Figure 4.3). In particular, the Brown Treecreeper, and Varied Sittella were frequently recorded foraging on rough-barked eucalypts during timed bird surveys and also opportunistically. Most sightings of these species were within Blue-leaved Ironbark Woodland, the most dominant vegetation type in the study area. The Speckled Warbler was also recorded in this vegetation type where the canopy was open and a grassy understorey was present.

Less commonly recorded threatened woodland birds encountered included the Hooded Robin, Glossy Black-Cockatoo, Diamond Firetail and Grey-crowned Babbler. The latter two species were more frequent within the box-dominated woodlands in the lower-lying areas. Rare sightings of the Superb Parrot, which is listed as vulnerable under the TSC Act and EPBC Act, were made within box-ironbark woodlands including Blue-leaved Ironbark Woodland and Box Gum Woodland. The Little Lorikeet was also rarely recorded from box woodlands including Fuzzy Box Woodland and Grey Box Woodland (Figure 4.3).

The Brown Treecreeper, Grey-crowned Babbler and Speckled Warbler were observed nesting within the PAA. It is likely that the Varied Sittella, Diamond Firetail and other threatened woodland birds are also nesting within the area. Habitat resources are available for larger hollow-nesting species including the Glossy Black-Cockatoo and although these were not observed nesting in the area, it is presumed that the PAA would contain a breeding population of such species.

The White-fronted Chat was recorded in Grey Box Woodland. This species is reported to be a rare visitor to the Dubbo region (Hosking *et al*, 2009). White-fronted Chats prefer damp, open grassy plains and low shrubs bordering wetland areas. Habitat for this species is limited in the study area and it is likely that its detection was in response to a high abundance of insects (NSWSC, 2010).

Two threatened waterbirds were also recorded. The Blue-billed Duck which is listed as Vulnerable under the TSC Act and as Migratory under the EPBC Act was recorded within the large dam in the east of the study area. The Australasian Bittern, listed as Endangered under the EPBC Act and TSC act, was recorded at night adjacent to a small dam on Danabar Road, most likely foraging on the numerous frogs in this area at the time (Figure 4.3).

The listed Barking Owl and Powerful Owl were recorded within the study area. The Barking Owl was most commonly recorded in the ironbark woodland in the north-east of the study area. The Powerful Owl was recorded in Grey Gum (*Eucalyptus punctata*) woodland in Goodiman SCA. As with woodland birds that nest in hollows, suitable nesting sites were available for threatened owl species within the PAA. No evidence was observed that these species are breeding within the PAA, however several areas, particularly within the eastern part of the PAA, contain large hollow-bearing trees.

Twelve unused mounds which could have been constructed by Malleefowl were found in the northern sector of the study area, along Spring Ridge Road (Figure 4.3). These incubation mounds are likely to be over 200 years old (M. Irvin, OEH *pers comm*, 2012). However, it is possible, given the presence of charcoal and stumps in some of the mounds, that these were a result of past clearing activities where the mounds were built-up by piling and burning of tree stumps. Notwithstanding this, a precautionary approach has been adopted which assumes that they are old, unused Mallefowl mounds.

The mounds were located in a stand of Dwyer's Red Gum Woodland. Within this area, Dwyer's Red Gums had a vegetation structure similar to mallee communities. Although the study area does not contain any true mallee communities, which is this species' preferred habitat, the Malleefowl is sometimes found in Grey Box, ironbark or Cypress Pine woodlands which are all found within the study area.

Potential habitat is present for several species that were not detected in the study area. These species and their habitats include:

- riparian woodlands: Black-breasted Buzzard, Little Eagle and Square-tailed Kite;
- wetlands and farm dams: Freckled Duck, Magpie Goose may occasionally use wetlands and dams in the study area;
- dry grasslands: Brolga and Spotted Harrier;
- open eucalypt forest and woodland: Bush Stone-curlew, Grey Falcon, Regent Honeyeater, Swift Parrot, and Black-chinned Honeyeater. In winter, the Flame Robin may also occupy these habitats; and
- regrowth communities: Gilbert's Whistler where there is Cypress Pine regrowth.

5.4.3 Threatened non-flying mammals

There were no non-flying mammal species listed under the EPBC Act or TSC Act recorded within the study area.

Potential habitat is present for the Eastern Pygmy Possum in open woodland where Johnson's Grass Tree (*Xanthorrhoea johnsonii*) occurs as an understorey species or the understorey is dense. Potential habitat is also present for the Spotted-tail Quoll, with movement corridors likely to occur along creek lines such as Laheys Creek, in gullies and rocky outcrops where they would den and form latrine sites. As feral predators occur within the study area, the likelihood of these species occurring is reduced as a result of likely predation and/or competition. Potential habitat also occurs along the creek lines and roadside reserves for the Squirrel Glider.

i Koala Habitat Assessment

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) defines Koala habitat as:

- potential Koala habitat- areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component; and

- core Koala habitat- an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

The two feed tree species listed on Schedule 2 of SEPP 44, White Box (*Eucalyptus albens*) and River Red Gum (*E. camaldulensis*) occur as sub-dominant canopy species or rarely within the low-lying parts of the study area, however both are considered rare within the study area. Areas of White Box Woodland to the south of the Project footprint could provide potential Koala habitat under the SEPP definition.

The Western Slopes and Plains Koala Management Area (DECC, 2008b) lists the following as important species for Koala:

- primary feed trees: River Red Gum and White Box (both rare in the study area);

- secondary feed trees: Dirty Gum (*E. chloroclada*) Blakely's Red Gum, Fuzzy Box, Inland Grey Box, Yellow Box, Dwyer's Red Gum; and

- supplementary feed trees: Narrow-leaved Stringybark and Red Stringybark.

While a number of known Koala feed trees are present within the study area, this species was not recorded during the surveys. No records exist within the study area for this species; however it has been recorded nearby within the Goonoo SCA and to the east within the Ulan area.

Dedicated Koala faecal pellet plots (using the SAT methodology) were undertaken throughout the site in areas of suitable habitat, however no pellets were observed. In addition, nocturnal call playback and spotlighting failed to identify any individuals within the study area, despite being conducted throughout the breeding period over two different years. For assessment purposes, and due to the presence of suitable habitat for this species, it is considered likely that Koalas occur in low numbers throughout the study area. The study area could also be important as a movement corridor for dispersal.

5.4.4 Threatened bats

Five species listed as threatened in NSW under the TSC Act, with two also listed under the EPBC Act were recorded within the study area (Figure 4.3). These species and the habitat type in which they were recorded are shown inTable 5.5 . The ironbark/stringybark woodland appears to be an important habitat type for threatened bat species. This vegetation type contained rocky outcrops that would constitute shelter habitat for cave-dwelling bats. Bats are also likely to forage in canopy gaps and from tree trunks, depending on their foraging strategy in these habitats. Abundant tree hollows (average of 52 per hectare) are present in ironbark/stringybark woodland that would constitute shelter and breeding habitat for tree-roosting bats (Table 5.5).

Table 5.5 Threatened bat species recorded in the study area

Species	General roosting habitat	Foraging strategy	Habitat type recorded
Large-eared Pied Bat	Cave roosting	Unknown	Ironbark/Stringybark Woodland
Little Pied Bat	Cave roosting	Gleaning from canopy and tree trunks	Red Gum Woodland
Eastern Bent-wing Bat	Cave roosting	Aerial pursuit in canopy gaps and over open habitat	Ironbark/Stringybark Woodland
Southern Long-eared Bat	Tree-roosting	Aerial pursuit in canopy gaps	Ironbark/Stringybark Woodland
Yellow-bellied Sheathtail Bat	Tree-roosting	Aerial pursuit over open habitat	Ironbark/Stringybark Woodland

Source: Churchill, 2008

5.4.5 Migratory species

Five bird species listed as Migratory under the EPBC Act were recorded within the study area (Table 5.4). The most commonly recorded migratory species was the Rainbow Bee-eater (*Merops ornatus*); however the Cattle Egret (*Ardea ibis*) and Great Egret (*A. alba*) were also common in wet soaks within paddocks and near farm dams.

5.4.6 Regionally significant species

The following sections discuss regionally significant species within the study area. Species are classed as regionally significant in the Central West CMA (Goldney *et al*, 2007) if they are:

- known to be declining within the bioregion; or
- known to be at the edge of their NSW distribution in the bioregion.

Regionally significant species have also been assigned a conservation priority for the Brigalow Belt South Bioregion, which is indicative of the level of threat from wood removal. Conservation priorities are defined in (NPWS, 2000):

- high level of threat, being tree and/or shrubby understorey dependent (conservation priority 1);
- possible threat, not known to use trees in Brigalow Belt South (conservation priority 2); or
- low level of threat, not found in wooded habitats or with shrubby understoreys (conservation priority 3).

i Birds

One hundred and twenty-four regionally significant birds were recorded within the study area. Commonly recorded birds listed as regionally significant included White-throated Treecreeper, Noisy Friarbird (*Philemon corniculatus*), Peaceful Dove (*Geopelia striata*), and Rufous Whistler.

Regionally significant species considered to be declining in the CWCMA and the BBS bioregion are included in Table 5.6. The local populations of such species are considered significant in the bioregion. All nine identified species were recorded rarely within the study area.

Table 5.6 Regionally significant bird species recorded within the study area

Common name	Scientific name	Status in CWCMA	Status in BBS bioregion	Conservation priority in bioregion	Conservation status in the study area
Crested Shrike-tit	*Falcunculus frontatus*	D, RV	R	2	R
Ground Cuckoo-shrike	*Coracina maxima*	D, RV	R	3	R
Little Woodswallow	*Artamus minor*	D, RE	R	2	R
Masked Woodswallow	*Artamus personatus*	D	R	2	R
Plum-headed Finch	*Neochmia modesta*	D, RE	R	3	R
Southern Whiteface	*Aphelocephala leucopsis*	D	R	3	R
White-browed Woodswallow	*Artamus superciliosus*	-	R	2	R
White-backed Swallow	*Cheramoeca leucosternum*	D, RV	R	2	R
White-browed Babbler	*Pomatostomus superciliousus*	D, RV	D	1	R

Notes: *1. Source: Goldney et al, 2007; Paull, 2002;*

2. D-declining, RV- regionally vulnerable, RE- regionally endangered, R-rare,

3. 1-high level of threat, being tree and/or shrubby understorey dependent, 2- possible threat, not known to use trees in Brigalow Belt South, 3- low level of threat, not found in wooded habitats or with shrubby understoreys,

4. R- rare (recorded at <10% of survey sites).

ii Mammals

Regionally significant mammals commonly recorded during surveys included the Chocolate Wattled Bat, Common Brushtail Possum, Common Ringtail Possum and Sugar Glider, which are considered to be declining and regionally vulnerable (Table 5.7).

Table 5.7 Regionally significant mammal species recorded within the study area

Common name	Scientific name	Status in CWCMA	Status in BBS bioregion	Conservation priority in BBS bioregion	Status in the study area
Chocolate Wattled Bat	*Chalinolobus morio*	-	ED	2	C
Common Brushtail Possum	*Trichosurus vulpecula*	D, RV	D	1	C
Common Ringtail Possum	*Pseudocheirus peregrinus*	D, RV	D	1	C
Common Wallaroo	*Macropus robustus*	-	R	2	R
Short-beaked Echidna	*Tachyglossus aculeatus*	D, RV	-	-	C
Sugar Glider	*Petaurus breviceps*	D, RV	-	-	R
Yellow-footed Antechinus	*Antechinus flavipes*	D	-	-	C

Notes: 1. Source: Goldney et al, 2007; Paull, 2002;

2. D-declining, RV- regionally vulnerable, R-rare, ED – edge of distribution, 1-high level of threat, being tree and/or shrubby understorey dependent, 2- possible threat, not known to use trees in Brigalow Belt South, R- rare (recorded at <10% of survey sites), C–common (recorded at 10-50% of survey sites), VC–very common (recorded at <50% of survey sites).

iii Reptiles and amphibians

Regionally significant reptiles and amphibians often recorded during surveys included the Broad-palmed Frog, Eastern Banjo Frog and Lesueur's Velvet Gecko. The local populations of such species are considered significant in the bioregion. All regionally significant reptiles and amphibians recorded during surveys are shown inTable 5.8.

Table 5.8 Regionally significant reptile and amphibian species recorded within the study area

Common name	Scientific name	Status in CWCMA	Status in BBS bioregion	Conservation priority in BBS bioregion	Status in the study area
Amphibians					
Bibron's Toadlet	*Pseudophryne bibronii*	D, RE	ED	3	R
Broad-palmed Frog	*Litoria latopalmata*	D	-	-	C
Eastern Banjo Frog	*Limnodynastes dumerillii*	-	-	-	C
Eastern Blue-tongued Lizard	*Tiliqua scincoides*	D	-	-	C
Green Tree Frog	*Litoria caerulea*	D, RV	-	-	R
Northern Banjo Frog	*Limnodynastes terraereginae*	D, RV	-	-	C
Ornate Burrowing Frog	*Limnodynastes ornatus*	D, RV, RE	-	-	C
Smooth Toadlet	*Uperoleia laevigata*	RV	-	-	C
Reptiles					
Lace Monitor	*Varanus varius*	D, RV	-	-	C
Lesueur's Velvet Gecko	*Oedura lesuerii*	RV	-	-	C

Table 5.8 Regionally significant reptile and amphibian species recorded within the study area

Common name	Scientific name	Status in CWCMA	Status in BBS bioregion	Conservation priority in BBS bioregion	Status in the study area
Jacky Lizard	*Amphibolurus muricatus*	D, RV	-	-	C
Mountain Dragon	*Rankinia diemensis*	D, RV	-	-	R
Nobbi Dragon	*Amphibolurus nobbi*	D	-	-	R
Bandy Bandy	*Vermicella annulata*	D, RE	-	-	R
Three-toed Skink	*Saiphos equalis*	D	-	-	R
Two-clawed Worm-skink	*Anomalopus leuckartii*	D	-	-	R
Wall Lizard	*Cryptoblepharus virgatus*	D, RV	-	-	R
White's Skink	*Egernia whitii*	-	ED	3	R
Yellow-faced Whip-snake	*Demansia psammophis*	D, RV	-	-	R

Notes: *1. Source: Goldney et al, 2007; Paull, 2002.*

2. D-declining, RV- regionally vulnerable, RE- regionally endangered, R-rare, ED – edge of distribution, 3- low level of threat, not found in wooded habitats or shrubby understoreys. R- rare (recorded at <10% of survey sites), C–common (recorded at 10-50% of survey sites), VC–very common (recorded at <50% of survey sites).

6 Impact mitigation

This chapter assesses the likely impacts from the Project on ecological values and functions with particular focus on impacts to threatened species and ecological communities recorded within the study area, or with the potential to occur within the study area. The assessment was undertaken based on NSW and Commonwealth legislation and guidelines to determine the significance of any mitigated impacts.

The strategies used to avoid, minimise and mitigate impacts follow a hierarchal approach (OEH, 2011a), including:

- avoidance of impacts;
- minimisation;
- mitigation measures; and
- provision of biodiversity offsets for impacts that remain.

The chapter discusses the mitigation measures required to minimise any potential impacts and the impacts remaining after mitigation that form the basis for the Offset Strategy.

6.1 Avoidance

Impacts to ecological features of the study area have been avoided where possible through environmental design changes throughout the planning stages of the Project. There will also be avoidance and minimisation of ecological impacts through appropriate environmental management during construction and operation of the Project. These measures are outlined in Section 6.2.

Several design changes have occurred since the original Project concept in 2009. These design changes maximise the efficiency of the proposed mine and minimise potential environmental impacts. An overview of these changes is provided in the following sections.

6.1.1 Creeks

Mine pits for the original Project concept were located over large sections of Laheys Creek and Sandy Creek and their floodplains. This concept would have required creek diversions to be constructed. The Project layout has been reconfigured to avoid creek lines and negate the need for creek diversions.

Avoidance of creeks also avoids large areas of vegetation in the floodplain and riparian zones, including Fuzzy Box Woodland, Grey Box Woodland and Box Gum Woodland, and the habitat these TECs provide. These TECs are listed under the NSW TSC Act, with Grey Box Woodland and Box Gum Woodland also listed under the EPBC Act.

6.1.2 Coal conveyor

The *Project Update Report* (EMM, 2011) describes the transport of coal from the coal handling and preparation plant (CHPP) to a rail loop and spur by a 12 km long conveyor. This conveyor required a cleared corridor between two sections of Tuckland State Forest which are part of a larger continuous area of remnant vegetation. This would have required the removal of approximately 6 ha of TEC. It also required that a product coal stockpile and coal loader would be located within approximately 1,500 m of 11 houses along Suzanne Road and impacting on native vegetation.

This conveyor is no longer proposed and instead the rail spur will extend from the Dunedoo-Gulgong rail line to the CHPP that will be adjacent to the mine area. The proposed rail spur will be approximately 28 km long, including the balloon loop. The rail spur will now pass largely through cleared agricultural areas and will be constructed on land owned by CHC, reducing the extent of clearing and disturbance within the locality.

6.1.3 Coal handling and preparation plant

Since the preparation of the *Project Update Report* (EMM, 2011), the CHPP and associated coal stockpiles have been moved approximately 1 km to the east to be adjacent to the rail loop. This is further from the banks of Laheys Creek.

Rearrangement of the infrastructure in this area, along with the removal of the need for the coal conveyor, has avoided a large known sub-population of Ingram's Zieria in the study area containing 340 individuals. This area will now be retained, monitored and managed during mine construction and operation.

6.1.4 Road diversions

The Project will require the closure of a section of Spring Ridge Road from the Golden Highway to south of the proposed main infrastructure area. It was originally proposed to seal and widen existing sections of Sweenys Lane and Sandy Creek Road (both currently narrow dirt roads) to allow traffic to travel at 100 km/hr. Given the current roadside environments of Sweenys Lane and Sandy Creek Road contain remnant stands of Fuzzy Box Woodland, Grey Box Woodland and Box Gum Woodland TECs and Ausfeld's Wattle, the proposed widening of the road was abandoned. Instead it is proposed to re-align Spring Ridge Road. The re-alignment was designed with the assistance of the Project ecologists to minimise the clearing of native vegetation and threatened flora species for this road diversion. The new route mainly traverses agricultural land that has been heavily disturbed. Only small areas of native vegetation will be impacted.

The Project will also require the realignment of a section of Dapper Road. The eastern part of this road was originally proposed to be realigned to tie in with the existing unformed 'paper' road (ie marked on a cadastral map as a road not in use) to the south of Dapper Road. This area contains a large patch of Grey Box Woodland. The road diversion was moved to minimise clearing of this TEC. Only a small area of Grey Box Woodland, associated with the tie in of the diversion with Spring Ridge Road, will now be impacted.

6.2 Minimisation and mitigation

Potential impacts from construction and operation of the Project on terrestrial ecology have been identified to determine appropriate mitigation strategies to reduce resultant impacts to an appropriate level.

6.2.1 Mitigation of potential issues

An overview of these and the measures that will be implemented to mitigate potential impacts from the Project is provided in Table 6.1. A description of the recommended content of the management plans discussed in the mitigation measures of Table 6.1 are provided in the following sections.

Table 6.1 Potential impacts and mitigation measures required

Potential impact	Mitigation measure
Pest species	
Weed invasion and spread into retained vegetation during clearing works and operation of the mine.	Measures to minimise the invasion and spread of weeds through the study area will be included within the biodiversity management plan (BMP).
Feral animal invasion and spread into retained vegetation during clearing works.	Measures to minimise the invasion and spread of feral animals through the study area will be included within the BMP.
Water availability, quality and quantity	
Removal of habitat and drought refuge for common and threatened species by removing large water storages from the study area.	A proposed new large water storage dam will provide a significant water resource.
Degradation of vegetation by erosion and sedimentation.	Erosion and sedimentation management will be included within the Project Environmental Management Plan (EMP) and monitored during the Project (PB, 2012).
Drawdown of shallow alluvial aquifers reducing availability of water to riparian vegetation.	None required. The potential for impacts has been assessed and only very small areas of riparian vegetation potentially have access to the alluvium aquifer (4.5 ha). Further, these often dry or become inaccessible during prolonged dry periods and are therefore not a permanent source of water for riparian zones.
Drawdown of shallow alluvial aquifers reducing refuge pools that provide drought refuge to terrestrial fauna.	Additional water storages for the mine will provide water resources for terrestrial fauna.
Vegetation	
Clearing of more than 1,800 ha of native woodland vegetation.	The amount of vegetation to be cleared will be minimised where possible during staged clearing works. Clearing boundaries are to be demarcated prior to clearing being undertaken to minimise unnecessary vegetation and habitat removal.
Introduction of non-local plant stock.	Native, locally sourced seed will be used for propagation for the rehabilitation activities where possible. Clearing works will coincide with tree seeding to maximise seed collection activities where possible.
Genetic isolation of vegetation communities and significant plant species as a result of habitat fragmentation.	Where possible, vegetation connectivity will be maintained during clearing works or progressively rehabilitated.
Disturbance of vegetation outside impact areas.	Clearing zones will be demarcated to restrict access. Revegetation/rehabilitation areas and areas not disturbed by mine activities will be managed for weeds, pest animals and access will be restricted.
Dust impacts on vegetation reducing plant health.	Dust minimisation and suppression will be included within the Project EMP. Monitoring of dust accumulation within significant habitat areas (eg areas containing Ingram's Zieria) will be undertaken as part of the adaptive monitoring strategy for the Project. If dust appears to be having a significant negative impact on threatened species, additional measures will be investigated to reduce impacts.
Removal of 65 ha of over-cleared vegetation types (greater than 95% cleared in the CMA).	Minimise clearing of vegetation in TEC areas through optimising detailed design and construction methods.

Table 6.1 Potential impacts and mitigation measures required

Potential impact	Mitigation measure
Removal of threatened flora.	Minimise clearing within known threatened flora areas through optimising detailed design and construction methods. Investigate the feasibility and potential for propagation and/or translocation of threatened flora impacted into surrounding undisturbed areas in consultation with OEH.
Vegetation and habitat degradation from invasion of feral animals into remnant vegetation.	Pest control will be undertaken in the areas in the PAA as part of the offset and rehabilitation programs.
Fauna and fauna habitat	
Impacts to fauna species during clearing.	Pre-clearing surveys will be undertaken to identify trees occupied by fauna or that provide fauna habitat. A two-stage clearing protocol will be adopted where non-habitat trees are cleared 24 hours prior to any habitat trees being cleared, to encourage fauna to move out of an area. Experienced fauna rescue personnel will be engaged where habitat trees are to be cleared and will be present during habitat tree clearing works.
Removal of identified threatened fauna habitat.	Habitat features important to threatened fauna species will be retained for reinstatement within rehabilitation areas where possible.
Loss of fauna habitat features within the landscape important to threatened fauna species.	Habitat features such as large logs and rocks will be placed aside to be used within rehabilitated areas.
Removal of hollow-bearing trees.	The BMP will investigate opportunities to minimise the impacts on fauna from the loss of hollow-bearing trees (eg nest boxes or relocation of hollows).
Removal of rocky outcrops that provide roosting habitat for microbats.	The BMP will investigate opportunities to minimise the impacts of the loss of rocky outcrop roosting habitat. Measures to reduce impacts to bats present in rocky outcrops during removal will also be investigated.
Increase in fauna car-strike from construction and operational traffic on local roads.	Road kill on access roads will be monitored as part of the ecological monitoring program, prior to construction starting to form a baseline. Speed restrictions, signage and driver education will be investigated if traffic on main access roads is shown to be causing a substantial increase in wildlife road kill.
Loss of habitat linkages.	Linkages will be reconnected where possible as part of the revegetation and rehabilitation works for the Project.
Noise during construction and operation disrupting fauna activity and breeding.	Noise minimisation and suppression will be included within the Project Environmental Management Plan (EMP).
Light impacts on diurnal fauna species at night and nocturnal species activity.	Light will be managed to minimise light spill into surrounding habitat areas. Light use will be minimised in proximity to habitat areas where possible.
Protected areas (NPWS and SF estate)	
Impacts to protected areas from migration of feral animal populations from impact areas.	Feral animal management will be undertaken in areas surrounding the impact area and will be coordinated with NPWS and SF to minimise impacts to protected areas in the locality.
Competition for territory and habitat resources from native fauna moving in from surrounding impact areas.	Relocation of habitat features, opportunities to mitigate the loss of hollow-bearing trees, as well as ongoing rehabilitation efforts will minimise the loss of habitat resources within the impact area.

i Management plans

The majority of mitigation measures will be incorporated into management plans for construction and operation of the mine. A biodiversity management plan and rehabilitation management plan will be prepared for the Project.

a. Biodiversity management plan

A biodiversity management plan (BMP) will be prepared for the Project. It will include methods to manage, protect and enhance vegetation and fauna habitat within the mine area and its surrounds. In particular, it will include:

- an overview of the important ecological values of the study area and their location;
- roles and responsibilities for implementation of the BMP;
- procedures for pre-clearing surveys;
- methods to demarcate clearing boundaries during staged mine works;
- fauna rescue and relocation protocols;
- requirements for road kill monitoring during construction;
- methods for the management of noxious weeds and pest animals;
- designs for fauna fencing or mitigation structures (eg underpasses);
- methods to mitigate the loss of hollow bearing trees (eg nest box installation or hollow relocation);
- methods to mitigate the loss of rocky outcrops (eg artificial cave roost installation); and
- methods to monitor mitigation measures.

b. Rehabilitation management plan

A rehabilitation management plan will be prepared for the Project based on the rehabilitation strategy (GSS Environmental, 2012). Approximately 1,900 ha of woodland will be rehabilitated within the Project disturbance area. The plan will detail the progressive rehabilitation of this area over the life of the Project. It will include strategies for rehabilitation such as:

- seed collection methods;
- topsoil management techniques to preserve soil seed banks;
- planting guides including species and recommended planting densities for all rehabilitation areas;
- watering regimes for rehabilitation areas;
- methods to minimise potential introduction and spread of soil pathogens and disease;
- key thresholds for survival of planted tube stock/broadcast seed; and

- measures to determine success of rehabilitation activities and contingencies with triggers for failed rehabilitation.

6.3 Impact assessment

Impacts remaining from the Project after avoidance, minimisation and mitigation has been applied are assessed in this section. Compensation for these impacts is described in section 6.4.

6.3.1 Direct impacts

i Impacts on threatened species and communities

Twenty-three listed threatened flora and fauna species and three TECs were identified within the study area. The significance of impacts following mitigation was assessed for these species and communities according to section 5A of the EP&A Act for those listed under the TSC Act and *'EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance'* for those listed under the EPBC Act (Appendix B). Assessments were also completed for those species likely to occur within the study area, but not recorded during the field surveys as shown in Table 6.2. The results are summarised in Table 6.2.

Table 6.2 Summary of potential impacts to threatened species and communities recorded or likely to occur within the study area

Species or community	Status		Recorded within the study area?	Impact description	Likely significance of mitigated impact (Appendix B)
	TSC Act	EPBC Act			
Threatened ecological communities					
Box Gum Woodland	E	CE	Yes	Removal of 12 ha	Significant
Fuzzy Box Woodland	E	-	Yes	Removal of 13 ha	Significant
Inland Grey Box Woodland	E	E	Yes	Removal of 54 ha	Significant
Threatened flora					
Ausfeld's Wattle	V		Yes	Removal of approximately 200 individuals from one sub-population	Not significant
Homoranthus darwinioides	V	V	Yes	Removal of 227 individuals from 1 sub-population	Significant
Ingram's Zieria	E	E	Yes	Removal of 727 individuals within 8 sub-populations	Significant
Philotheca ericifolia	-	V	No	Removal of potential habitat	Not significant
Pine Donkey Orchid	V	-	No	Removal of potential habitat	Not significant
Rulingia procumbens	V	V	No	Removal of potential habitat	Not significant
Scant Pomaderris	E	-	No	Removal of potential habitat	Not significant

Table 6.2 Summary of potential impacts to threatened species and communities recorded or likely to occur within the study area

Species or community	Status		Recorded within the study area?	Impact description	Likely significance of mitigated impact (Appendix B)
	TSC Act	EPBC Act			
Tylophora linearis	V	E	Yes	Removal of 9 individuals, representing the local known population (within the study area)	Significant
Threatened fauna					
Australasian Bittern	E	-	Yes	Removal of 9 ha of foraging habitat	Not significant
Barking Owl	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant
Black-breasted Buzzard	V	-	No	Removal of potential habitat	Not significant
Black-chinned Honeyeater	V	-	No	Removal of potential habitat	Not significant
Blue-billed Duck	V	-	Yes	Removal of 9 ha of foraging habitat	Not significant
Brolga	V	-	No	Removal of potential habitat	Not significant
Brown Treecreeper	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant
Bush Stone-curlew	E	-	No	Removal of potential habitat	Not significant
Diamond Firetail	V	-	Yes	Removal of 1,800 ha of foraging and breeding woodland habitat	Significant
Eastern Bent-wing Bat	V	-	Yes	Removal of 1,800 ha of foraging habitat and 16.7km of cliff line (non-breeding) roosting habitat	Not significant
Eastern Cave Bat	V	-	No	Removal of potential habitat	Not significant
Eastern Pygmy Possum	V	-	No	Removal of potential habitat	Not significant
Flame Robin	V	-	No	Removal of potential habitat	Not significant
Freckled Duck	V	-	No	Removal of potential habitat	Not significant
Gilbert's Whistler	V	-	No	Removal of potential habitat	Not significant
Glossy Black-Cockatoo	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant
Grey-crowned Babbler	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant
Hooded Robin	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant

Table 6.2 Summary of potential impacts to threatened species and communities recorded or likely to occur within the study area

Species or community	Status		Recorded within the study area?	Impact description	Likely significance of mitigated impact (Appendix B)
	TSC Act	EPBC Act			
Koala	V	V	No	Removal of 142 ha of potential secondary and 27 ha of potential supplementary habitat	Not significant
Large-eared Pied Bat	V	V	Yes	Removal of 1,800 ha of foraging and 16 km of cliff line (roosting and potential breeding habitat)	Significant
Little Eagle	V	-	No	Removal of potential habitat	Not significant
Little Lorikeet	V	-	Yes	Removal of 1,800 ha of foraging and potential breeding habitat	Not significant
Little Pied Bat	V	-	Yes	Removal of 1,800 ha of foraging habitat and 16km of cliff line habitat	Significant
Malleefowl	E	E	No (abandoned mounds)	Removal of potential habitat	Not significant
Masked Owl	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant
Painted Honeyeater	V	-	No	Removal of potential habitat	Not significant
Pale-headed Snake	V	-	No	Removal of potential habitat	Not significant
Powerful Owl	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant
Regent Honeyeater	CE	E, Mi	No	Removal of potential habitat	Not significant
Scarlet Robin	V	-	No	Removal of potential habitat	Not significant
Southern Long-eared Bat	V	V	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant
Sloane's Froglet	V	-	No	Removal of potential habitat	Not significant
Speckled Warbler	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant
Spotted Harrier	V	-	No	Removal of potential habitat	Not significant
Spotted-tail Quoll	V	V	No	Removal of potential habitat	Not significant
Square-tailed Kite	V	-	No	Removal of potential habitat	Not significant
Squirrel Glider	V	-	No	Removal of potential habitat	Not significant
Superb Parrot	V	V	Yes	Removal of 1,800 ha of foraging (overwintering) habitat	Not significant
Swift Parrot	E	E	No	Removal of potential habitat	Not significant
Turquoise Parrot	V	-	Yes	Removal of 1,800 ha of foraging habitat	Not significant
Varied Sittella	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant

Table 6.2 Summary of potential impacts to threatened species and communities recorded or likely to occur within the study area

Species or community	Status		Recorded within the study area?	Impact description	Likely significance of mitigated impact (Appendix B)
	TSC Act	EPBC Act			
White-fronted Chat	V	-	Yes	Removal of 9 ha of foraging habitat	Not significant
Yellow-Bellied Sheathtail Bat	V	-	Yes	Removal of 1,800 ha of foraging and breeding habitat	Significant

Notes: 1. TSC Act- Threatened Species Conservation Act 1995, EPBC Act – Environment Protection and Biodiversity Conservation Act 1999. CE – critically endangered, E – endangered, V- vulnerable, TEC – threatened ecological community.

It was concluded that impacts are likely to be significant for three TECs, three threatened flora species and 21 threatened fauna species recorded within the study area (Table 6.2).

Box Gum Woodland to be removed for the Project represents approximately 1% of the community within the PAA. The Grey Box Woodland represents approximately 8% of the community in the study area and the Fuzzy Box Woodland represents 10% of that occurring within the PAA (Table 6.5). While these are relatively small in comparison with the total area of vegetation to be removed, these are still considered significant due to the status of these communities in the region. These impacts will be compensated for by revegetation activities within the Project footprint and by Project offsets to ensure that there is an improvement in the quality and quantity of these TECs in the region in the long-term.

Four threatened flora species recorded within the PAA will be directly impacted by the Project. Impacts on Ausfeld's Wattle is not considered to be significant in accordance with Section 5a of the EP&A Act, given that only 0.4% of the local known population will be directly impacted. The Threatened Species Profile Database shows that this species can only withstand a loss of five individuals within the Central West CMA. However, the high abundance of the species within the study area, particularly adjacent to the area to be impacted, is considered to reduce the potential impacts to this species. While a significant impact is not considered likely for this species, impacts will still be compensated within the Biodiversity Offset Strategy.

Significant impacts are likely for Ingram's Zieria, *Homoranthus darwinioides* and *Tylophora linearis*, as the Project will remove between 58%, 53% and 100% respectively of the locally identified populations. This loss will be compensated through biodiversity offsets (see Section 1.7). This will include the identification, protection and management of additional populations of these species, where possible within the offset sites, the investigation of translocation and/or propagation of plants to be introduced into offset areas, and funding for conservation management in the region where land-based offsets are not available.

Thirty-nine threatened fauna species, of which 20 were recorded in the PAA, may be directly or indirectly impacted by the Project. Due to the progressive removal of foraging and breeding habitat, significant impacts in accordance with Section 5a of the EP&A Act are likely for:

- forest owls: Barking Owl, Masked Owl and Powerful Owl;
- woodland birds: Brown Treecreeper, Diamond Firetail, Glossy Black-cockatoo, Grey-crowned Babbler, Hooded Robin, Speckled Warbler and Varied Sittella; and
- microbats: Southern Long-eared Bat and Yellow-bellied Sheathtail Bat, Large-eared Pied Bat, Little Pied Bat.

These species are associated with the PAA's woodland areas, depending on habitat resources such as hollow-bearing trees and clifflines. Progressive rehabilitation during mining will include replanting woodland habitat, the reinstatement of habitat features, such as fallen timber and rock salvaged during clearing, and methods to compensate for the loss of hollow-bearing trees. This will help bird and bat species to maintain territories in the locality, by providing habitat features in the medium to long term.

Habitat resources also occur outside the disturbance footprint, with abundant similar habitat available in the proposed offset areas next to the Project area. In addition, large areas of contiguous vegetation occur for these species in nearby conservation areas in the PAA and the locality, including Goonoo SCA and the Goulburn River NP. Offsets will aim to improve the connectivity of conservation areas and the quality of remnant vegetation within the locality and region. This will potentially increase movement corridors for genetic exchange, foraging habitat and increase breeding resources for threatened fauna species.

ii Potential impacts to migratory species

Three listed migratory species were identified within the study area. An assessment of the significance of potential impacts (mitigated) of the Project was undertaken for these species using the *'EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance'* for those listed under the EPBC Act (Appendix B). The results are summarised in Table 6.3. No significant impact is anticipated on migratory species after mitigation measures have been applied.

Table 6.3 Summary of potential impact to migratory species

Species or community	Status		Impact description	Outcome of Significance Assessment (mitigated) (Appendix B)
	TSC Act	EPBC Act		
Cattle Egret	-	Mi	Removal of 9 ha of foraging habitat. None of the habitat to be removed has been identified as 'important habitat'.	Not significant
Great Egret	-	Mi	Removal of 9 ha of foraging habitat. None of the habitat to be removed has been identified as 'important habitat'.	Not significant
Rainbow Bee-eater	-	Mi	Removal of 2,765 ha of foraging habitat. None of the habitat to be removed has been identified as 'important habitat'.	Not significant

Notes: 1.Mi – migratory, TSC Act- Threatened Species Conservation Act 1995, EPBC Act – Environment Protection and Biodiversity Conservation Act 1999

iii Key threatening processes

Key threatening processes (KTPs) are the events and processes that threaten, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Thirty six KTPs are currently listed in NSW under the TSC Act and nineteen KTPs are listed under the EPBC Act. Table 6.4 lists the KTPs with the potential to be exacerbated as a consequence of the Project. The table also summarises the likely impacts of the Project on these KTPs.

Table 6.4 Key threatening processes and significance of threat

Key threatening process	Relevance to Project and study area
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Changes to the runoff surface area of the Laheys Creek and Sandy Creek catchments may result in lower flows in wet periods. In addition, the deep pools which are likely to be associated with the shallow alluvial aquifers within the study area may dry up more often as a result of the Project. This may impact on riparian vegetation reliant on the existing flow regimes of the creeks and also the fauna that depend on surface water. While riparian vegetation (including Box Gum Woodland and Grey Box Woodland TECs) and recorded threatened fauna species may be reliant on stream flow and deep riparian pools for drought refuge, this threat will be minimised as other large more permanent water sources are available and the Project will not remove significant amounts of water in times of high flow from the creeks of the study area.
Bush rock removal	The mine footprint requires the removal of bush rock and rocky outcrops. Investigation into the replacement of roosting areas for threatened microbats within infrastructure (bridges and culverts) will be investigated within the BMP.
Clearing of native vegetation	1,867 ha of native woodland vegetation will be cleared within the impact area. Vegetation of conservation significance has been avoided through footprint realignments and all woodland vegetation to be cleared will be rehabilitated within the Project area.
Competition and grazing by the feral European Rabbit	While European Rabbits occur within the study area, their current impact appears to be minor within the study area. It is considered that the proposed works will not significantly increase the level of this threat. Feral animal control will be undertaken for offset and rehabilitation areas.
Competition and habitat degradation by feral goats	Feral goats are present in large numbers in the study area (up to 50 observed in some areas). The removal of vegetation for mine operations is likely to cause local populations to shift to other sensitive areas nearby such as Yarrobil NP and Goodiman SCA. Feral animal control will be undertaken within unmined areas during the mine life, rehabilitation areas and within offset areas in association with local NP managers, minimising these potential impacts.
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	This fungus is known to occur in nearby conservation areas. It could be spread to the site from machinery and workers vehicles, shoes and tools. Appropriate controls will be included within the BMP to minimise the potential spread of this disease to and within the study area.
Ecological consequences of high frequency fires	No fires will be lit for mine operations, however some construction plant may be used that could spark in grasslands on hot days, posing a risk to retained native vegetation. Appropriate bushfire controls will be in place for the Project to reduce this threat.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	The Eastern Banjo Frog (common in the study area) is not a threatened species, but may become threatened as a result of chytridiomycos in the near future (NSWSC, 2003). Stream-associated frog species may also be at risk as the pathogen is waterborne. Construction plant and vehicles driving between habitat areas (dams and creeks) may move this pathogen from potentially infected areas to areas not previously infected. No disease-infected frogs were recorded within the study area and appropriate controls will be included within the BMP to minimise the potential spread of this disease to and within the study area.
Introduction and establishment of Exotic Rust Fungi of the order Uredinales pathogenic on plants of the family Myrtaceae	The area of highest risk in NSW is the coastal zone from the Illawarra north to the Queensland border, particularly Myrtaceae-dominated communities of heath, woodland and forest. The disease is yet to establish in drier climatic regions such as the ACT and western/inland regions on NSW. Appropriate controls will be included within the BMP to minimise the potential spread of this disease to and within the study area.

Table 6.4 Key threatening processes and significance of threat

Key threatening process	Relevance to Project and study area
Loss and/or degradation of sites used for hill-topping by butterflies	Butterflies which may hill-top (meeting of sexes for mating purposes) in the study area include *Ogyris genoveva* and *Ogyris olane*, both are common species that are widely distributed within the region. Potential hill topping areas will be disturbed by the Project, but rehabilitation areas will also create potential habitat.
Loss of hollow-bearing trees	Hollow-bearing trees are currently a limiting habitat feature within the study area. The loss of any hollow-bearing trees therefore represents a substantial threat to local hollow-dependent fauna. Hollow replacement measures will be investigated for the Project as part of the BMP.
Predation by the feral cat	While feral cats occur within the study area, this species does not appear to be a large threat to the fauna species identified within the study area. It is considered that the proposed works will not significantly increase the level of this threat. Feral animal control will be undertaken within unmined areas during the mine life, rehabilitation areas and within offset areas in association with local NP managers, minimising these potential impacts.
Predation, habitat degradation, competition and disease transmission by feral pigs	High activity levels of feral pigs were recorded in the study area. The removal of vegetation for mine operations is likely to cause local populations to shift to other sensitive areas nearby such as Yarrobil NP and Goodiman SCA. Feral animal control will be undertaken within unmined areas during the mine life, rehabilitation areas and within offset areas in association with local NP managers, minimising these potential impacts.
Removal of dead wood and dead trees	The proposed works will remove dead wood and dead trees from the mining operations area. Such habitat features will be collected during clearing works and reinstated to rehabilitated areas during the operation of the mine.
Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases	This KTP is associated with reductions in the bioclimatic range within which a given species or ecological community exists due to emissions induced by human activities of greenhouse gases. It is known to be a threat in semi-arid environments, such as parts of the PAA. The Project will increase emissions from the use of machinery and plant, adding to greenhouse gases. However, as the PAA occurs within a transitional environment, it is considered that the ecosystems present are able to tolerate climatic changes and may be less susceptible to potential impacts. Therefore loss of terrestrial climatic habitat will be minor as a result of the Project.
Predation by European red fox	Foxes have direct impacts on a range of native animal species. They prey particularly on small to medium-sized, ground-dwelling and semi-arboreal mammals, and ground-nesting birds. As no small threatened mammals were identified within the PAA and it is unlikely that the Malleefowl is still present, it is unlikely that the Fox would be significantly impacting on threatened species in the locality. The Project is unlikely to increase the risk of predation by the Fox.
Psittacine Circoviral (beak and feather)Disease affecting endangered psittacin species	Threatened species potentially threatened by this process in the study area include the Glossy Black-Cockatoo, Little Lorikeet and Superb Parrot. No disease-infected birds were recorded within the study area and appropriate controls will be included within the BMP to minimise the potential spread of this disease to and within the study area.

iv Critical habitat

Critical habitat has not been declared for any species, population or community that occurs in the study area.

Critical habitat has been broadly defined in the draft recovery plan for Box Gum Woodland (DECCW, 2010) to occur on the moderate to highly fertile soils of the western slopes of NSW. Given the currently highly fragmented and degraded state of this ecological community, all areas of Box Gum Woodland that meet the minimum condition criteria outlined in the EPBC Act Policy Statement (DEH, 2006b, described in Section 5.1.1) should be considered critical to the survival of this ecological community.

The PAA occurs within this region and consequently all remnant areas identified as Box Gum Woodland EEC are considered critical habitat under the draft recovery plan. The Project will rehabilitate disturbed areas with species indicative of this community. Areas of critical habitat for Box Gum Woodlands will also be included within offset sites, where remnants of the community will be rehabilitated, improved and protected.

v Vegetation clearing

Up to 1,867 ha of woodland vegetation, representing 17% of the woodland vegetation within the PAA, and 967 ha of Native Pasture vegetation will be directly impacted by the Project (Table 6.5). An additional 1,725 ha of introduced pasture and disturbed areas will be impacted, with a total disturbance area of up to 4,700 ha. The majority of vegetation to be removed is within the proposed mining areas. Some smaller areas occur along the road diversions, pipeline route and rail spur corridor.

Woodland vegetation to be cleared represents less than 1% of the remnant woodland outside of conservation areas in the Central West CMA (clipped to the Dubbo 1:250,000 map sheet), and 7% of the vegetation outside of conservation areas within the Talbragar CMA sub-region (within the Dubbo map sheet) (Table 6.6).

Table 6.5 Vegetation impacts from the Project

Vegetation type	Biometric vegetation type	TEC	Area within PAA (ha)*	Area to be removed (ha)^	Percent of vegetation type in the PAA to be removed
Blakely's Red Gum Woodland	CW111 Blakely's Red Gum Rough-barked Apple Flats Woodland	Box Gum Woodland	62	0	0
Blue-leaved Ironbark Woodland	CW115 Blue-leaved Ironbark woodland on sandy uplands and slopes of the Darling Riverine Plains Bioregion		5,230	1,018	19%
Box Gum Grassy Woodland	CW112 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	Box Gum Woodland	815	7	1%
Cypress Pine Woodland	CW107 Black Cypress Pine - Narrow-leaved Stringybark heathy woodland of the southern Brigalow Belt South Bioregion		488	191	39%
Dwyer's Red Gum Woodland	CW133 Dwyer's Red Gum - Currawang grassy mid-high woodland of central NSW		129	83	64%

Table 6.5 Vegetation impacts from the Project

Vegetation type	Biometric vegetation type	TEC	Area within PAA (ha)*	Area to be removed (ha)^	Percent of vegetation type in the PAA to be removed
Fuzzy Box Woodland	CW138 Fuzzy Box on loams in the Nandewar Bioregion and northern Brigalow Belt South Bioregion	Fuzzy Box Woodland	129	13	10%
Grey Box Woodland	CW145 Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Grey Box Woodland	660	54	8%
Mugga Ironbark Grey Box Woodland	CW155 Mugga Ironbark - Inland Grey Box - pine tall woodland of the NSW South Western Slopes Bioregion		55	1	2%
Mugga Ironbark Woodland	CW156 Mugga Ironbark - Inland Grey Box shrubby woodland of the Brigalow Belt South Bioregion		81	0	0%
Narrow-leaved Stringybark Woodland	CW107 Black Cypress Pine - Narrow-leaved Stringybark heathy woodland of the southern Brigalow Belt South Bioregion		22	0	0%
Red Stringybark Woodland	CW177 Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion		888	22	2%
Regrowth	CW115 Blue-leaved Ironbark woodland on sandy uplands and slopes of the Darling Riverine Plains Bioregion		813	365	45%
Rough-barked Apple Woodland	CW111 Blakely's Red Gum Rough-barked Apple Flats Woodland	Box Gum Woodland	226	5	2%
Scribbly Gum Open Forest	CW176 Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion		5	5	100%
Slaty Gum Woodland	CW191 Slaty Gum woodland of the slopes of the southern Brigalow Belt South Bioregion		874	103	12%
Tumbledown Gum Woodland	CW202 Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes		123	0	0%
White Box Woodland	CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW	Box Gum Woodland	206	0	0%
Total woodland and regrowth in moderate- good condition			**10,804**	**1,867**	**17%**
Native Pasture in low condition			3,000	967	32%
Introduced Pasture/Disturbed (non-native)			7,000	1,796	26%
Total native vegetation (does not include introduced pasture)			**14,804**	**2,834**	**19%**
Total disturbance area			**20,804**	**4,630**	**23%**

*Note: TEC – threatened ecological community, PAA – Project application area. *Based on available mapping and limited groundtruthing outside the impact area.*

Seventy-nine hectares of the vegetation to be cleared are TECs. This includes 12 ha of Box Gum Woodland (incorporating Box Gum Grassy Woodland, Blakely's Red Gum Woodland and Rough-barked Apple Woodland vegetation types), 13 ha of Fuzzy Box Woodland and 54 ha of Inland Grey Box Woodland (Table 6.5). TECs account for approximately 4% of the total native vegetation to be cleared.

Progressive clearing in the Project footprint will mean that only a proportion of the total vegetation will be removed at any one time. Progressive rehabilitation will re-instate more than 1,900 ha of woodland representative of the existing vegetation types, and 1,700 ha of pasture. The total area of woodland vegetation in the PAA will be maintained and increased in the long-term as a result of the rehabilitation program and the implementation of the offset strategy.

Table 6.6 Vegetation clearing related to the CMA region and sub-region

Region*	Current area of woodland (ha)	Amount in conservation areas (NPWS estate and State Forests) (ha)	Amount of non-conservation woodland (ha)	Percent reserved	Percent cleared of non-conservation vegetation for the Project (1,867 ha)
Central West CMA	318,031	74,662	243,369	24%	1%
Talbragar CMA Sub-region	28,008	2,504	25,504	9%	7%

*Notes: 1. *clipped to the 1:250,000 Dubbo map sheet.*

vi Removal of fauna habitat

Up to 1,867 ha of woodland fauna habitat will be removed by the Project (Table 6.7). Of this total area, 1,040 ha is representative of ironbark/stringybark woodland. This habitat type provides resources for a range of common and threatened fauna and flora species. This habitat type also contains significant habitat features inclduing structural diversity, hollow-bearing trees and fallen timber.

Box woodlands habitat type will be the least impacted of the habitat types, with 80 ha to be removed. However, this habitat type was found to have the highest density of hollow-bearing trees within the study area and specific habitat for some threatened woodland bird species.

Two significant and limiting fauna habitat features within the study area will be directly impacted: hollow-bearing trees and rocky outcrops. Mitigation measures will be incorporated into construction and operation of the Project to minimise these impacts. However, the success of such measures including artificial nesting and roosting structures will continue to be investigated (Goldingay and Stevens, 2006), particularly for a number of hollow-dependent threatened fauna species recorded within the study area such as the Barking Owl, Glossy Black-Cockatoo and microbats. Impacts from the removal of the structural and habitat features within the study area are considered to be significant, particularly for threatened species that might rely on these resources for breeding and do not have the ability to migrate to new areas, establish new territories or await the rehabilitation of habitat onsite.

Species such as the Brown Treecreeper, Grey-crowned Babbler, Glossy Black-Cockatoo, Speckled Warbler, Diamond Firetail, forest owls, Varied Sittella, Hooded Robin, Yellow-bellied Sheathtail Bat, Little Pied Bat, Southern Long-eared Bat and potentially the Large-eared Pied Bat were observed or have the potential to breed in the study area. The species are associated mainly with box woodland and ironbark/stringybark woodlands of the study area. Collectively, up to 1,500 ha of potential threatened species breeding habitat will be removed gradually over the life of the Project.

Table 6.7 Fauna habitat to be removed by the Project

Vegetation community	Area to be cleared (ha)	Associated threatened fauna species recorded
Box woodlands	80	Brown Treecreeper, Glossy Black-Cockatoo, Superb Parrot, Diamond Firetail, Grey-crowned Babbler, Hooded Robin, Little Lorikeet, Speckled Warbler, Varied Sittella, Eastern Bentwing Bat, Large-eared Pied Bat, Little Pied Bat, Southern Long-eared Bat, Yellow-bellied Sheathtail Bat
Ironbark/stringybark woodland	1,040	Barking Owl, Masked Owl, Powerful Owl, Brown Treecreeper, Glossy Black-Cockatoo, Superb Parrot, Diamond Firetail, Grey-crowned Babbler, Hooded Robin, Little Lorikeet, Speckled Warbler, Varied Sittella, Eastern Bentwing Bat, Large-eared Pied Bat, Little Pied Bat, Southern Long-eared Bat, Yellow-bellied Sheathtail Bat
Red gum woodland	191	Eastern Bentwing Bat, Large-eared Pied Bat, Little Pied Bat, Southern Long-eared Bat, Yellow-bellied Sheathtail Bat
Cypress Pine woodland	191	Grey-crowned Babbler, Speckled Warbler
Regrowth	365	Hooded Robin
Total	**1,867**	

Land will be progressively disturbed and rehabilitated over the life of the mine. More than 1,900 ha of woodland will be revegetated, with removed habitat features re-instated in these areas. However, the rehabilitation of habitat features and structural diversity within these areas will be slow, particularly for factors that are currently limiting fauna occupancy in the area such as hollow-bearing trees which can take over 100 years to develop.

Progressive rehabilitation during the mining process will include replanting woodland habitat, the reinstatement of habitat features such as fallen timber and rock salvaged during clearing and methods to compensate for the loss of hollow-bearing trees. This will assist bird and bat species to maintain territories in the locality, by providing habitat features in the medium to long term.

Habitat resources also occur outside the proposed impact area, with abundant similar habitat available in the proposed offset areas adjacent to the Project area. In addition, large areas of contiguous vegetation occur for these species in nearby conservation areas in the PAA and the locality including Goonoo SCA and the Goulburn River NP. Offsets will aim to improve the connectivity of conservation areas and the quality of remnant vegetation within the locality and region. This will potentially increase movement corridors for genetic exchange, foraging habitat and increase breeding resources for threatened fauna species.

6.3.2 Indirect impacts

i Noise

Mine construction and operation will emit noise in the study area. This includes noise levels of up to 35 or 40 db(A) up to 4 km from the pit areas (EMM, 2012). Construction and operational noise has the ability to disrupt fauna behaviour and result in impacts to breeding success, ability to establish territories, to forage for prey and result in habitat avoidance and abandonment (National Park Service, 1994). This is particularly the case if the proposed mine operates 24 hours a day and as a result of sudden loud noises such as blasting. Impacts are likely to be greatest surrounding the mine pit areas.

Mitigation measures will be employed to minimise the impacts of construction and operational noise from the Project in surrounding habitats. Some fauna species may habituate to periodic noise disturbances in surrounding habitat. However, threatened and locally rare fauna species are likely to be particularly susceptible to changes in behaviour and breeding success that may result from noise.

Avoidance behaviour is an anticipated reaction of local fauna to noise from the Project. This may reduce the area of suitable habitat for some fauna species surrounding active mining areas, creating additional pressure on habitat and habitat resources within surrounding remnant vegetation.

Further, traffic noise has been found to reduce the distance over which acoustic signals such as bird songs can be detected, an effect known as acoustic interference or masking (Paris and Schneider, 2008). An increase in traffic on local roads and machinery use in the study area could impact on bird species, particularly those that call in low frequency bands. Vehicular traffic associated with access roads, haul roads, active mine areas and associated machinery, may result in acoustic interference impacts on fauna species. This may disrupt the social behaviour of threatened bird species recorded within the study area and reduce breeding success and other acoustic-related actions.

Potential indirect impacts from noise will be monitored during the Project in surrounding areas where sensitive receivers occur. The distribution and abundance of threatened fauna within the study area will also be monitored as part of the biodiversity management plan. Information from both monitoring programs will be combined to determine if elevated noise levels from construction or operation of the Project are having adverse impacts on threatened bird species. Using an adaptive monitoring approach, recommendations will be made to reduce any impacts during the life of the mine during annual biodiversity reporting for the Project, with follow-up monitoring investigating the effectiveness of such measures, should they be required.

ii Dust

The Project involves the movement of large volumes of topsoil, rock and coal. The movement of such material using machinery is likely to cause airborne dust which may be deposited in the areas surrounding the active mine and emplacement areas (ENVIRON, 2012).

Dust can have impacts on plants at an individual and ecosystem level. It can accumulate on leaf surfaces and reduce essential physiological processes including photosynthesis, respiration and transpiration (Farmer, 1993). It can lead to decreased plant health which makes individuals more susceptible to pathogens and other disturbances increasing mortality risk. Dust can also result in changes to the composition of plant communities, with the overabundance and dominance of dust-tolerant species over time where impacts are considerable (Farmer, 1993).

Studies by Chaston and Doley (2006) found that the most sensitive plant functions may be altered with dust loads of about 8 g/m^2 for dust with medium diameters of 50 µm. Maximum deposition rates of 2 g/m^2/month have been modelled at sensitive receivers within the study area, with loads of up to 8 g/m^2/month only occurring within the active mine areas where no vegetation will occur. Maximum deposition rates of 2 to 4 g/m^2 are anticipated in areas that could be vulnerable to dust deposition, such as Ingram's Zieria patches, which is still well below the estimated load criteria identified by Chaston and Doley (2006).

Measures will be incorporated into the construction and operational stages of the Project to minimise the risk of airborne dust impacts. A monitoring strategy with specific triggers and management actions will be prepared as part of the biodiversity management plan for the Project, to ensure that indirect impacts are not having significant impacts on remnant vegetation, particularly threatened plants.

iii Fragmentation, edge effects and connectivity

Fragmentation of habitat occurs where areas that were once continuous become divided into separate, isolated fragments by non-woodland areas. It can decrease genetic exchange in vegetation and fauna populations that cannot navigate non-woodland areas creating isolation (Saunders *et al*, 1991). Remnant vegetation within the study area is confined to roadside verges and steeper topography. A large (approximately 6,000 ha) connected patch of remnant vegetation occurs within the north-eastern part of the study area with other remnants scattered on the higher elevations of the remaining parts of the study area and highly fragmented by agricultural areas.

The Project will create cleared areas between remnant vegetation and will also lead to the fragmentation of some patches of vegetation within the study area. However, the disturbance areas are centred on already cleared, agricultural land in the north-west of the study area, with a large proportion of vegetation to be cleared being regenerating vegetation, isolated patches or along the edge of the large north-east patch. Fragmentation effects will be temporary during the life of the mine (21 years). During this time, progressive rehabilitation of mine areas will be undertaken which will reconnect some of these fragments and re-establish habitat connectivity within the study area.

The study area is currently highly fragmented, which may account for the dominance of highly mobile threatened fauna species, as opposed to more sedentary species. Highly mobile species can typically occur in habitat patches with varying levels of fragmentation. Threatened flora populations within the study area occur in highly fragmented patches. Species will experience increased fragmentation for the life of the Project. However, staged revegetation and rehabilitation works are expected to reinstate some connectivity for species of the study area.

'Edges' in vegetation are created by clearing within or adjacent to the patch of vegetation. Increasing edges in remnant vegetation can lead to changes in microclimate and ecological processes. These changes are known as edge effects. Microclimatic changes can include changes in light, temperature, humidity and wind, which can favour certain species, leading to changes in structure and diversity in these areas. Disturbance-tolerant species such as weeds can flourish in these changed conditions, and an increase in edge also increases the chance of invasion and use of remnant vegetation by feral animals (Oliveira-Filho *et al*, 1997). The greater the edge area relative to the total area of forest and woodland, the greater the potential for edge effects to occur.

The north-east of the study area is currently impacted by edge effects, where low-lying fertile land has been cleared for agriculture between steeper areas. Edge effects are also evident in the long, linear remnants on the road verges and along the creek lines of the study area. Edge effects are likely to increase in areas surrounding the proposed mine pits and other disturbance areas, where land use will change and extend into remnant patches of vegetation.

Active ongoing rehabilitation and regeneration works will be undertaken within these areas to create buffers to remnant vegetation patches. In the long-term, the Project will reduce the current amount of edge within the large north-east remnant (including the remnant to the south of the infrastructure area) both during staged works, with a more than 60% decrease in edge (from 46 km to 18 km of edge), and as a result of ongoing rehabilitation of the final landform, with a 40% decrease in edge (a reduction to 28 km which includes rehabilitated buffer zones between agricultural areas and remnant vegetation).

iv Drawdown impacts on potential GDEs

There appears to be some connection of the semi-permanent pools along Sandy Creek, Laheys Creek and the Talbragar River with the alluvium aquifer and also the regional Permo-Triassic aquifer where it is exposed in the creek beds. These pools naturally dry out during extended dry periods. Some of the areas where alluvium has been identified within Sandy and Laheys creeks are within the Project potential drawdown zone of this aquifer. However, only a small area contains woodland or deep-rooted vegetation that could potentially access this water source in dry periods.

A total of 4.5 ha of woodland vegetation occurs within the areas mapped as containing alluvium. While most of these areas contain TECs, only half of these are within the proposed drawdown zone and have the potential to be impacted by the Project. As there does not appear to be a clear association of specific vegetation communities to the areas where alluvium and associated aquifers occur (ie six communities identified in these areas also occur elsewhere in the study area where alluvium is not available) groundwater use by terrestrial woodland is likely to be opportunistic rather than dependent.

Groundwater levels in the alluvium appear to take approximately six to eight months after a major flood event to return to pre-flood levels, suggesting that pools may be sustained via groundwater discharge for a similar length of time between high flow events (PB, 2012). Provided there are no significant decreases in flood events as a result of the decrease in catchment size from the mine, only minor impacts are expected to these systems. Therefore it is unlikely that significant impacts will occur for fauna species, particularly given the availability of other large, and more permanent, water storages within the study area.

v Potential impacts on land under the NSW Brigalow and Nandewar Community Conservation Area Act 2005 and NPWS estate

The Project will not directly impact on any areas reserved under the BNCCA Act. However, indirect impacts on these areas may result from the Project activities. Such impacts may occur as a result of the movement of native and feral fauna species from the Project disturbance areas into these protected areas. Such movements may impact on the existing fauna populations of the reserves through competition for habitat resources and territories and also on the vegetation from overgrazing or disturbance from species such as the feral pig.

Potential indirect impacts on biodiversity values in these areas as a result of the Project will be minimised through the implementation of the environmental management measures. Environmental management methods discussed in the biodiversity management plan will be coordinated with the local National Parks and Wildlife Service and Forestry offices to ensure consistency with the management of the Project area and nearby protected areas.

The *Guidelines for developments adjoining land and water managed by the Department of Climate Change and Water* (DECCW, 2010d) have been used to assess the proposed rail loop which occurs near Goodiman SCA and the pipeline which occurs near Yarrobil NP in some locations. The following section assesses the key issues to be considered for proposals adjoining NPWS estate that are relevant to the Project:

- Erosion and sediment control:

Appropriate erosion and sediment controls will be detailed within the construction and operational management plans for the Project. Any structures will be monitored during construction to ensure that the works are not impacting on the adjoining NPWS estate. No waterways occur in proximity to the proposed rail loop in this area and therefore impacts to hydrological regimes are unlikely.

- Stormwater runoff:

Appropriate drainage will be installed along the rail loop alignment including stormwater detention basins where required to ensure that no stormwater runoff from disturbed areas enters the NPWS estate.

- Pests, weeds and edge effects:

The proposed rail spur and power line easement requires some clearing of native vegetation immediately adjacent to the NPWS estate. However, the area to be cleared is adjacent to an existing power line easement which has already been cleared and is continuously managed to reduce fire hazard. It also occurs adjacent to a local road which cuts through the conservation area. Therefore it is considered that this area is already subject to edge effects and the Project is not likely to significantly increase these impacts.

The existing road through Goodiman SCA will remain throughout the life of the Project and therefore no access issues are likely for conservation area management.

The pipeline will be buried under agricultural land where it occurs in proximity to Yarrobil NP, therefore the potential for edge effects will not be increased. The pipeline will be rehabilitated to existing land use (agricultural) in these areas.

The proposed rail spur and power line easement occur near the boundary of Goodiman SCA in some locations. However, as the power line easement occurs between the SCA and the rail spur, there is some opportunity for a low, shrubby vegetated buffer to be created in these areas with a wider buffer provided where additional space isavailable.

- Boundary encroachments and access through NPWS estate:

All construction and operational access will occur along the proposed power line and pipeline easement. No access will be provided along the existing local road which extends through the Goodiman SCA or through Yarrobil NP.

- Visual, odour, noise, vibration, air quality and amenity:

No official walking trails, camping and picnic areas occur in Goodiman SCA or in Yarrobil NP in proximity to the work areas. Therefore no impacts on amenity will occur.

Potential indirect impacts on flora and fauna within the SCA and NP from the construction works will be temporary and mitigation measures will minimise any potential impacts from noise and dust.

- Threats to ecological connectivity:

The habitat in Goodiman SCA is connected to other habitat areas on all sides, with the largest linkages occurring to the south and west. A small area of vegetation is connected to the SCA to the north in proximity to the rail spur. However this linkage is already severed by the road through the SCA and the power line easement which traverses the north-west corner of the SCA. This linkage will be further severed by the construction of the rail spur and the power line easement.

Several other vegetated links occur in the locality which connects the habitat within the SCA to surrounding habitat areas and the Tuckland SF. These links will be enhanced through the recommended rehabilitation works in the proposed offset areas. A number of fauna movement structures have been incorporated into the design of the rail spur to ensure safe passage of fauna and to maintain and enhance current links. Three drainage structures are being designed to incorporate requirements to allow for dry fauna passage in the vicinity of the SCA.

As the proposed pipeline adjacent to Yarrobil NP will be buried, there is not likely to be any consequences of its construction on local ecological connectivity of habitat.

vi Impacts to matters of National Environmental Significance

Matters of NES identified within the PAA include threatened ecological communities, plants, birds, bats, and migratory species. Two EPBC Act-listed TECs will be impacted by the Project:

- 54 ha of Grey Box Grassy woodlands and Derived Native Grasslands of South-eastern Australia; and
- 12 ha of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

The Project is also likely to result in significant impacts for EPBC Act-listed Ingram's Zieria, *T. linearis* and *H. darwinioides*. Significant impacts are also likely for the Large-eared Pied Bat and Southern Long-eared Bat with the loss of with the loss of 1,400 ha of foraging habitat. Potential roosting and breeding habitat constituting 16 km of cliff line will also be lost for the Large-eared Pied Bat.

Impacts to matter of NES are discussed further in Appendix D.

6.3.3 Cumulative impacts

Cumulative impacts are the successive, incremental and combined impacts of one or more activities on society, the economy and the environment. Cumulative impacts result from the accumulation and interaction of impacts from past, present or future activities. They can be both positive and negative and can vary in intensity as well as spatial and temporal extent (Franks *et al*, 2010). The loss of native vegetation, habitat values and alteration to flow regimes in the PAA from the Project may combine spatially and temporally to result in cumulative impacts locally and within the region.

The Project occurs on the edge of a potential growth region for coal mining (Franks *et al*, 2010). Several mineral mines and coal mines occur within the wider region to the east. This includes three large coal mines: Ulan, Moolarben and Wilpinjong. Other smaller mineral mines occur, or are proposed within the region including a zirconium mine south of Dubbo. Therefore impacts from the Project may combine with those from other existing and future mines projects, particularly for TECs, threatened flora and threatened fauna.

At other coal projects to the east, the vegetation communities and fauna habitat is different to that in the Cobbora Project area. However these projects will all impact on areas of Box Gum Woodland TEC, with a net cumulative impact of more than 225 ha, of which the Project contributes 5%.

Cumulative impacts to the Southern Long-eared Bat are shared between Cobbora and Moolarben with the loss of important values such as hollow-bearing trees and contiguous habitats. Cumulative impacts are also likely for cave-roosting microbats as cliff-lines are a limiting factor in the locality. The combined projects will impact on approximately 30 km of cliff-line which provides roosting and potential breeding habitat for the Eastern Bent-wing Bat, Large-eared Pied Bat and Little Pied Bat. The Cobbora Project represents half of this loss.

However, despite the potential negative cumulative impacts, the Project is also likely to have a beneficial cumulative impact through the investment in biodiversity offsets and rehabilitation. Offsets will add to the conservation network and to habitat corridors within the wider region, protecting important areas of identified threatened species and community habitat. Disturbed offset areas will be rehabilitated with native vegetation representative of the likely original communities, including areas indicative of Box Gum Woodland.

6.4 Offsets

A biodiversity offset strategy has been developed for the Project and is included as Appendix C to this report. The following section provides an overview of the strategy.

6.4.1 Offset principles

The biodiversity offset strategy was developed under the NSW *OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) projects* (the OEH policy) (Appendix C). The strategy uses the Biobanking assessment methodology to quantify vegetation and habitat impacts.

The biodiversity offset strategy has also been developed in accordance with the principals within the Commonwealth *Draft Policy Statement: Use of Environmental Offsets under the EPBC Act* (DEWR, 2007), the Commonwealth *Draft Environmental Offsets Policy* (SEWPaC, 2011) and the *Principles for the use of biodiversity offsets in NSW* (OEH, 2011).

In line with the guiding offset principles, the Project offsets will:

- provide a net improvement in the quantity, quality and conservation of biodiversity values within the region in the medium to long term through:
    - the rehabilitation and protection of woodland, particularly the Box Gum Woodland, Inland Grey Box Woodland and Fuzzy Box Woodland TECs; and
    - the protection of threatened flora and fauna habitat and habitat features (eg hollow-bearing trees).
- provide long-term protection for threatened flora and fauna and TECs;
- improve vegetation and habitat connectivity between existing conservation areas within the locality; and
- protect areas identified as key corridors within the Central West Catchment Action Plan (CWCMA, 2011) and as NPWS conservation priorities.

6.4.2 Offset strategy

In accordance with the OEH Policy and relevant offsetting principles, the key objectives of the biodiversity offset strategy are to:

- provide 'like for like' land-based offsets representing a 'no net loss' outcome for red flags (TECs and over-cleared vegetation types identified within the OEH vegetation types database for the Central West CMA) and threatened species for which species credits have been identified, based on the BioBanking assessment requirements (Tier 2 outcome under the OEH Policy);

- provide a minimum of a negotiated 'mitigated net loss' outcome using the variation criteria within the OEH Policy for all other vegetation communities (Tier 3 outcome under the OEH Policy); and

- ensure a minimum of 80% of offset requirements are land-based, with remaining offsets including investment in key projects, aimed at threatened species management in the region and enhancement of land-based offsets.

The Project will cause impacts equivalent to 124,091 ecosystem credits according to the Biobanking calculator due to clearing of native vegetation communities in moderate to good condition. In addition, impacts on threatened species will cause impacts equivalent to 49,541 species credits. Thus the offset strategy will need to provide compensation by providing equivalent ecosystem and species credits in offset areas in accordance with the key objectives.

High priority areas have been identified within and surrounding the PAA, south of Goodiman State Conservation Area (SCA) outside the disturbance areas on CHC-owned land. Significant wildlife corridors will be created in such areas by the permanent dedication and management of CHC lands. The aim of onsite offsets will be to provide vegetated links to existing conservation areas and large areas of retained native vegetation.

6.4.3 Offset package

A total of 5,667 ha of CHC-owned land has been identified as biodiversity offset areas (Figure 6.1). These areas will be conserved in perpetuity to protect and enhance the ecological values present. The offsets include approximately 1,758 ha of pasture areas which will be rehabilitated to represent adjacent remnant vegetation. More than 458 ha of TECs have been identified within the CHC-owned offset sites and an additional 991 ha will be rehabilitated within the offsets.

Offsets will be protected using formal conservation agreements and potential dedication to the reserve network. An Offset Management Plan will be prepared to ensure biodiversity values are protected and enhanced. With the proposed compensatory measures outlined, the Project will improve the connectivity of remnant habitat within the locality.

Offset to impact ratios have been calculated for the TECs and for all vegetation to be impacted by the Project. The ratios achieved are considered adequate to compensate for impacts to the Box Gum Woodland EEC and Grey Box Woodland EEC, when compared with other recent offset precedents in the region. However, additional offsets are required to compensate for the loss of Fuzzy Box Woodland (Table 6.8). For this community the offset to impact ratio for vegetation in moderate to good condition, including the proposed rehabilitation areas, is 2.6:1 with the identified offset areas. It is considered that additional areas are required to increase this to at least 3:1 to be in line with other recent offset precedents.

Table 6.8 Vegetation types identified in CHC-owned offset sites

Vegetation	Area to be impacted (ha)	Area within offsets (ha)[1]	Area to be rehabilitated in offsets (ha) (discounted value in brackets[2])	Offset to impact ratio including rehabilitation[2]
Box Gum Woodland EEC	12	347	270 (135)	40:1
Grey Box Woodland EEC	54	111	684 (342)	8.4:1
Fuzzy Box Woodland EEC	13	0	37 (8.5)	1.4:1
Other vegetation (mod-good condition)	1,788	3,451	767 (383.5)	2.1:1
Total	**1,867**	**3,909**	**1,758 (879)**	**2.6:1**

Note: 1.Does not include areas to be rehabilitated within the offset areas.

2. Rehabilitation areas have been discounted by 50% in the calculations of ratios.

In accordance with the OEH Offset Policy, the biodiversity values of the identified offset areas have been calculated using the Biobanking assessment methodology to compare biodiversity credit outcomes. CHC is committed to aiming for a 'no net loss' outcome for red flag vegetation types, which includes TECs and over-cleared vegetation types.

A total of 7,954 ecosystem credits were generated by the Project for the seven red flag vegetation types to be impacted. The offsets generated a total of 26,393 ecosystem credits. This is triple the required credits when red flag vegetation types are combined, and represents a 'no net loss' outcome for all but one of these vegetation types, Fuzzy Box Woodland.

An additional 35,959 ecosystem credits were generated in the offset areas for other vegetation types not identified as red flags. These areas provide habitat for threatened species not identified as requiring species credits. The credits generated by the offsets do not meet the credits required to gain a 'no net loss' outcome. Therefore non red flag vegetation types will be offset according to a 'mitigated net loss' outcome under the Offset Policy. CHC is committed to a minimum offset to impact ratio of 3:1 for these vegetation types using the variation criteria in the Offset Policy.

Additions to the offset package are being negotiated to meet outstanding ecosystem credit requirements. The unsecured offsets represent an additional 1,543 ha adjacent to the Project. These areas have not been surveyed for biodiversity values but are likely to contain similar values to the existing offset areas given their proximity. Surveys are proposed in spring summer of 2012/2013 for these areas. It is likely that the minimum ecosystem offsets are achievable with these proposed potential additions to the offset package.

i Threatened species

CHC is committed to a 'no net loss' outcome under the Offset Policy for threatened species which have generated species credits. Species credits were generated within the offset areas for five of the seven affected threatened species. Species credits have been met for three of these. Additional credits are required for *Homoranthus darwinioides, Tylophora linearis*, Ingram's Zieria and Large-eared Pied Bat breeding habitat to meet the desired outcome.

Proposed offset additions will add threatened species habitat to the package. Targeted surveys will be conducted in spring/summer to confirm the presence of threatened species and their habitat in the offset areas. Should further surveys and additional offsets still not meet the requirements for species credits, indirect offsets will be investigated and negotiated with OEH and SEWPaC or the outcome goal may be reduced to a 'mitigated net loss'.

6.4.4 Offset outcomes

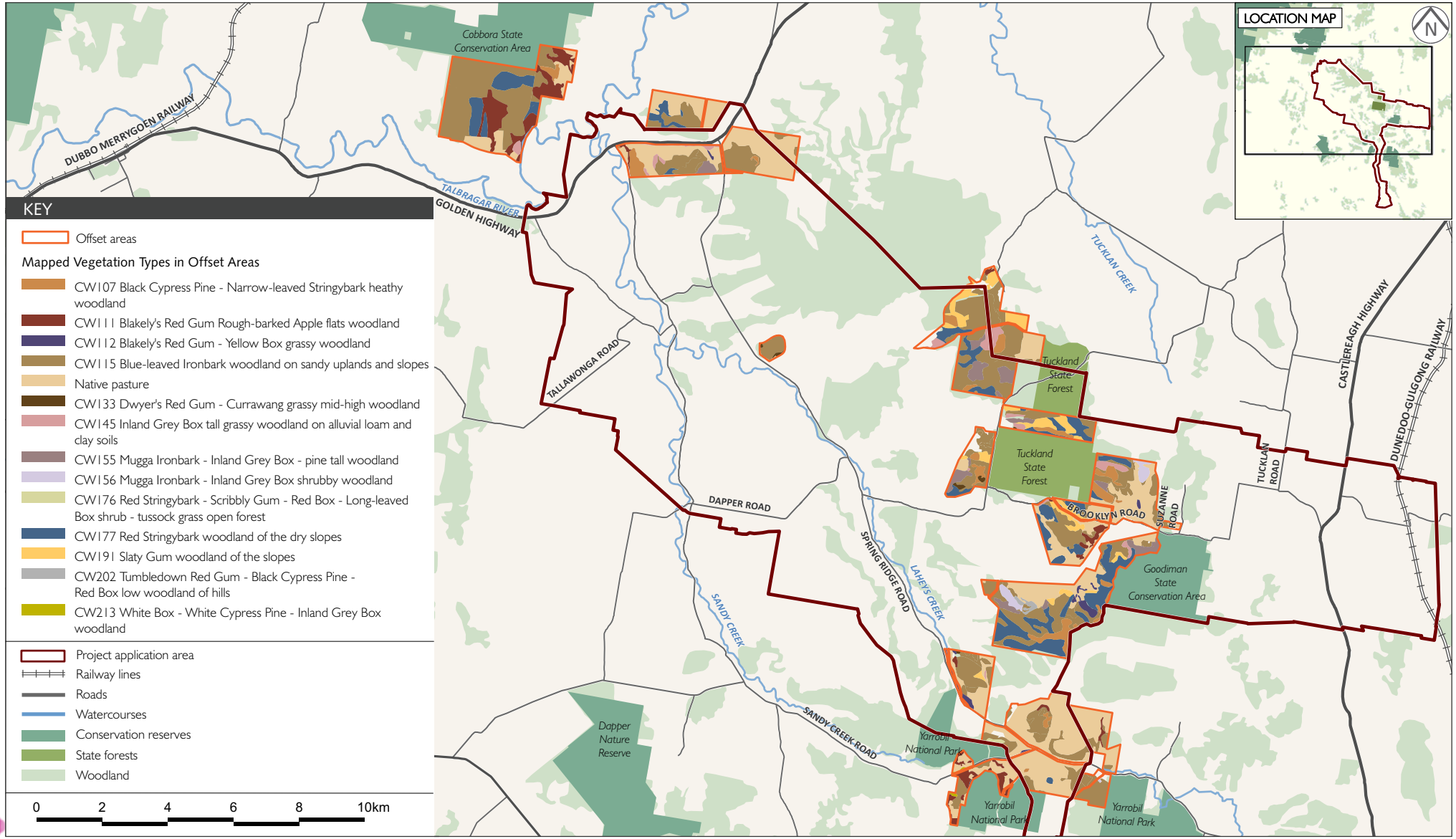
CHC is committed to aiming for a 'no net loss' outcome for red flag vegetation types and identified threatened species requiring species credits. Additional credits are required for Fuzzy Box Woodland, *Homoranthus darwinioides, Tylophora linearis*, Ingram's Zieria and Large-eared Pied Bat breeding habitat to meet this outcome.

While 5,667 ha of offset areas have been identified for inclusion into the offset package for the Project, further targeted surveys are required to confirm the presence of threatened species and their habitat in these areas. Additions to the offset package, with 1,543 ha of identified potential offset areas adjacent to the Project, are being negotiated. These unsecured areas have not been surveyed for biodiversity values but are likely to contain similar values to the existing offset areas and Project area given their location.

Should further surveys and additional offsets still not meet the requirements for red flag vegetation types and species credits, indirect offsets will be investigated and negotiated with OEH and SEWPaC or the outcomes may be reduced to a 'mitigated net loss'.

All other vegetation types, which provide habitat for other threatened species, will be offset with a 'mitigated net loss' outcome using the variation criteria in the Offset Policy. CHC is committed to a minimum offset to impact ratio of 3:1 for this vegetation. It is considered that this minimum is achievable with the proposed additions to the offset package.

Offsets will be protected using formal conservation agreements and potential dedication to the reserve network. An Offset Management Plan will be prepared to ensure biodiversity values are protected and enhanced in the offset areas. The offset package will improve the connectivity of remnant habitat within the locality. These outcomes along with rehabilitation of lower quality vegetation will result in an improvement to the quality, quantity and protection of biodiversity within the region in the medium to long term.



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EMM

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Offset Areas

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Figure 6.1

6.5 Monitoring

Monitoring allows adaptive management of the biodiversity values during the life of the Project and beyond. The aim of monitoring for the Project will be:

- to determine the effectiveness of the mitigation and offset measures within the study area and its surrounds; and
- to ameliorate and compensate potentially significant Project impacts.

A monitoring program will be prepared for the Project and detailed in the BMP. It will include requirements for monitoring diversity and abundance of terrestrial biodiversity, focusing on threatened species, populations and communities. Quantitative measurements and key triggers will be used to determine if Project mitigation measures are successful. The program will incorporate a before/after/control/impact (BACI) methodology to ensure any changes detected by the monitoring program are not a result of seasonal and stochastic events within the locality.

Ecological monitoring will be undertaken in a number of locations throughout the study area and surrounds (reference sites). This may include un-cleared areas within the final disturbance footprint during progressive clearing works, retained vegetation areas surrounding the disturbance footprint, and areas progressively rehabilitated. Monitoring would also be undertaken within the offset areas in accordance with the offset package.

7 Conclusions

The Project occurs within an agricultural region that is dominated by agricultural grazing land with large tracts of remnant vegetation on the less fertile slopes and ridges. The Project will require the removal of 967 ha of native pasture and 1,867 ha of woodland and regrowth with a total impact area of up to 4,700 ha (including 1,866 of introduced pasture and disturbed areas). This includes the removal of 12 ha of Box Gum Woodland, 13 ha of Fuzzy Box Woodland and 54 ha of Grey Box Woodland, all of which are listed as threatened ecological communities.

The overall removal of vegetation and fauna habitat is considered to be minor within the regional context, based on vegetation mapping. Woodland to be cleared represents 17% of the woodland within the PAA. This is 7% of the non-conserved woodland of the Talbragar CMA sub-region and less than 1% within the Central West CMA.

More than 1,900 ha of the disturbance area will be progressively rehabilitated over the life of the Project to woodland indicative of the vegetation types that are currently present. A further 1,700 ha of land will be returned to pasture and cropping as part of the rehabilitation strategy for the Project.

Assessments of significance were applied under section 5A of the EP&A Act as well as assessments under the EPBC Act, to determine the significance of potential impacts to threatened flora and fauna species. The Project is likely to result in significant impacts to some threatened species after mitigation. These include the plants (Ausfeld's Wattle, Ingram's Zieria, *Tylophora linearisI*), woodland birds (Barking Owl, Brown Treecreeper, Diamond Firetail, Glossy Black Cockatoo, Grey-crowned Babbler, Hooded Robin, Speckled Warbler, Masked Owl, Powerful Owl, Varied Sitella) and microbats (Large-eared Pied Bat, Little Pied Bat, Southern Long-eared Bat and Yellow-Bellied Sheathtail Bat).

Avoidance, minimisation and mitigation measures have been devised in the design phase and will be incorporated into construction and operations. Unavoidable residual impacts will be compensated through an offset package.

Consultation has been undertaken with the OEH to ensure that offsets are compatible with regional conservation priorities. High priority areas have been identified within the PAA, south of Goodiman SCA outside the disturbance areas on CHC owned properties. Significant wildlife corridors will be created in such areas by the permanent dedication of CHC lands. These areas contain known habitat for a number of threatened species and ecological communities and create links between existing conservation areas.

Offsets will be protected using formal conservation agreements and potential dedication to the reserve network. An offset management plan will be prepared to ensure biodiversity values are protected and enhanced. With the ongoing ecological management, rehabilitation works and the offset package, the Project will improve the connectivity of remnant habitat within the locality and result in an improvement to the quality, quantity and protection of biodiversity within the region.

7.1 Key threshold assessment

The Guidelines for Threatened Species Assessment (DPI and DEC, 2005) require that ecological assessments assess key thresholds. The four thresholds are discussed in the following section for the Cobbora Coal Project.

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

Potential impacts from the Project on biodiversity have been and will be avoided, minimised and mitigated through design changes, and the implementation of management plans and mitigation measures during construction and operation. Any remaining impacts will be compensated through an offset package, using the framework provided within the offset strategy (Appendix C), and negotiated with OEH and SEWPaC. The Project is likely to result in gains to biodiversity values, based on the improvement of biodiversity values within the region as a result of the offset package which would not happen in the absence of the Project.

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

The Project will progressively remove habitat for threatened fauna and threatened ecological communities within the locality, and will remove threatened flora species. The long-term viability of these species and communities could be compromised within the locality as a result. This is particularly the case for the local population of *Tylophora linearis,* which will be entirely removed for the Project. In addition, a significant proportion of Ingram's Zieria and *Homoranthus darwinioides* will be removed. While the Project includes measures to minimise and mitigate this loss, it will still result in the reduction of the long-term viability of some of the local populations of threatened species and communities. These impacts will be compensated by the offset package, which will directly target these species to maximise their long-term viability in the locality and region.

3. *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 Project may reduce the long-term viability of local populations of threatened species and communities recorded within the study area (as discussed in 2 above). This may increase the chances of local extinction of some of these species and communities in the future. However, as significant populations and areas of threatened species and their habitat occur within conservation areas of the region, some within the locality, this threat is reduced. Some populations within conservation areas such as Ingram's Zieria within Goonoo SCA, are considered to be stable and additional areas of known and potential habitat will be added to regional conservation through Project offsetting.

It is not certain if the Project will accelerate the extinction of any listed species or threatened communities or increase their risk of extinction. It is possible that the Project could make local populations more susceptible to stochastic events which could increase the risk of extinction regionally. The offset strategy aims to improve the connectivity of habitat for biodiversity in the locality to reduce this threat.

4. *Whether or not the proposal will adversely affect critical habitat?*

Critical habitat has been identified for the Box Gum Woodland TEC (under the NSW draft recovery plan), but this is not listed under the TSC Act. Critical habitat has been identified as those areas within the moderate to highly fertile soils of the western slopes of NSW (DECCW, 2010). The study area is considered to represent critical habitat for this community under this definition. Approximately 12 ha of this community will be impacted by the Project, with the fertile alluvial plains of the study area containing potential habitat. Areas of critical habitat for Box Gum Woodlands will be included within offset areas, where remnants of the community will be expanded and rehabilitated.

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