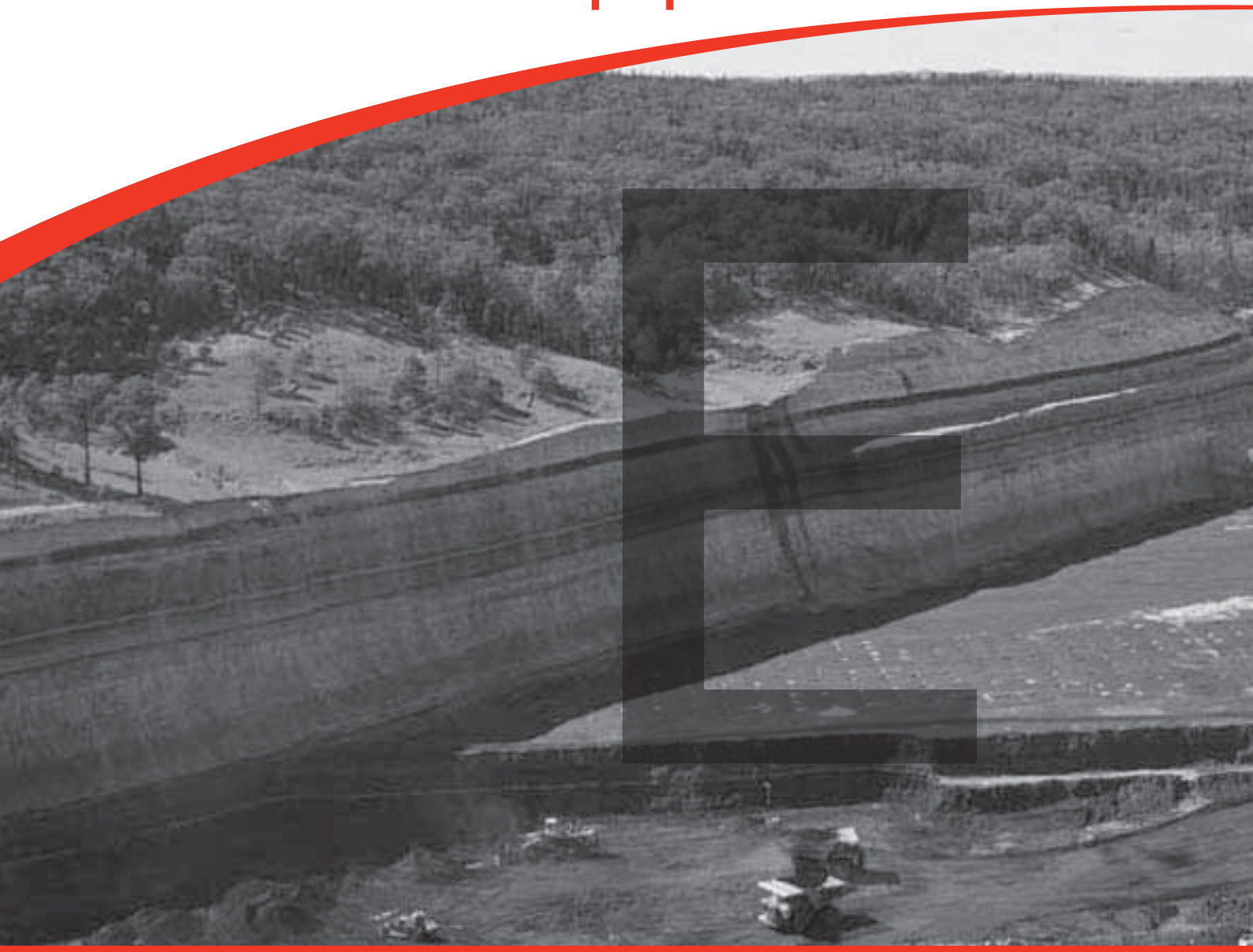
Appendix E

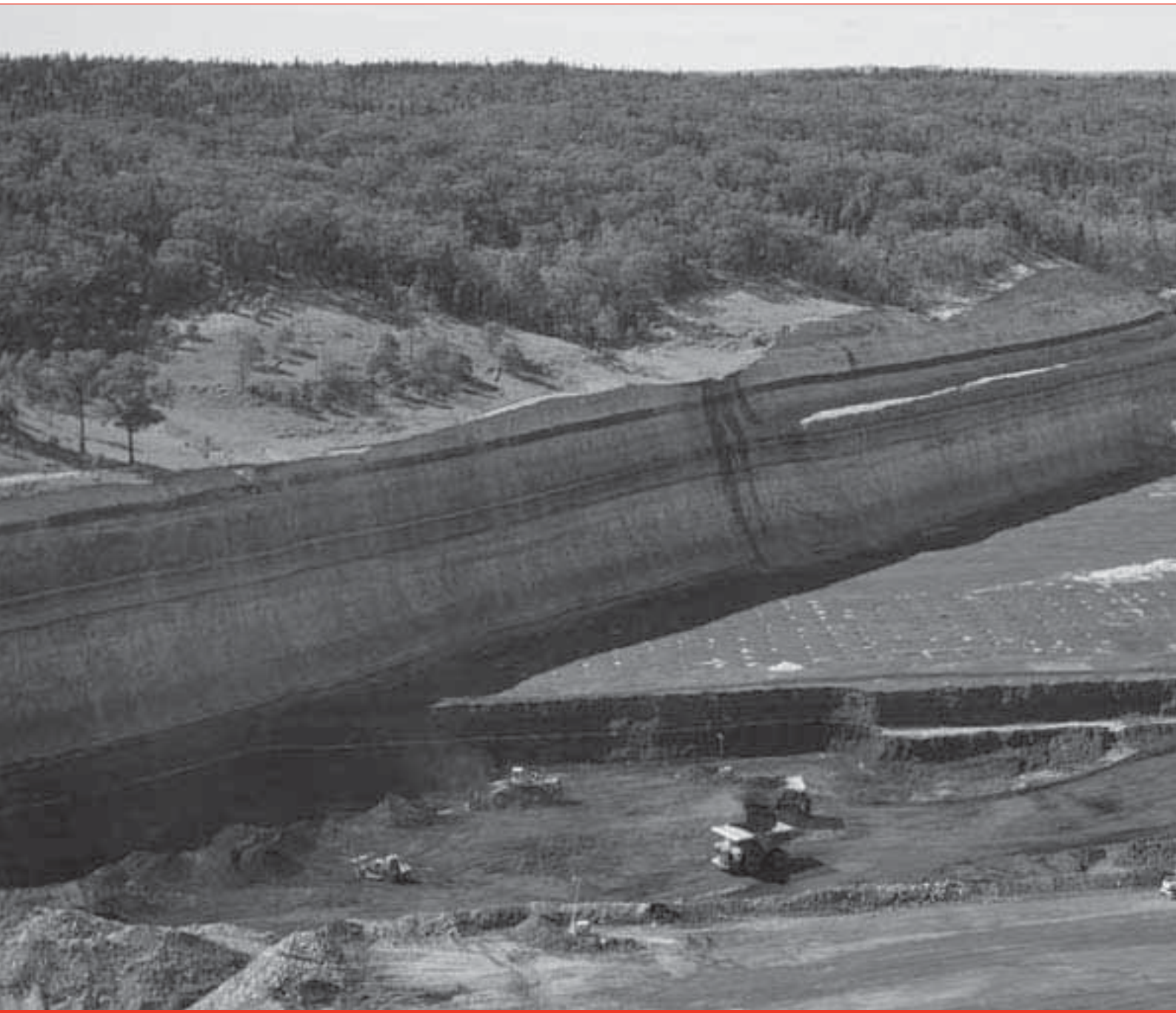


Ecological impact assessment

Moolarben Coal Project Stage 1 Optimisation Modification, Environmental Assessment – May 2013

MOOLARBENCOAL
PART OF THE YANCOAL AUSTRALIA GROUP

EMM
EMGA Mitchell McLennan



Ecological Assessment

Moolarben Coal Project - Stage 1 Optimisation Modification

Prepared for Moolarben Coal Operations Pty Limited | 13 May 2013

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

Ecological Assessment

Final

Report J12090RP3 | Prepared for Moolarben Coal Operations Pty Limited| 13 May 2013

Prepared by	**Katie Whiting**	Approved by	**Luke Stewart**
Position	Senior Ecologist	Position	Director
Signature		Signature	
Date	13 May 2013	Date	13 May 2013

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Version	Date	Prepared by	Reviewed by
1	24 February	K. Whiting	R. Baker L. Stewart
2	13 May 2013	K. Whiting	L. Stewart

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 Moolarben Coal Project (MCP) is in the Western Coalfields of NSW, approximately 40 km north-east of Mudgee. The MCP is bordered by the Goulburn River to the north-west; privately owned grazing land to the north; Goulburn River NP, Wilpinjong Coal Mine and Munghorn Gap Nature Reserve to the east; privately-owned grazing land to the south; and privately-owned grazing land, Ulan settlement and Ulan Coal Mine to the west.

The MCP, operated by Moolarben Coal Operations Pty Limited (MCO), is an approved open cut and underground coal mine comprising three open cuts, referred to as Open Cuts 1, 2 and 3, and one underground mine, referred to as Underground 4. To date, mining has occurred within Open Cut 1 only, commencing in 2010 at the south-western perimeter and progressing in a north-easterly direction.

The current disturbance limit granted under MP 05_0117 is restricting the extraction of large quantities of the deposit which are economically viable in today's market. The proposed modification will extend the disturbance boundary enabling increased resource utilisation, a longer life for Open Cuts 1 and 2 and promote the continuity of Stage 1 operations. All of the elements of the proposed modification are listed in Section 1.2.

EMGA Mitchell McLennan Pty Limited (EMM) was engaged by MCO to undertake an ecological assessment of the proposed modification. Direct disturbance areas relate exclusively to the proposed extension areas.

Based on the outcomes of the impact assessment, a biodiversity offset strategy was developed to ensure the proposed modification provides a net positive biodiversity outcome. The biodiversity offset strategy was prepared by Eco Logical Australia and is given as Appendix D and summarised in Chapter 8 of this report.

ES2 Regional context and site description

The proposed modification is in the upper west of the Hunter-Central Rivers Catchment Management Authority (CMA) area, and falls within the Kerrabee Interim Biogeographic Regionalisation for Australia (IBRA) subregion. It is located in the north-west corner of the Sydney Basin bioregion, and borders both the South Western Slopes and Brigalow Belt South Bioregions.

For the purposes of the ecological assessment, the 'study area' is bound by the proposed extension areas and additional areas comprising the riparian corridor of Moolarben Creek and vegetation directly west of the proposed extension areas (Figure 2.1). Additional areas were included within the study area to assist with identifying off-site and indirect impacts. As such, the areas of vegetation communities referenced for the study area are larger than those that will be directly disturbed by the proposed modification, as detailed in Chapter 6.

The study area ranges in elevation from 460 m above sea level (asl) along Moolarben Creek, to 560 m asl on the upper slopes of the ridgeline in the eastern part of the study area. The ridgeline extends north and south of the proposed extension areas and contains rock outcropping of sandstone, conglomerates and siltstones, forming rocky outcrops in some locations. The elevation decreases markedly to the west toward Moolarben Creek, where the land-use is predominantly cattle and sheep grazing.

Moolarben Creek is the only waterbody in the study area. It lies between approximately 100 m and over 1 km to the west of the proposed extension area.

ES3 Method

Numerous studies have been completed within the study area and surrounds. A gap analysis was undertaken to familiarise the study team with information available and allow any information gaps to be identified. The review of existing material enabled the development of the scope for field investigations and ecological risks to be identified.

An outcome of the risk assessment was the revision of the proposed extension area footprints to ensure vegetation to east was conserved and connectivity between vegetation to the north, in Goulburn River NP, and to the south, in Munghorn Gap Nature Reserve, was maintained. In addition, the mine plan was modified to ensure no disturbance of Moolarben Creek, its riparian zone or floodplain.

Vegetation types were assessed in the field using a combination of plot-based surveys and rapid assessment surveys. Vegetation type boundaries were mapped either on foot or from a vehicle using a global positioning satellite receiver, whilst referencing aerial photographs and topographic maps. Field based assessments were followed by aerial photograph interpretation and analysis using a geographic information system, to create a comprehensive vegetation map of the proposed extension areas.

Targeted searches were undertaken for threatened flora and fauna species likely to occur in the study area. This included targeted flora surveys, active reptile searches, diurnal bird timed area searches, nocturnal bird spotlighting and call broadcasting, ultrasonic detection of microbat calls, microbat harp trapping, microbat roost searches, arboreal mammal trapping, searches for tracks, scats and signs, the Koala (*Phascolarctos cinereus*) spot assessment technique and camera trapping.

ES4 Results

ES4.1 Flora and vegetation communities

Six native and one exotic vegetation type were recorded in the study area. These comprised Shrubby White Box Forest, Grassy White Box Woodland, Ridgetop Broad-leaved Ironbark – Black Cypress Pine Forest on shallow sands, Ridgetop Broad-leaved Ironbark Grey Gum Forest, Rough-barked Apple Alluvial Woodland, Rough-barked Apple – Cypress Pine Woodland on slopes, and exotic pasture. When assessed against the benchmarks for the assigned Biometric Vegetation Types, all native vegetation communities were considered to be in good condition as they fell within the benchmark values.

Of these six native vegetation communities, one meets the description of White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Nineteen individuals that were suspected to be Cannon's Stringybark (*Eucalyptus cannonii*), listed as vulnerable under both the TSC and EPBC Acts, were found in the proposed Open Cut 1 extension area. Samples were taken which were reviewed by identification botanists at the Royal Botanic Gardens in Sydney. The identification botanists concluded that the samples collected were hybrids of Cannon's Stringybark and Red Stringybark (*Eucalyptus macrorhyncha*). The hybrid is not recognised in the approved Commonwealth conservation advice (DSEWPaC 2008) or the NSW Environment Impact Assessment Guidelines (NPWS 2000). No other individuals of this species were detected in the study area.

ES4.2 Fauna

The study area contains a variety of habitat types including open forests on hillsides and ridges, footslope grassy woodlands, riparian grassy woodlands and exotic pasture. A variety of fauna habitat resources were also recorded including tree hollows, fallen timber, rocky outcrops and bushrock, dense shrubs, and flowering and fruiting plants.

Two amphibian, five reptile, 53 diurnally-active bird, three nocturnally-active bird, five arboreal and ground-dwelling mammal, 11 microbat and four pest species were recorded in the study area. A number of regionally significant fauna species were recorded comprising the Common Death Adder, Turquoise Parrot, Common Koel, Emu, Brown Treecreeper, Jacky Winter, Eastern Yellow Robin, Rufous Whistler and Diamond Firetail.

Three threatened diurnally-active birds, namely, the Brown Treecreeper, Diamond Firetail and Turquoise Parrot were recorded in the study area. The study area was also considered to contain potential habitat for a number of other threatened diurnally-active bird species, including the Regent Honeyeater.

Two threatened forest owls, the Powerful Owl and Masked Owl, were recorded in the study area, which was also considered to contain potential habitat for the Barking Owl.

No threatened non-flying mammal species were recorded in the study area, nor was evidence of their presence. Three tree species that are recognised as secondary and supplementary feed trees in the region (DECC 2008) were recorded. Habitat is considered to be limited for threatened non-flying mammals, comprising the Squirrel Glider, Spotted-tail Quoll and Koala which were not recorded during surveys.

Two threatened microbats, the Eastern Bentwing Bat and Eastern Cave Bat, were recorded in the study area, which is considered to contain potential habitat for a number of other threatened cave and tree-roosting bat species previously recorded nearby.

ES5 Impact assessment

The proposed modification will disturb 178 hectares (ha) of land, comprising 171 ha of native forest and woodland, including 17.2 ha of the White Box Yellow Box Blakely's Red Gum Woodland which is listed as endangered ecological community under the TSC Act (containing 16.5 ha of the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is listed as a critically endangered ecological community under the EPBC Act), 154.2 ha of other non-threatened native vegetation communities and 6.6 ha of cleared land or exotic pasture. The proposed modification is also likely to result in a significant impact (as defined in DECC 2007a and DEH 2006) on one threatened bird, Brown Treecreeper, and one threatened cave-roosting microbat, Eastern Cave Bat.

Two significant and limiting fauna habitat features, hollow-bearing trees and rocky outcrops, will be directly impacted by the proposed modification. Collectively, approximately 178 ha of potential threatened species habitat will be removed gradually over the life of the proposed modification.

Species such as the Black-chinned Honeyeater, Diamond Firetail, East-coast Freetail Bat, Gilbert's Whistler, Greater Broad-nosed Bat, Hooded Robin, Large-eared Pied Bat, Little Pied Bat, Masked Owl, Painted Honeyeater, Powerful Owl, Barking Owl, Regent Honeyeater, Southern Long-eared Bat, Speckled Warbler, Varied Sittella and Yellow-bellied Sheathtail Bat were observed or have the potential to occur in the proposed extension areas.

The proposed modification is also likely to result in cumulative impacts for the loss of vegetation communities, threatened flora and fauna species and benefits by adding to the regional network of offset areas managed for biodiversity outcomes.

ES6 Avoidance, mitigation and monitoring

Ecological risks were considered during the detailed mine design process. Measures to avoid adverse potential impacts are reflected in the final mine design.

The management of ecology at the MCP, including rehabilitation and offset areas, is undertaken in accordance with a Landscape Management Plan (LMP). The LMP includes a biodiversity mitigation strategy that aims to achieve a 'maintain and enhance' ecological outcome, resulting in a net positive biodiversity benefit in the post-developed landscape.

Consistent with this strategy, the proposed Open Cut 1 extension area will be principally rehabilitated to create Grassy White Box Woodlands and Broad-leaved Ironbark Forests with stands of Forest Oaks. The Box Gum Woodland mosaic will contain some areas of relatively dense tree and/or shrub cover, providing good shelter habitat and some areas of natural grassland. Species will be chosen to improve faunal biodiversity and habitat.

The majority of the proposed Open Cut 2 extension area will also be rehabilitated with native vegetation to develop habitats similar to the existing undisturbed environment. It is noted, however, that a small area in the south-western section will be restored to agricultural land, consistent with its pre-mining landuse.

Habitat resources occur outside the disturbance footprint, with abundant similar habitat available in wooded areas to the east, and in the connected corridor with Goulburn River NP to the north, which is approximately 404 times the size of the proposed extension areas, and Munghorn Gap Nature Reserve to the south of the study area, which is approximately 34 times the size of the proposed extension areas. While connectivity is being retained with these areas, proposed offset measures aim to improve the connectivity of local 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.

ES7 Offset measures

A biodiversity offset strategy and biodiversity offset package have been prepared to compensate for unavoidable residual impacts. The biodiversity offset package comprises seven strategically located properties that will be permanently protected via an appropriate conservation mechanism and managed for conservation outcomes. The biodiversity offset package accords with both NSW and Commonwealth offsetting principles and achieves a maintain or improve outcome.

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1 Introduction

1.1 Background

The Moolarben Coal Project (MCP) is an approved open cut and underground coal mine in the Western Coalfields of NSW, approximately 40 km north-east of Mudgee (Figure 1.1). EMGA Mitchell McLennan Pty Limited was engaged by Moolarben Coal Operations Pty Limited (MCO) to undertake a terrestrial ecology impact assessment for the Moolarben Coal Project – Stage 1 Optimisation Modification (proposed modification).

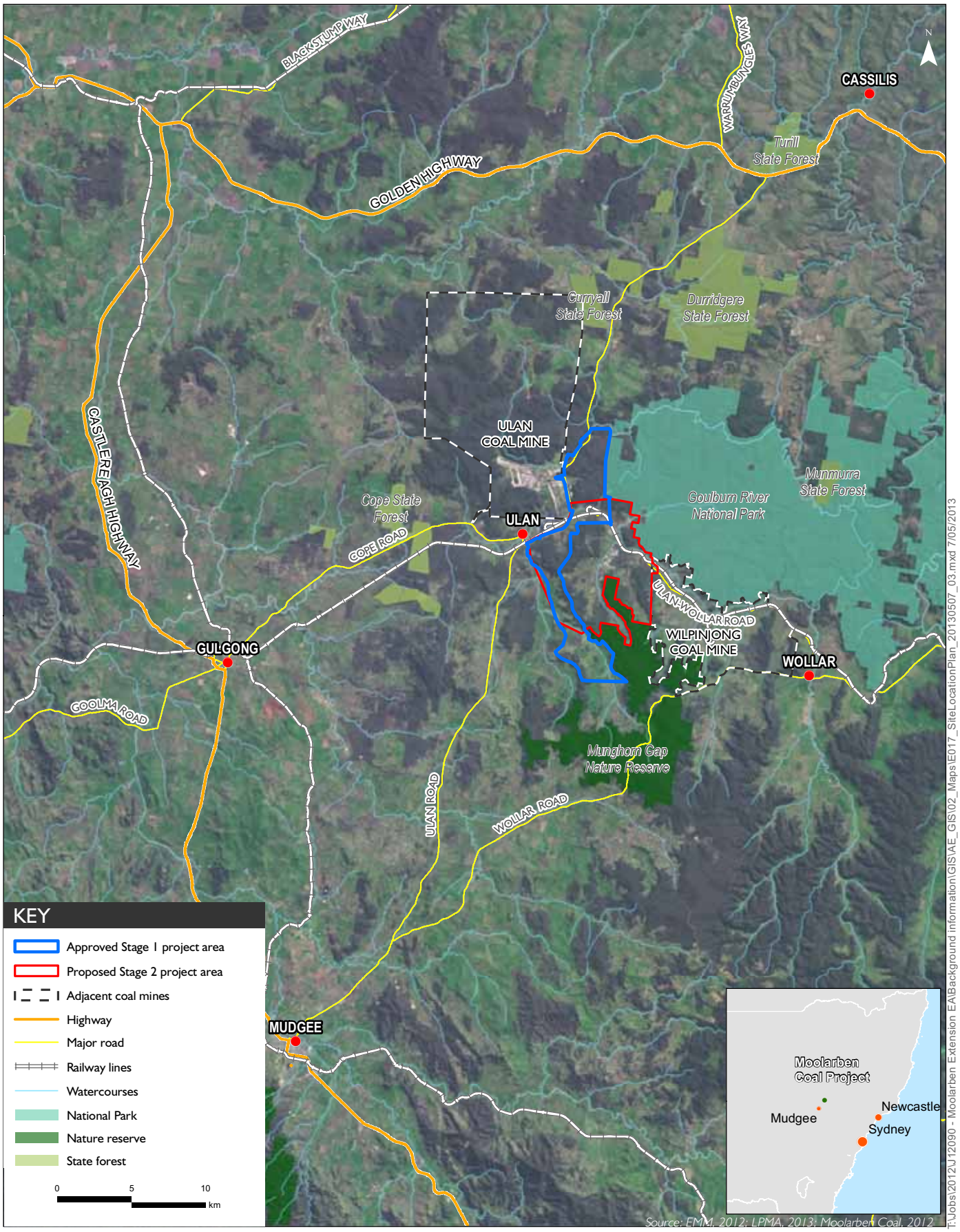
The MCP Stage 1 Major Project approval 05_0117 (MP 05_0117) was approved under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2007. Since gaining approval, MP 05_0117 has been modified on seven occasions to make administrative changes, changes to infrastructure and allow the construction of a borefield. The main components of the MCP Stage 1, as modified, comprise:

- three open cut pits, referred to as Open Cuts 1, 2 and 3, which have an approved combined maximum extraction rate of 8 million tonnes per annum (Mtpa) of run of mine (ROM) coal;
- one underground mine, referred to as Underground 4, which has an approved maximum extraction rate of 4 Mtpa of ROM coal;
- coal handling, processing, rail loop, load-out and water management infrastructure; and
- associated facilities including offices, bathhouses, workshops and fuel storages.

To date, mining has occurred within Open Cut 1 only, commencing at the south-western perimeter and progressing in a north-easterly direction.

The current disturbance limit granted under MP 05_0117 is restricting the extraction of large quantities of the deposit which are economically viable in today's market. The proposed modification will extend the disturbance boundary enabling increased resource utilisation, a longer life for Open Cuts 1 and 2 and promote the continuity of Stage 1 operations. All of the elements of the proposed modification are listed in Section 1.2.

The MCP is bordered by the Goulburn River to the north-west; privately owned grazing land to the north; Goulburn River National Park (NP), Wilpinjong Coal Mine and Munghorn Gap Nature Reserve to the east; privately-owned grazing land to the south; and privately-owned grazing land, Ulan settlement and Ulan Coal Mine to the west.



MCP location plan

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 1.1

1.2 Overview of proposed modification

The elements of the proposed modification to MP 05_0117 comprise:

- the extension of mining within Open Cuts 1 and 2;
- the construction and operation of additional water management infrastructure; and
- a minor change to the rehabilitation sequencing and final landform.

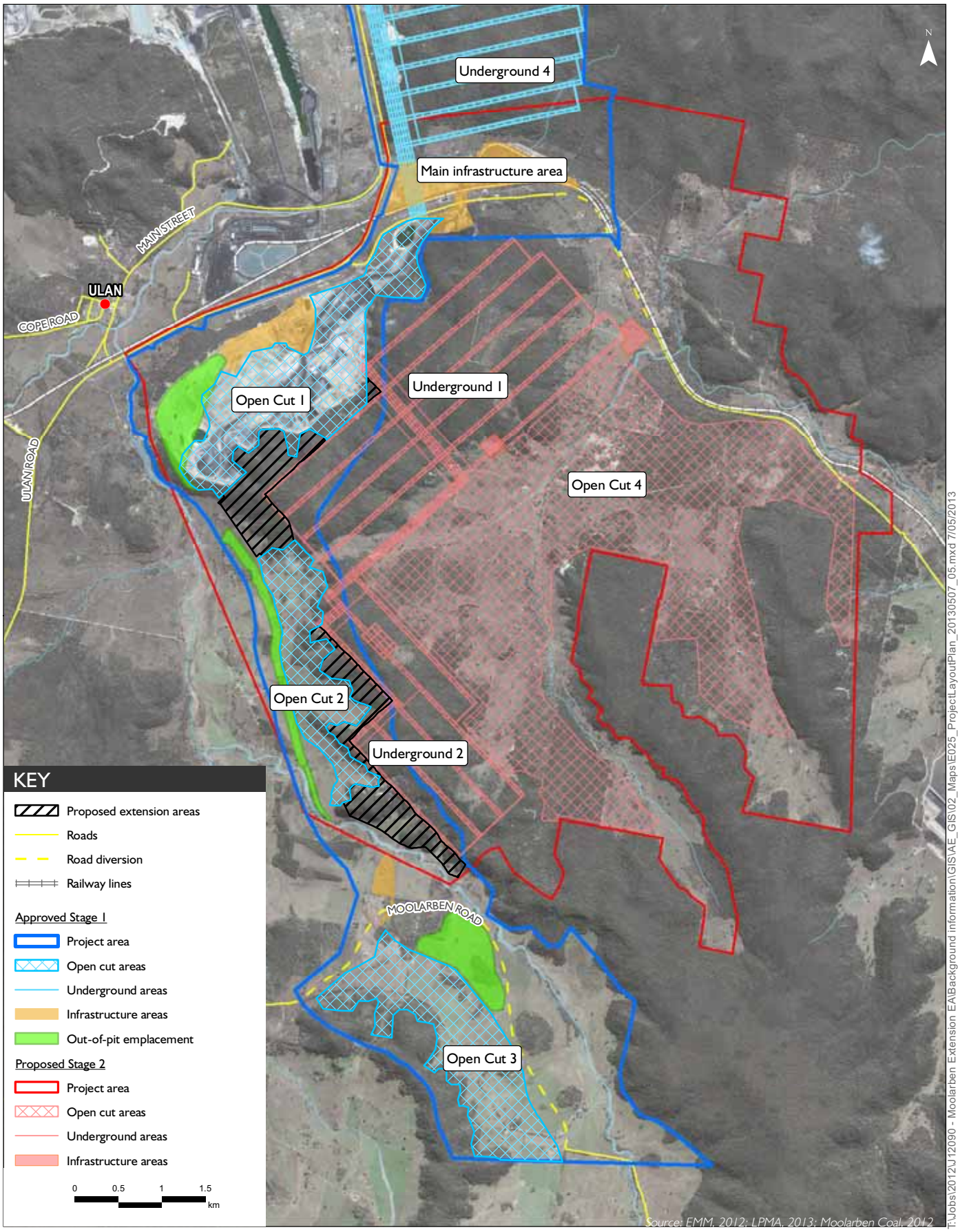
The project approval period will be extended to accommodate the proposed modification.

No other changes are proposed under the modification: there will be no change to the maximum annual rate of coal production, mining methods, equipment, manning levels, coal handling and processing, external coal transport or operating hours.

The proposed modification elements are shown in Figure 1.2. They are all within the Stage 1 project approval boundary, which forms the 'project area' for the proposed modification. Within the project area, Open Cut 1 and 2 extension areas are referred to collectively as the 'proposed extension areas'. It is noted that proposed extension areas include a disturbance buffer of up to 50 m that will enable the development of a services road and infrastructure if required, such as water pipelines. This ensures that all potential impacts associated with the proposed extension to mining have been assessed.

1.3 Relationship to other projects

A Major Project Application for Stage 2 of the MCP, MP 08_0135, is currently being assessed by the Department of Planning and Infrastructure (DP&I). If approved, Stage 2 will consist of one open cut pit, Open Cut 4, and two underground mines, Undergrounds 1 and 2, and associated additional infrastructure. This terrestrial ecology impact assessment is based on the assumption that Stage 2 of the MCP will be approved, enabling potential worst case impacts to be assessed.



Proposed modification layout plan

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 1.2

1.4 Report structure

The report is structured as follows:

- Chapter 1 Introduction: provides background information on the current approval, project location and an overview of the proposed modification;
- Chapter 2 Proposed modification context: provides an overview of existing environmental conditions and environmental legislation, policies and guidelines relevant to the ecological assessment;
- Chapter 3 Methods: details the methods used to conduct the ecological assessment;
- Chapter 4 Results: details the results of the ecological assessment;
- Chapter 5 Conservation significance: discusses the conservation significance of flora and fauna recorded in the proposed extension areas;
- Chapter 6 Impact assessment: assesses the potential impacts of the proposed modification on threatened species, populations, populations and communities;
- Chapter 7 Avoidance, mitigation and monitoring: details the proposed measures to avoid and mitigate potential impacts;
- Chapter 8 Offset measures: describes the biodiversity offset measures, proposed to provide an a positive biodiversity outcome; and
- Chapter 9 Conclusion: provides a brief summary of the key assessment outcomes and conclusion.

2 Proposed modification context

2.1 Regional context

The MCP is in the upper west of the Hunter-Central Rivers Catchment Management Authority (CMA) area, within the Kerrabee IBRA subregion. It is in the north-west corner of the Sydney Basin Bioregion, and borders both the South Western Slopes and Brigalow Belt South Bioregions (Figure 2.1).

The north-west corner of the Sydney Basin Bioregion is a transitional zone for flora species; representing plants and communities from the south-east, north-west and western parts of NSW.

2.2 Site overview

The proposed modification includes the extension of mining in the northern most pit, Open Cut 1, and the yet to be developed pit to its south, Open Cut 2. The proposed extension areas are bound by Ulan-Wollar Road in the north, a large expanse of native bushland to the east and Moolarben Creek in the south-west (Figure 2.1), which flows into the Goulburn River.

The proposed extension areas cover approximately 178 hectares (ha) and connect to large expanses of native bushland to the north, east and south. Forest and woodland cover most of the proposed extension areas, with small agricultural areas in the south-western section and three disused hard rock quarries on the western edge.

Land use practices such as previous clearing and ongoing grazing, in and adjacent to the proposed extension areas, have contributed to the decline in condition of native vegetation communities and fauna habitats. Sheep and cattle grazing to the south and the west of the proposed extension has contributed to a reduction in floristic diversity and condition of native vegetation communities and habitat condition on the western edge of the proposed extension areas.

2.2.1 Climate

The climate in the vicinity of the study area is typical of temperate regions and is characterised by hot dry summers dominated by thunderstorms, and cold winters with frequent frosts. Rainfall data collected by the Bureau of Meteorology (BoM) was obtained for Ulan Post Office which is located immediately west of the project area; and Wollar (Barrigan Street) which is 10 km to the east. The Ulan Post Office (Station No. 062036) has 101 years of rainfall data from 1906 to 2007 and the Wollar Station (Station No. 062032) has 111 years from 1901 to 2012.

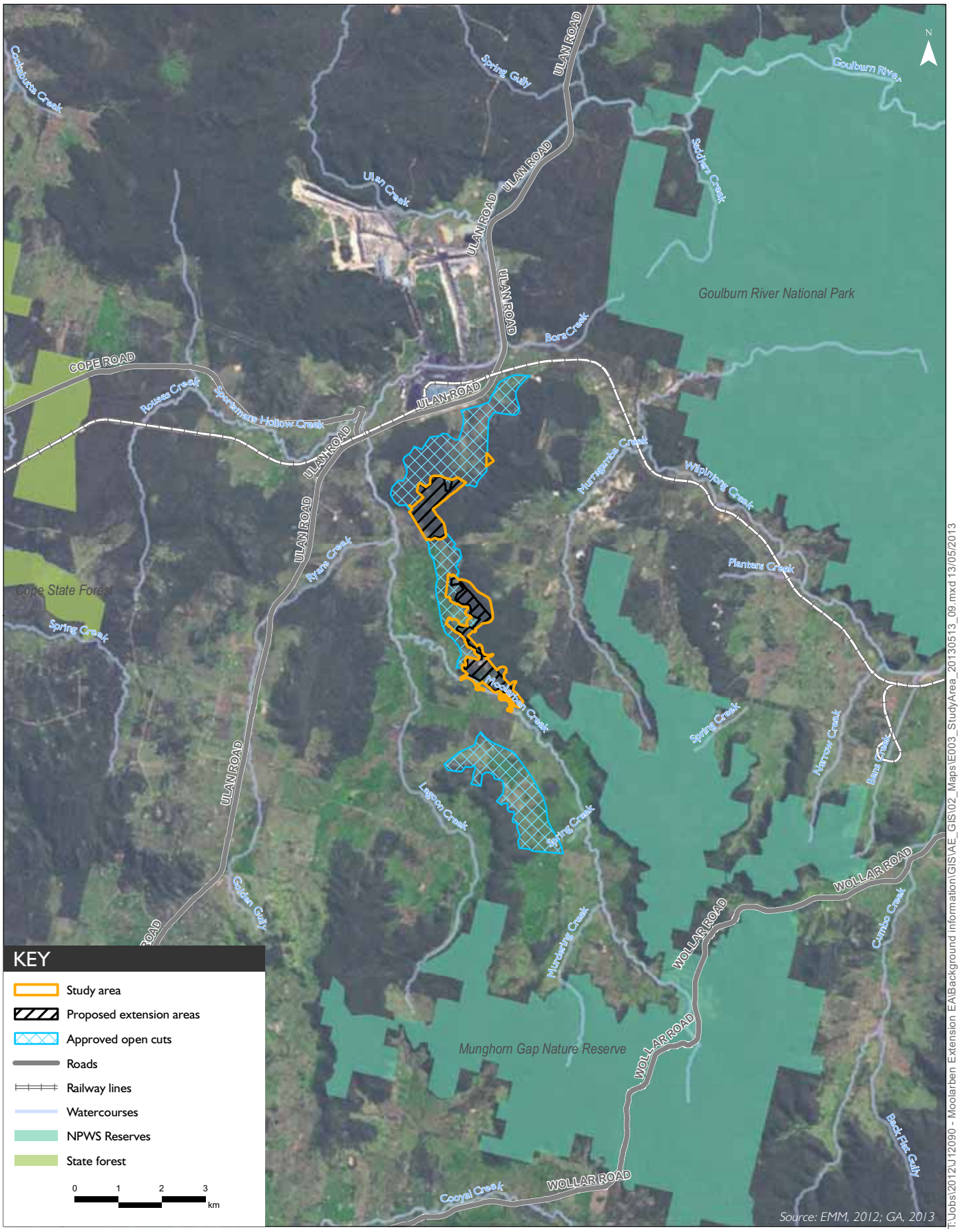
Table 2.1 presents the average rainfall from the Ulan Post Office and Wollar.

Table 2.1 Rainfall data for the study area

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ulan Post Office (1906-2007)	72.8	61.6	52.6	41.3	45.2	46	47.6	47.4	42	55.3	57.8	65.2	643.3
Wollar Station (1901-2012)	66.5	62.9	51.9	38.9	38.1	43.9	42.9	41.6	40.9	51.9	55.8	59.3	588.9

Source: Bureau of Meteorology

The average total annual rainfall is 643.3 mm at Ulan and 588.9 mm at Wollar.Table 2.1 shows that rainfall is slightly higher in summer, but relatively uniform throughout the year.



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Study area and surrounds

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 2.1

2.2.2 Topography, geology, soils and waterbodies

i Topography

The study area ranges in elevation from 460 m above sea level (asl) along Moolarben Creek, to 560 m asl on the upper slopes of the ridgeline in the eastern part of the study area. The ridgeline extends north and south of the proposed extension areas and contains rock outcropping of sandstone, conglomerates and siltstones, forming rocky outcrops in some locations. The elevation decreases markedly to the west toward Moolarben Creek, where the land-use is predominantly cattle and sheep grazing.

ii Geology and soils

The underlying geology of the study area is sedimentary with units from the Permian, containing the Illawarra Coal Measures. These units mainly consist of quartz-lithic sandstone, mudstone, claystone and coal. An overview of regional geology, soils and vegetation of the Bioregions in the study area is provided in Table 2.1.

Table 2.2 Regional description of geology, soils and vegetation

Bioregion and subregion	Geology and landforms	Soils	Vegetation
Sydney Basin Bioregion Kerrabee IBRA subregion	Triassic Narrabeen Group quartz and lithic sandstones and shales. Singleton coal measures exposed in valley floors. Numerous volcanic necks of Jurassic age and small areas of ridge top Tertiary basalt flows. Quaternary sandy alluvium in main valleys. Sandstone plateau with cliffed edges into wide valleys with sandy alluvial fill. Volcanic necks form circular depressions or low domes depending on relative erodibility of adjacent rock types.	Shallow sandy profiles, bare rock outcrop on plateaus. Sandy texture contrast soils on slopes, harsh texture contrast soils on coal measures, deep sands and loams in alluvium. Basalts have red brown structured loams and clay loams, often buried by slope debris where the volcanic necks form depressions.	Yellow Bloodwood, Broad-leaved Ironbark, Rough-barked Apple, Grey Gum with Scribbly Gum and shrubs and patches of dry heath on plateau. Rough-barked Apple, Forest Red Gum, Grey Box, White Box, Yellow Box, Fuzzy Box, with Queensland Blue Grass and three-awned spear grass in valleys. River Oak on the main streams. Volcanic necks and domes always support distinctive local vegetation, usually box species with a grassy understorey.
South Western Slopes Bioregion Upper slopes subregion	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 valley 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 woodland. Red Stringybark on upper slopes with Black Cypress Pine, Kurrajong, Red Ironbark, White Gum, White Box, Yellow Box and Blakeley's Red Gum on lower slopes.

Table 2.2 Regional description of geology, soils and vegetation

Bioregion and subregion	Geology and landforms	Soils	Vegetation
Brigalow Belt South 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.	Narrow-leaved Ironbark, White Cypress Pine, White Box on hills and slopes. Patches of Black Cypress Pine, Hill Red Gum, occasional Kurrajong and scrubby acacia in rocky outcrops. Grey Box, Yellow Box, Rough-barked Apple on valley floors. River Red Gum on larger streams and River Oak on tributaries.

Source: Morgan 2001, Morgan and Terrey 1992

The geology of the study area is shown on the *Hunter Coalfield Regional 1: 100 000 Geology Map* (Glen and Beckett 1993). The study area contains three different geological formations (Table 2.3).

Table 2.3 Geology of the study area

Map code	Era	Period	Stratigraphy	Formation	Occurrence in study area
Pi	Paleozoic	Permian – Late Carboniferous	Permian Coal Measures	Cockabutta Creek Sandstone Member	Valleys and footslopes
Rn	Mesozoic	Triassic – early Jurassic	Narrabeen Group	Siltsone/sand	Ridgelines
Tb	Cainozoic	Tertiary	Extrusion and intrusion	Basalt, tholeiite	Valley between the proposed extension areas

Source: Glen and Beckett 1993

The Munghorn Plateau and Lees Pinch soil landscapes cover much of the ridgelines of the study area, while an isolated occurrence of the Ulan Soil Landscape occurs near the proposed Open Cut 2 extension area, and a small occurrence of the Bald Hill Landscape occurs between the proposed extension areas (Jammel Environmental and Planning Services 2006). The landform characteristics, lithology, typical soils and limitations of these landscapes are summarised in Table 2.4 (adapted from Murphy and Lawrie 1998).

Table 2.4 Regional soil landscapes intersecting the study area

Landscape	Landform	Lithology	Typical Soils	Limitations
Ulan	Low undulating rises and creek flats. Elevations between 360-570 m. Slopes between 2-10%. Local relief varies between 10-40 m.	Undifferentiated and Illawarra Coal Measures Shale, sandstone, conglomerate, chert, coal and torbanite.	Yellow podzolic, Yellow Solodic /solonetz, yellow and brown earths, and earthy sands.	Moderate to high erosion hazard and susceptible to soil structure degradation. Imperfectly drained on the lower slopes and depressions. High soil salinity levels and low soil fertility.
Lees Pinch	Sandstone plateau and hill slopes with boulder debris. Elevations between 400- 680 m. Slopes between 15-40%. Local relief from 60-240m.	Narrabeen Group and Illawarra Coal Measures Sandstone, Wollar sandstone, conglomeratic sandstone, chert, shale coal, torbanite.	Shallow siliceous sands, shallow acid soils, yellow earths, yellow podzolic soils.	Steep slopes are high erosion hazard when cover is low. Very low fertility, acidic surface soils. Low to very low water holding capacity and high permeability.
Munghorn Plateau	Low undulating hills form plateaux from 600 – 700 m. Slopes from 3 – 10% and local relief varies from 20 – 60 m.	Narrabeen Group and Illawarra Coal Measures Sandstone, Wollar sandstone, conglomeratic sandstone, chert, shale coal, torbanite.	Shallow siliceous sands, shallow acid soils, yellow earths, yellow podzolic soils.	High to very high erosion hazard when ground cover is low. Low soil fertility and low water holding capacity.
Bald Hill	Low hillocks with elevations from 460 – 600 m. Slopes 10-35%. Local Relief from 60 – 120 m. Drainage lines are 300 – 500 m apart.	Tertiary Basalt, Olivine basalt, dolerite, teschenite.	Euchrozems – chocolate soils Intergrades, Chocolate soils.	Steep slopes with rock outcrops; stoniness; moderate to high fertility and water holding capacity.

iii Waterbodies

Moolarben Creek is the only waterbody in the study area. It lies between 100 m and over 1 km to the west of the proposed extension areas (see Figure 1.2). It is a narrow creek that flows north into the Goulburn River.

2.2.3 Protected areas

Two areas protected under the NSW *National Parks and Wildlife Act 1974* (NPW Act) occur in proximity to the study area (Figure 2.1). These are Goulburn River NP, covering an area of approximately 72,000 ha, and Munghorn Gap Nature Reserve, covering an area of approximately 6,000 ha.

Cope State Forest (SF) and Durridgere SF are located approximately 8 km west and 16 km north-east of the project area, respectively. These are the only areas reserved under the *Forestry Act 1916* in close proximity (Figure 2.1).

2.3 Legislation

2.3.1 Threatened Species Conservation Act 1995

The NSW *Threatened Species Conservation Act 1995* (TSC Act) is administered by the NSW Office of Environment and Heritage (OEH). The Act aims to manage terrestrial threatened species, populations and ecological communities.

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 proposed modification on threatened species, populations and ecological communities are considered in detail in Chapter 6 of this ecological assessment.

2.3.2 Environment Protection and Biodiversity Conservation Act

The *Environment Protection and Biodiversity Conservation Act 1999* (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 EPBC 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 MNES;
- 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 MNES relevant to the proposed modification are:

- listed threatened species and communities; and
- listed migratory species.

The potential impacts of the proposed modification on threatened species, communities and migratory species are considered in detail in Chapter 6 of this ecological assessment.

2.3.3 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.

2.3.4 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 Guidelines: The assessment of significance* (DECC 2007a) (the guidelines), provide assistance with interpreting and applying the factors of assessment. The aim of the guideline 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 proposed modification. The assessments of significance within this ecological assessment have been undertaken in accordance with these guidelines.

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

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

- potential Koala habitat - areas of native vegetation where the trees of the types listed in Schedule 2 of SEPP 44 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 5.4.1 addresses the likelihood that Koalas or their habitat are present within the study area.

2.3.6 Groundwater Dependent Ecosystems Policy

The Groundwater Dependent Ecosystems Policy (DLWC 2002) 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.

No impacts on groundwater dependent ecosystems are expected from the proposed modification. This is further discussed in Section 6.1.3v.

2.3.7 EPBC Act Policy Statement 1.2: Significant Impact Guidelines

The EPBC Act *Policy 1.2: Significant Impact Guidelines* (DEH 2006) provides assistance in determining if an action should be referred to the Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC) for a decision by the Minister for SEWPaC on whether assessment and approval is required under the EPBC Act. These guidelines were used to assess potential impacts to MNES.

3 Methods

3.1 Overview

The following tasks were undertaken to investigate biodiversity and the likely ecological impacts associated with the proposed modification:

- literature and database review;
- gap analysis and risk assessment;
- terrestrial flora surveys;
- terrestrial fauna surveys; and
- impact assessment.

3.2 Guidelines

The field investigations were conducted in accordance with the NSW *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005). The guidelines were complemented by information from threatened species profiles, and the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - working draft* (DEC 2004a). Plot and transect surveys were carried out in accordance with Section 3.5.1 of the *Biobanking Assessment Methodology* (DECC 2008b).

Where appropriate and available for the investigations, the SEWPaC threatened species survey guidelines were also used.

The survey was generally conducted in accordance with the following guidelines:

- *Spot assessment technique* (Phillips and Callaghan 2011);
- *Survey guidelines for Australia's threatened birds* (SEWPaC 2011a);
- *Survey guidelines for Australia's threatened mammals* (SEWPaC 2011b); and
- *Survey guidelines for Australia's threatened reptiles* (SEWPaC 2011c).

3.3 Literature and database review

Relevant literature and databases were reviewed to compile a list of threatened species, populations and communities likely to occur in the study area. Material reviewed comprised:

- *Moolarben Coal Project Flora, Fauna and Aquatic Ecology Assessment* (Moolarben Biota 2006);
- *Moolarben Coal Project Stage 2 Ecological Impact Assessment* (Ecovision Consulting 2008);
- *Moolarben Coal Flora and Fauna Monitoring 2011/2012 Summary* (EcoLogical 2012);
- *Ulan Coal Mine Continued Operations Environmental Assessment* (Umwelt 2009);

- *Wilpinjong Coal Project Terrestrial Fauna Assessment* (Mount King Ecological Surveys 2005);
- *Bird list for Munghorn Gap Nature Reserve* (Eremaea Birds 2012);
- *Goulburn River National Park and Munghorn Gap Nature Reserve Plan of Management* (NPWS 2003);
- *Protected Matters Search Tool* (SEWPaC 2012a);
- *NSW Wildlife Atlas Database for threatened species of the Gulgong 1:100,000 map sheet* (OEH 2012a);
- *Threatened species profiles for the Hunter-Central Rivers CMA* (OEH 2012b);
- *Species Profiles and Threats (SPRAT) Database* (SEWPaC 2012b);
- *PlantNET – the Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney* (RBGDT 2012), which included a database search for ROTAP species; and
- *Atlas of Living Australia* (Australian Government 2012).

Table 3.1 provides a list of these rare and threatened species, populations and communities identified through the literature and database review as having the potential to occur in the study area. It also includes an overview of survey methods and optimal timing for their detection. Following an initial scoping assessment in which the presence of suitable habitat was assessed, species deemed unlikely to occur were excluded from further analysis (see Appendix A). Targeted surveys were then formulated to detect species with the potential to occur in the study area.

Table 3.1 Survey requirements for threatened species, populations and communities

Threatened biodiversity	Status			Survey method	Survey timing requirements
	TSC Act	EPBC Act	ROTAP		
Ecological communities					
White Box Yellow Box Blakely's Red Gum Woodland	E	CE	-	Quadrats, transects and rapid vegetation assessments	Year round
Plant species					
Cannon's Stringybark (*Eucalyptus cannonii*)	V	V		Targeted threatened flora search	Year round
Hoary Sunray (*Leucochrysum albicans* var. *tricolor*)	-	E		Timed area search, targeted search	Year round, easiest to detect when flowering (spring/summer)
Pine Donkey Orchid (*Diuris tricolor)*	V	-		Targeted threatened flora search	September to October (only detectable when flowering)
Pseudanthus divaricatissimus	-	-	3RCa		Year round, easiest to detect when flowering (spring)
Scant Pomaderris (*Pomaderris queenslandica*)	E	-		Targeted threatened flora search	Year round, flowers desirable for identification (spring-summer)
Silky Swainson Pea (*Swainsona sericea*)	V	-		Targeted threatened flora search	Spring

Table 3.1 Survey requirements for threatened species, populations and communities

Threatened biodiversity	Status			Survey method	Survey timing requirements
	TSC Act	EPBC Act	ROTAP		
Ecological communities					
Cymbidium canaliculatum population in the Hunter Catchment	E	-		Targeted threatened flora search	Year round
River Red Gum (*E. camaldulensis*) population in the Hunter Catchment	E	-		Targeted threatened flora search	Year round (easiest when buds and fruits are present)
Reptiles					
Broad-headed Snake (*Hoplocephalus bitorquatus*)	V	-	-	Spotlighting hollow trees (summer) and searches under rocks (winter)	Year round
Little Whip Snake (*Suta flagellum*)	V	-	-	Searches under rocks and ground debris	September to May
Pink-tailed Worm Lizard (*Aprasia parapulchella*)	V	V	-	Targeted ground habitat search (rock rolling)	September to February
Birds					
Barking Owl (*Ninox connivens*)	V	-	-	Call playback, spotlighting, stag watching, searches for pellets and owl wash	Year round
Black-breasted Buzzard (*Hamirostra meanosternon*)	V	-	-	Timed area search, targeted search	Year round
Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)	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 multicolor*)	V	-	-	Timed area search, targeted search	Year round
Gang Gang Cockatoo (*Callocephalon*	V	-	-	Timed area search, targeted search	Year round

Table 3.1 Survey requirements for threatened species, populations and communities

Threatened biodiversity	Status			Survey method	Survey timing requirements
	TSC Act	EPBC Act	ROTAP		
fimbriatum)					
Gilbert's Whistler (*Pachycephala inornata*)	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
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
Powerful Owl (*Ninox strenua*)	V	-	-	Call playback, spotlighting, stag watching, searches for pellets and owl wash	Year round
Rainbow Bee-eater (*Merops ornatus*)	-	Mi	-	Timed area search, targeted search	Year round
Regent Honeyeater (*Anthochaera phrygia*)	CE	E, Mi	-	Timed area search, targeted search	Late autumn to early spring
Rufous Fantail (*Rhipidura rufifrons*)	-	Mi	-	Timed area search, targeted search	Year round
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
Swift Parrot (*Lathamus discolor*)	E	E	-	Timed area search, targeted search	Winter

Table 3.1 Survey requirements for threatened species, populations and communities

Threatened biodiversity	Status			Survey method	Survey timing requirements
	TSC Act	EPBC Act	ROTAP		
Turquoise Parrot (*Neophema pulchella*)	V	-	-	Timed area search, targeted search	Year round
Varied Sittella (*Daphoenositta chrysoptera*)	V	-	-	Timed area search, targeted search	Year round
Mammals					
Brush-tailed Rock Wallaby (*Petrogale penicillata*)	E	E	-	Spotlighting, baited infrared camera	Year round
Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)	V	-	-	Ultrasonic detection, harp trapping	October to March
Eastern Cave Bat (*Vespadelus troughtoni*)	V	-	-	Ultrasonic detection, harp trapping	October to March
East-coast Freetail Bat (*Mormopterus norfolkensis*)	V	-	-	Ultrasonic detection, harp trapping	October to March
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V	-	-	Spotlighting, baited infrared camera	Year round
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V	-	-	Ultrasonic detection, harp trapping	October to March
Koala (*Phascolarctos cinereus*)	V	V	-	Spotlighting, call playback, searches for scats and scratches	Year round
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	V	-	Ultrasonic detection, harp trapping, searches for roosts in sandstone overhangs	October to March
Little Bentwing Bat (*Miniopterus australis*)	V	-	-	Ultrasonic detection, harp trapping, searches for roosts in sandstone overhangs	October to March
Little Pied Bat (*Chalinolobus picatus*)	V	-	-	Ultrasonic detection, harp trapping, searches for roosts in cliff crevices	October to March
Southern Long-eared Bat (*Nyctophilus corbeni*)	V	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

Table 3.1 Survey requirements for threatened species, populations and communities

Threatened biodiversity	Status			Survey method	Survey timing requirements
	TSC Act	EPBC Act	ROTAP		
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V	-	-	Ultrasonic 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, Mi - migratory*

2. IR – infrared

3. ROTAP – Rare or Threatened Australian Plan

4. 3RCa – ROTAP with geographic range greater than 100 km, rare, population adequately reserved.

5. Source for survey timing requirements: DECC 2009; DEC 2004, SEWPaC 2011a-2011c

6. Following this table, threatened fauna species are referred to by common name only.

3.4 Gap analysis and risk assessment

As demonstrated in Section 3.3, many studies have been completed within the study area and surrounds. A gap analysis was undertaken to familiarise the study team with information available and allow any information gaps to be identified and an ecological risk assessment to be completed.

As an outcome of the risk assessment, the mine design was modified to ensure no disturbance of Moolarben Creek, its riparian zone or floodplain and connectivity was maintained between vegetated areas to north and south of the proposed extension areas.

The review of existing material enabled the development of the scope for field investigations. 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 then formulated to detect species with the potential to occur in the study area.

Although the entirety of the study area was previously surveyed by Moolarben Biota (2006) when Stage 1 of the MCP was assessed, it was determined that additional surveys were required due to the time elapsed, and the changes to vegetation and fauna habitat use that may have occurred within this timeframe (for example, as an outcome of indirect impacts from the clearing associated with Open Cut 1). Further, the Moolarben Biota (2006) study area was much larger than that for the proposed modification and, therefore, a lower level of survey effort was dedicated to the proposed extension areas. Accordingly, additional surveys were also required to confirm and refine the results of Moolarben Biota's 2006 study.

3.5 Flora survey methods

3.5.1 Vegetation mapping review

Existing vegetation mapping and databases were reviewed to provide information on the vegetation communities previously recorded or likely to occur in the study area. Table 3.2 provides a summary of information reviewed and data obtained for the proposed extension areas.

Table 3.2 Information reviewed and data obtained

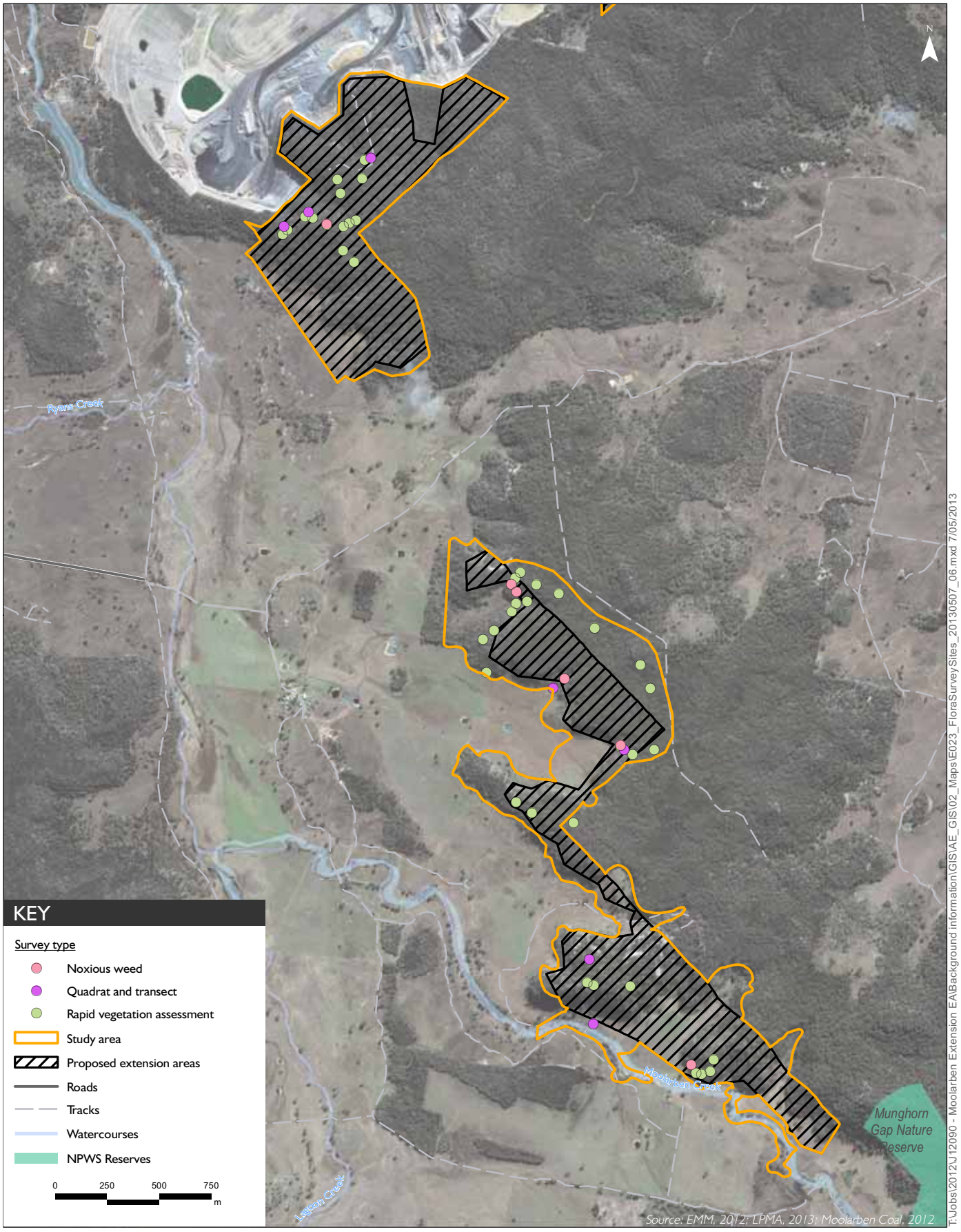
Source	Data obtained	Relevance to the proposed modification
Moolarben Coal Project Flora, Fauna and Aquatic Ecology Assessment (Moolarben Biota 2006)	Vegetation mapping and GIS layers Species lists from plot surveys and rapid assessments	Vegetation mapping and data incorporated into EMM mapping and vegetation type assessments
Moolarben Coal Project Stage 2 Ecological Impact Assessment (Ecovision Consulting 2008)	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 Naming of vegetation types adopted where relevant
Hunter, Central and Lower North Coast Vegetation Classification and Mapping project (Somerville 2009a and 2009b)	Vegetation mapping and GIS layers	Preparation for field mapping within the study area, vegetation type classification for broad scale mapping
The Vegetation of the Central Hunter Valley, NSW (Peake 2006)	Vegetation mapping and GIS layers	Vegetation type classifications
Biometric Vegetation Types (DECC 2008a)	Vegetation types by CMA region	Vegetation of the study area assigned to Biometric type

3.5.2 Vegetation type mapping

Vegetation types were assessed in the field using a combination of plot-based surveys (see Section 3.5.3) 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 proposed extension areas. Figure 3.1 shows the flora survey locations.

Vegetation types identified within the study area were compared to the NSW Biometric Vegetation Types Database (DECC 2008a), Somerville (2009a and b) and vegetation types identified in Ecovision Consulting (2008). This comparison provided an appreciation of the extent and distribution of the vegetation types within the locality and region.

The proposed modification was surveyed in summer 2012, after a wet winter and dry spring. Due to the dry conditions, no significant flowering events occurred. The dry climate experienced during the survey is representative of monthly averages for the area.



Flora survey locations

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 3.1

3.5.3 Plot-based surveys

Eight plot (20 x 20 m) and transect (50 m) surveys were undertaken in accordance with Section 3.5.1 of the *Biobanking Assessment Methodology* (DECC 2008b). Site attributes recorded in the plots and transects included:

- native plant species richness;
- percent cover of the native canopy, mid-storey and understorey;
- exotic plant cover;
- the number of trees with hollows;
- regeneration of canopy species; and
- the total length of fallen logs.

The number of quadrats to be completed was determined through stratification using existing vegetation mapping for the area.

3.5.4 Rapid vegetation assessments

Rapid assessments were undertaken at 42 locations across the study area (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.

3.5.5 Threatened ecological community identification

Vegetation plot data and rapid assessment data were reviewed against the State and Commonwealth descriptions of threatened ecological communities (TECs) known from the region to determine their presence in the study area. A comparison was also undertaken with published TEC species lists, habitat descriptions and distributions, and published identification guidelines.

3.5.6 Targeted threatened flora searches

Targeted searches for threatened flora (listed under the TSC Act and/or the EPBC Act) were undertaken within suitable habitats of the study area using the random meander method in suitable habitat. Targeted searches were undertaken at all flora survey locations shown in Figure 3.1. 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 Figure 3.1. Where a rare or threatened species was recorded, 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 Fauna survey methods

3.6.1 Fauna habitat assessment

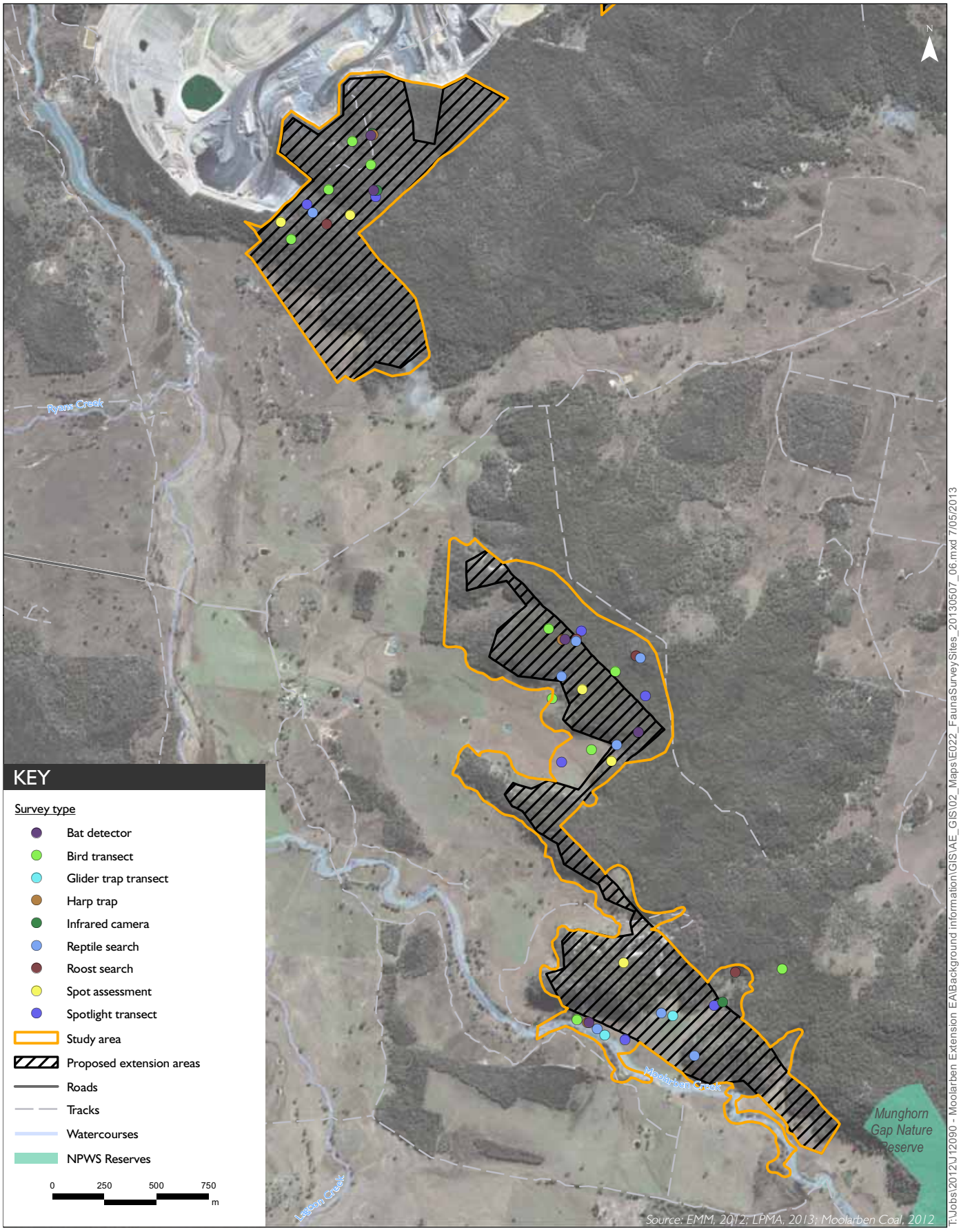
An assessment of fauna habitat types and habitat condition was undertaken to determine appropriate locations for targeted sampling of fauna species. Specific habitat features that were searched for included:

- 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 feed trees;
- chewed She-oak (*Allocasuarina spp*.) or Cypress Pine (*Callitris 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 shows the locations and the types of fauna surveys undertaken.

3.6.2 Active reptile searches

Active reptile searches were targeted to reptile habitats including rocky outcrops and creeks. Searches were conducted between 9:00 – 11:00 over six days to increase the likelihood of detection of different reptile species. Observations were made on rocky outcrops and along creeks by searching for basking reptiles. Rocks and fallen timber were also turned over to search for burrowing or resting reptiles. On warm nights, basking reptiles were surveyed by spotlighting large trees and dirt tracks. Identification of species was made in the field and taxonomy was as per Wilson and Swan (2010). The total reptile survey effort was 24 person hours.



Fauna survey locations

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 3.2

3.6.3 Bird surveys

i Diurnal bird timed area search

Timed searches, each being 20 minutes in duration, were used to survey diurnal (day active) birds. 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 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 in Figure 3.2. The total survey effort for diurnal birds was eight person hours.

ii Nocturnal bird spotlighting and call broadcasting

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 during the survey period). Call broadcasting for threatened owl species was also conducted. The total survey effort for nocturnal birds was 30 person hours.

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. The total survey effort for fauna signs was over 80 person hours.

3.6.4 Microbat surveys

i Ultrasonic detection

Echolocation calls of microchiropteran bats were recorded within representative habitat in the study area. Calls were recorded over the entire night using Wildlife Acoustics SM2Bat detectors. Detectors were located adjacent to harp traps where possible (or nearby rock outcropping) and were placed in a total of eight areas for four nights in each location (Figure 3.2).

Microbat sonograms were viewed in 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 Surveys) who has an extensive local reference library of calls from Ulan, and *The Bat Calls of NSW: Region based guide to the echolocation calls of Microchiropteran bats* (Pennay, Law and Reinhold 2004).

ii Harp trapping

Harp traps were placed at eight locations over four nights (Figure 3.2). 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. The total number of trap nights was 32.

iii Roost searches

Surveys targeting cave dwelling bat species were undertaken in rocky outcrops. Scat searches were undertaken in caves and rocky outcrops, and SM2Bat detectors were placed to try to identify the roosting species.

3.6.5 Arboreal and ground-dwelling mammals

i Arboreal Elliott trapping

Forty B-Elliott traps were installed at 1.8 m height on trees to target the Squirrel Glider (*Petaurus norfolcensis*) and other arboreal mammals. Traps were baited with a mixture of oats, honey and peanut butter, and trees were sprayed with a honey and water mixture to attract fauna. The total number of trap nights was 160 trap nights.

Local materials (leaves and/or grasses) were placed as bedding on the floor of the trap, and waterproof bags were placed on the end of the trap to protect captured animals against heat, cold and rain. Traps were installed on the western side of the tree to prevent captured animals overheating in the morning sun. Trap checking commenced at 6:00 am and was completed no later than 8:00 am.

ii 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 six nights. Where possible, nights with rainfall and greater moon influence were avoided as they are known to affect spotlight success (DEC 2004a).

iii 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. A total of over 80 person hours were spent searching for tracks, scats and signs.

iv Spot assessment technique

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 assess the presence and activity level of Koalas in the study area.

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 five person hours were spent searching for habitat signs, specifically Koala pellets, over the survey period.

In accordance with SEPP 44, areas were identified as potential Koala habitat where feed trees listed in 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.

Potential feed trees identified in the study area include Grey Gum (*E. punctata*)and Narrow-leaved Stringybark (*E. sparsifolia*) (DECC 2008c and SEPP 44).

v Camera traps

Two motion-sensitive infrared (IR) and white light cameras were placed for two nights at eight sites during the survey. The camera traps were baited with a sponge soaked in honey and truffle oil, targeting ground-based carnivores and omnivores. Cameras were positioned in identified fauna runways, often in gullies or in areas where water was available. The total number of camera trap nights was 64, and locations are shown on Figure 3.2.

3.7 Survey effort summary

A summary of all survey methods, survey effort (ie number of hours spent surveying and number of plots surveyed) and survey timing for the proposed modification is provided in Table 3.3.

Table 3.3 Summary of survey effort

Taxa group	Survey method	Total survey effort
Flora		
	Plot and transect surveys	7 plots and 7 transects
	Rapid vegetation assessments	42 points
	Targeted threatened flora searches	80 person hours
Fauna		
General	Habitat assessments and searches for signs	Over 80 person hours
Reptiles	Active search	24 person hours
	Nocturnal search	48 person hours
Birds	Timed diurnal search	8 search areas (20-60 minutes per search)
Microchiropteran bats	Anabat detection	32 detector nights
	Harp trapping	32 trap nights
	Koala spot assessment	5 person hours
	Infrared camera surveys	64 trap nights
Arboreal mammal trapping	Arboreal B Elliott traps	160 trap nights
Koala	Spot assessment technique	5 person hours
Nocturnal birds and mammals	Call broadcasting and spotlighting	30 person hours

3.7.1 Limitations

The survey effort, design and timing targeted the threatened species considered likely to occur in 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), in accordance with the precautionary principle. However, this was only applied if surveys were undertaken outside the season of optimal detection. If habitat was present for such species, along with recent nearby records from the extensive surveys that have occurred in the locality, it was conservatively assumed that such species may occur in the study area.

i Flora

Vegetation surveys and threatened flora searches were undertaken using Sivertsen (2009) *Native Vegetation Interim Type Standard* and *Draft Threatened Biodiversity Survey and Assessment: Guidelines* (DEC 2004b). The number of plots surveyed complied with requirements according to site stratification using existing vegetation mapping, however did not apply when retrofitted to actual vegetation communities mapped in the study area.

A rigorous approach was applied in reassessing the study area, as the proposed extension areas have been surveyed in their entirety. Quadrat data for the Stage 1 and Stage 2 project environmental assessments (EA) (Moolarben Biota 2006; Ecovision Consulting 2008) were used to supplement the range of condition and structure of vegetation communities. A high number of rapid vegetation assessments (42) were also undertaken. Therefore, it is considered that the flora survey effort was comprehensive.

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.

Surveys were conducted after the flowering period (September to November) of the Pine Donkey Orchid. Using the precautionary principle, the presence of this species was assumed where suitable habitat was recorded.

ii Fauna

Surveys were conducted in summer 2012, outside the survey season for birds that may occupy the study area in winter. These include the Gang-gang Cockatoo, Flame Robin, Swift Parrot and Regent Honeyeater. The Gang-gang Cockatoo was previously recorded by Moolarben Biota (2006), and is therefore conservatively assumed to be present in the study area during winter. The Flame Robin, Swift Parrot and Regent Honeyeater were not recorded by Moolarben Biota (2006), and is therefore assumed they potentially occur in the study area.

3.7.2 Naming conventions

Naming conventions for each group targeted are shown in Table 3.4. While the nomenclature for many groups is relatively straightforward (ie flora, birds), some species of bat 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 recorded in the study area is referred to as the Southern Long-eared Bat (*Nyctophilus corbeni*). Nomenclature for this species within the report is consistent with the SEWPaC description for this threatened species.

Table 3.4 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 (OEH 2012b) and Churchill (1998) (with the exception of *N.corbeni* as discussed above which is based on Parnaby (2008))
Mammals	Menkhorst and Knight (2004)

4 Results

4.1 Literature and database review

4.1.1 Literature review

i Moolarben Coal Project Flora, Fauna and Aquatic Ecology Assessment

The *Moolarben Coal Project Flora, Fauna and Aquatic Ecology Assessment* (Moolarben Biota 2006) was undertaken for Stage 1 of the MCP. The study area for the Stage 1 assessment was bound by Goulburn River NP to the north-east and Munghorn Gap Nature Reserve in the south-east. The current study area for the proposed modification is a small part of this larger area.

Twenty two vegetation associations were recorded in the Stage 1 study area within six terrestrial stratification units comprising Disturbed Vegetation, Sedimentary Ironbark Forests, Box Woodlands, Tablelands Red Gum Woodland, Sedimentary Scribbly Gum Woodlands and Alluvial Apple Woodlands. Two threatened flora species, namely the Pine Donkey Orchid and Cannon's Stringybark (*Eucalyptus cannonii*) were recorded.

The following threatened fauna species were recorded:

- birds: Gang-gang Cockatoo, Glossy Black-Cockatoo, Powerful Owl, Gilbert's Whistler, Grey-crowned Babbler, Speckled Warbler, Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater and Diamond Firetail; and
- mammals: Squirrel Glider, Large-eared Pied Bat, Little Pied Bat, Eastern Bentwing Bat, Southern Long-eared Bat and Yellow-bellied Sheathtail Bat.

ii Moolarben Coal Project Stage 2 Ecological Assessment

The *Moolarben Coal Project Stage 2 Ecological Impact Assessment* (Ecovision Consulting 2008) included detailed flora and fauna surveys and impact assessment. The study area of the Stage 2 Ecological Assessment is directly east of the proposed extension areas, so recorded species are indicative of the species and communities that could occur in the proposed extension areas (albeit the study area for Stage 2 is substantially larger than the current study area). The western part of the Stage 2 study area is directly adjacent to the proposed extension areas. Some of the vegetation in this area is characterised as White Box Yellow Box Blakely's Red Gum Derived Native Grassland (DNG), an endangered ecological community (EEC).

Fourteen native and one exotic vegetation community were identified by Ecovision Consulting (2008) in the Stage 2 study area. The surveys identified the presence of the threatened *Pomaderris queenslandica.* Threatened fauna species identified comprised:

- Birds: Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Gang-gang Cockatoo, Glossy Black-Cockatoo, Grey-crowned Babbler, Hooded Robin, Painted Honeyeater, 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.

iii Moolarben Coal Flora and Fauna Monitoring 2011/2012 Summary

The *Moolarben Stage 1 Biodiversity Offset Monitoring Summary* (EcoLogical 2012) compiled ecological data from four biodiversity offset sites adjacent to the MCP, therefore, the ecological values identified may be indicative of those in the study area. The main vegetation types identified at nearby offset sites comprised:

- Blakely's Red Gum Grassy Woodland and DNG;
- Rough-barked Apple Alluvial Woodland;
- Ironbark – Cypress – Stringybark Forest and DNG;
- Inland Scribbly Gum Forest; and
- Grey Box – Blakely's Red Gum Open Forest.

The following threatened and migratory species were identified:

- Birds: Glossy Black-cockatoo, Brown Treecreeper, Varied Sittella, Little Lorikeet, Hooded Robin, Scarlet Robin, Rainbow Bee-eater, Speckled Warbler, Diamond Firetail; and
- Microbats: Large-eared Pied Bat, Little Pied Bat, Eastern False Pipistrelle, Little Bentwing Bat, Eastern Bentwing Bat and Greater Broad-nosed Bat.

iv Ulan Coal Mine Continued Operations Environmental Assessment

The *Ulan Coal Mine Continued Operations Environmental Assessment* (Umwelt, 2009) provided an environmental assessment of an extension to open cut mining at the Ulan Coal Mine under Part 3A of the EP&A Act. Ulan Coal Mine is approximately 1.5 km to the north of the open cut extension area, therefore, is likely to be indicative of the species and communities that could occur within the study area.

Umwelt completed a detailed survey of the site. 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 (*Acacia ausfeldii*), Pine Donkey Orchid, Cannon's Stringybark, Hoary Sunray and *Homoranthus darwinioides*;
- threatened fauna species:
    - birds: Barking Owl, Black-breasted Buzzard, Black-chinned Honeyeater, Blue-billed Duck (*Oxyura australis*), Brown Treecreeper, Bush Stone-curlew, Diamond Firetail, Flame Robin, Gang-gang Cockatoo, Glossy Black-Cockatoo, Grey-crowned Babbler, Hooded Robin, Little Lorikeet, Magpie Goose (*Anseranas semipalmata*), Painted Honeyeater, Powerful Owl, Regent Honeyeater, Speckled Warbler, Square-tailed Kite, Scarlet Robin, Spotted Harrier, Swift Parrot, Turquoise Parrot and Varied Sittella;
    - mammals: Koala, Brush-tailed Rock-wallaby and Squirrel Glider; and

- bats: Eastern Bentwing-bat, Eastern Cave Bat, Southern Long-eared Bat, Large-eared Pied Bat, Southern Myotis and Little Pied Bat (Umwelt, 2009).

v Wilpinjong Coal Project Terrestrial Fauna and Bat Fauna Assessment

The *Wilpinjong Coal Project Terrestrial Fauna Assessment* (Mount King Ecological Surveys 2005) and *Wilpinjong Coal Project Bat Fauna Assessment* (Greg Richards and Associates 2005) were completed to assess terrestrial fauna species diversity, relative abundance and habitats in the study area, with a focus on threatened fauna species.

Threatened species recorded during the assessment comprised:

- birds: Black-chinned Honeyeater, Painted Honeyeater, Brown Treecreeper, Diamond Firetail, Glossy Black-cockatoo, Hooded Robin, Speckled Warbler, Square-tailed Kite, Masked Owl, Turquoise Parrot; and

- mammals: Squirrel Glider, Large-eared Pied Bat, Eastern False Pipistrelle, Little Bentwing Bat, East-coast Freetail Bat, and Yellow-bellied Freetail Bat.

vi Vertebrate Fauna of Munghorn Gap Nature Reserve

Munghorn Gap Nature Reserve is directly south-east of the study area (Figure 2.1). The nature reserve is on a dissected sandstone plateau, and vegetation is characterised by dry, low shrubby forests of *Eucalyptus* and *Callitris* species. Elevation reaches 590 m at the highest point in the reserve, which is a similar elevation to the study area.

A fauna survey of the nature reserve was completed in 2002, with the aim of sampling vegetation communities, birds, reptiles, arboreal mammals, forest owls and microbats. The reserve was found to provide suitable habitat for declining woodland birds that occur in the sheep-wheat belt of NSW, including the Hooded Robin, Brown Treecreeper, Speckled Warbler, Diamond Firetail, Grey-crowned Babbler, Black-chinned Honeyeater and Painted Honeyeater. The nature reserve is also home to other threatened diurnal birds including the Turquoise Parrot, Regent Honeyeater, Square-tailed Kite, Swift Parrot and Pied Honeyeater.

Several pairs of the threatened Powerful Owl were recorded. No evidence was found during surveys to support historical records of the Koala in the nature reserve. A threatened microbat, the Large-eared Pied Bat was also recorded.

Pest species recorded included feral pigs, goats, foxes and rabbits in open country adjoining the reserve.

vii Munghorn Gap Nature Reserve bird list

A bird list has been compiled at Munghorn Gap Nature Reserve from 1 January 1900 to 17 December 2012. A total of 118 bird species have been recorded in the reserve, including 12 threatened and migratory species. Moderate reporting rates (36-41%) have been recorded for the Diamond Firetail, Speckled Warbler and Little Lorikeet, with lower reporting rates (5-27%) for the Little Eagle, Turquoise Parrot, Rainbow Bee-eater, Brown Treecreeper, Regent Honeyeater, Black-chinned Honeyeater, Varied Sittella, Scarlet Robin and Hooded Robin.

viii Goulburn River National Park and Munghorn Gap Nature Reserve Plan of Management

The MCP is between the Goulburn River NP (north of the study area) and Munghorn Gap Nature Reserve (south-east of the study area) which contain large undisturbed tracts of vegetation and, therefore, provide useful reference to the species, populations and communities that may occur in the study area. Munghorn Gap Nature Reserve is part of the Mudgee-Wollar Important Bird Area.

Goulburn River NP and Munghorn Gap Nature Reserve are botanically significant as they are part of a transitional zone containing a mixture of plants from the south-east, north-west and western parts of NSW. A number of plant species endemic to the Sydney sandstone reach their northern and western limits in the NP and nature reserve. The dry climate and low elevation of the Great Dividing Range has allowed for the occurrence of many characteristically western plants into the area. A number of rare and endangered plant species, including *Acacia dangarensis* which is endemic to Mount Dangar, are found on this basalt peak. Other species include *Cynanchum elegans*, *Kennedia retrorsa* and *Lasiopetalum longistamineum* (NPWS 2003).

The area is known to support threatened species including the Brush-tailed Rock Wallaby, New Holland Mouse, Square-tailed Kite, Powerful Owl, Large-eared Pied Bat, Eastern Bentwing Bat, Swift Parrot, Turquoise Parrot, Painted Honeyeater, Glossy-black Cockatoo, Malleefowl, Regent Honeyeater and the Broad-headed Snake. The Emu population in the park is considered important for the region as it is the only wild population in the Sydney Basin (NPWS 2003).

4.1.2 Database review

i Threatened ecological communities

Eight TECs have the potential to occur within the Kerrabee IBRA sub-region of the Hunter-Central Rivers CMA (see Table 4.1). Of these, three TECs were considered to have a high potential to occur in the study area.

Table 4.1 Threatened ecological communities known to occur within the Hunter-Central Rivers CMA (Kerrabee sub-region) and identified in the Species Profile and Threat Database search

Threatened ecological community	Status		Potential for occurrence in study area
	TSC Act	EPBC Act	
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	-	Low
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC	-	Moderate
Coolibah-Black Box woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions	EEC	-	Low

Table 4.1 Threatened ecological communities known to occur within the Hunter-Central Rivers CMA (Kerrabee sub-region) and identified in the Species Profile and Threat Database search

Threatened ecological community	Status		Potential for occurrence in study area
	TSC Act	EPBC Act	
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	EEC	EEC	High
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	-	CEEC	High
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	EEC	-	Low
Weeping Myall Woodlands	EEC	-	Low
White Box Yellow Box Blakely's Red Gum Woodland	EEC	CEEC	High

Source: *OEH 2012, SEWPaC 2012*

Notes: *1. 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, VEC – vulnerable ecological community*

ii Threatened species

A total of 46 threatened species have been recorded previously, or are predicted to occur within the area covered by the Gulgong 1:100,000 mapsheet or within 20 km of the study area:

- seven plant species;
- one amphibian species;
- two reptile species;
- twenty-eight bird species; and
- eight mammal species.

iii Threatened species predicted to occur

Predictive modelling from the Species Profile and Threat Database (SPRAT) indicates that nine flora, 17 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 (SEWPaC 2012a).

4.1.3 Threatened populations

Three threatened populations were predicted to occur in the study area comprising (OEH 2012b):

- *Acacia pendula* endangered population in the Hunter Catchment;
- *Cymbidium canaliculatum* endangered population in the Hunter Catchment; and
- River Red Gum endangered population in the Hunter Catchment.

4.2 Risk assessment

The key ecological risks identified from the literature and database review and risk workshop comprised:

- potential removal of White Box Yellow Box Blakely's Red Gum Woodland EEC/White Box Yellow Box Blakely's Red Gum Woodland CEEC in the proposed modification areas;
- potential removal of rare (*Pseudanthus divaricatissimus*) and threatened (Pine Donkey Orchid, Cannon's Stringybark and Hoary Sunray) flora species and their habitats;
- potential reduction in habitat for TSC Act listed threatened fauna species (12 bird species, and five microbat species). Two of the microbat species are also listed under the EPBC Act;
- reduction in known habitat for TSC Act listed threatened birds including Brown Treecreeper, Diamond Firetail, Painted Honeyeater and Speckled Warbler;
- reduction in ease of use of habitat linkages between Goulburn River NP and Munghorn Gap Nature Reserve through the development of the proposed extension areas;
- increased noise, light and dust in retained habitat areas to the east and south of the open cut pits (ie reduction in suitable habitat for some flora and fauna species);
- invasion of introduced species (weeds and pests) in retained habitat areas to the east and south of the proposed extension areas;
- cumulative loss of Box Gum Woodland CEEC/EEC, threatened flora and fauna and their habitats with surrounding projects (MCP Stage 2, Ulan Coal Mine and Wilpinjong Coal Mine); and
- location of suitable and representative offset sites that satisfy the OEH and SEWPaC requirements.

4.3 Field results

4.3.1 Vegetation mapping

i Vegetation types of the study area

The focus of vegetation mapping was on the proposed extension areas to identify direct impacts to vegetation (ie amount of vegetation clearing), and extended outside this area to identify indirect impacts to vegetation (ie noise, dust and light).

Six native and one exotic vegetation type were recorded in the study area. Table 4.2 lists these vegetation types and their coverage in the study area. An overview of each vegetation type is provided in Section 4.3.2 i-vii. A vegetation map showing the spatial distribution of the vegetation types across the disturbance areas is provided in Figure 4.1 and Figure 4.2.

Native vegetation in the north of the study area is adjacent to an existing mine pit (Open Cut 1), and vegetation in the south is adjacent to agricultural land and an approved, but as yet, undeveloped mine pit. It is subject to edge effects including weed invasion and grazing. In addition, three disused rock quarries exist within areas of native vegetation on the western edge of the proposed extension areas.

The condition of vegetation types was compared with the Biometric benchmark data (DECC 2008a) for the Hunter-Central Rivers CMA. All remnants were assigned a good condition rating with respect to their structure, however all vegetation communities had a lower diversity of understorey plant species. A discussion of the conservation status of the recorded vegetation types is provided in Section 5.1.

Ridgetop Broad-leaved Ironbark Grey Gum Forest was the most abundant vegetation type in the study area, accounting for approximately 50% of all vegetation. Exotic pasture was the least abundant vegetation type, with only 11 ha recorded in the study area (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 in the study area

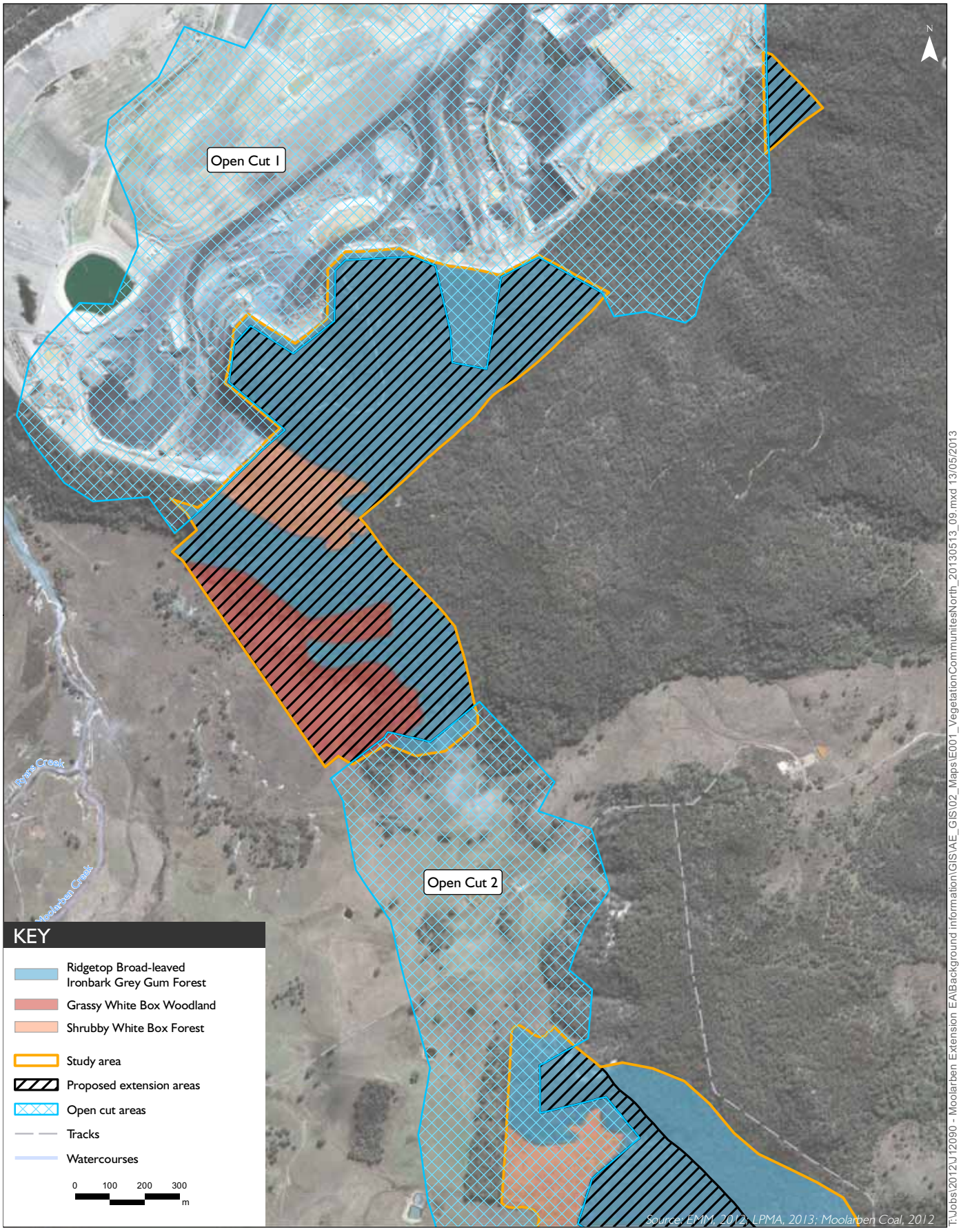
Vegetation type	Threatened Ecological Community	Coverage in study area (ha)
Shrubby White Box Forest	-	32
Grassy White Box Woodland	Box Gum Woodland	18
Ridgetop Broad-leaved Ironbark – Black Cypress Pine on shallow sands	-	16
Ridgetop Broad-leaved Ironbark Grey Gum Forest	-	130
Rough-barked Apple Alluvial Woodland	-	8
Rough-barked Apple – Cypress Pine Woodland on slopes	-	40
Exotic pasture	-	11
Total	-	**255**

4.3.2 Vegetation type assessment

For ease of assessment, vegetation types identified in the study area were classified according to the naming system adopted by Ecovision Consulting (2008). Two communities additional to those described by Ecovision Consulting (2008) were recorded. Vegetation communities were assigned to Biometric Vegetation Types for the Hunter-Central Rivers CMA as described in DECC (2008). The results of the vegetation type assessment are provided in Table 4.3.

Table 4.3 Vegetation type assessment against vegetation databases

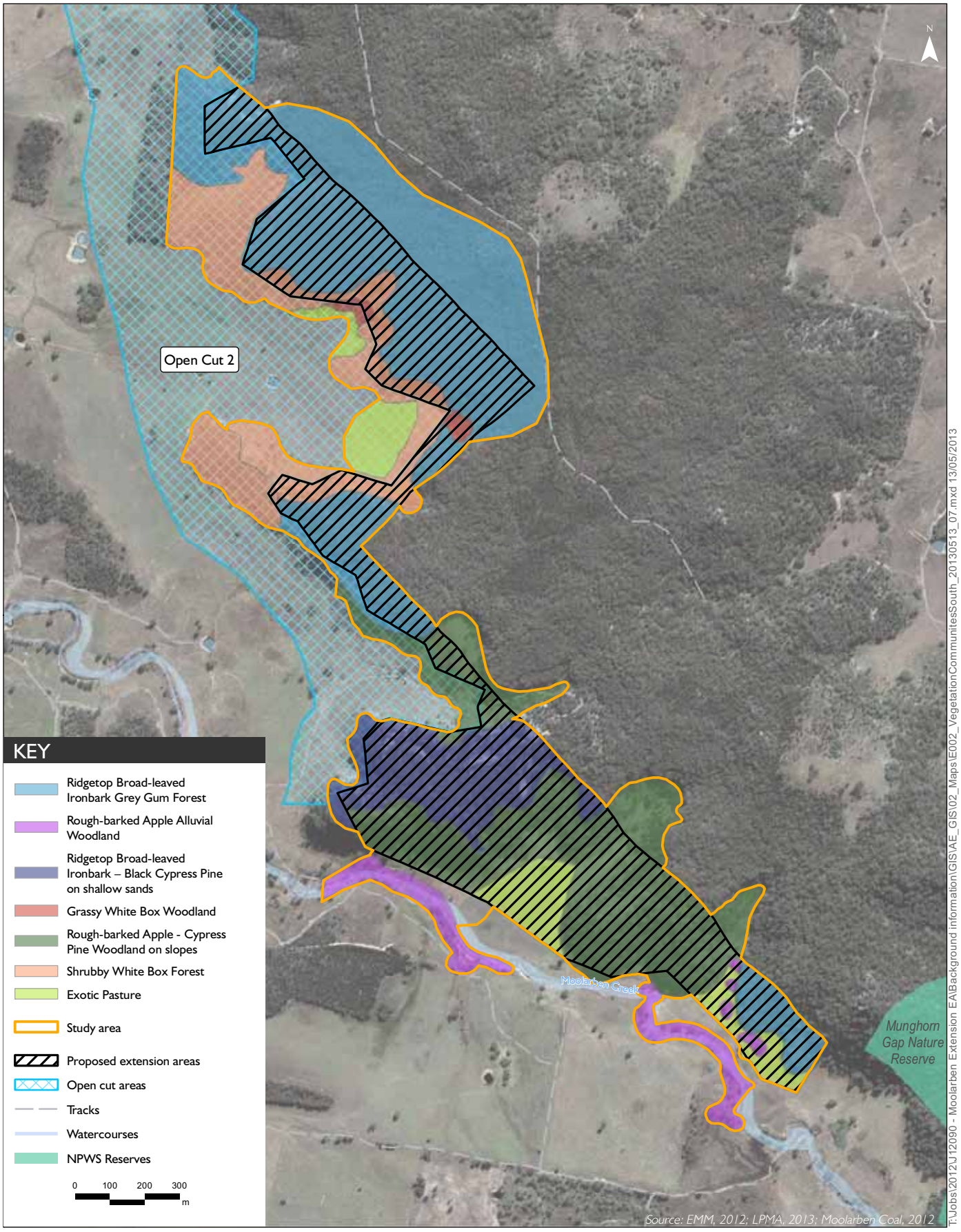
Current assessment vegetation type	Vegetation formation	Vegetation class (Keith 2004)	Somerville (2009)	Peake (2006)	Plant community type (PCT) database (OEH 2012)	Biometric vegetation type (BVT)
Shrubby White Box Forest	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forest	None described	None described	HU824: White Box – Black Cypress Pine shrubby woodland of the Western Slopes	HU653: White Box – Narrow-leaved Ironbark open forest on hills of the central Hunter Valley, Sydney Basin
Grassy White Box Woodland	Grassy Woodlands	Western Slopes Grassy Woodland	MU159: White Box Grassy Woodland	None described	-	HU654: White Box – Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South
Ridgetop Broad-leaved Ironbark – Black Cypress Pine on shallow sands	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forest	MU136: Narrow-leaved Stringybark/Large-fruited Grey Gum heathy open forest in the Wollemi	MU15: Western Hunter Narrabeen Exposed Grey Gum – Stringybark Woodland	-	HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin
Ridgetop Broad-leaved Ironbark Grey Gum Forest	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Dry Sclerophyll Forests	MU134: Narrow-leaved Stringybark Heathy Open Forest in Towarri and Wingen Maid NP	MU15: Western Hunter Narrabeen Exposed Grey Gum – Stringybark Woodland	-	HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin
Rough-barked Apple Alluvial Woodland	Dry Sclerophyll Forests (Shrubby sub-formation)	North Coast Dry Sclerophyll Forests	None described	None described	-	HU605: Rough-barked apple grassy open forest on valley flats of the North Coast and Sydney Basin
Rough-barked Apple – Cypress Pine Woodland on slopes	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Hinterland Dry Sclerophyll Forests	None described	None described	HU870: Narrow-leaved Ironbark – Black Pine – Narrow-leaved Wattle shrub – grass open forest on sandstone slopes of the upper Hunter Valley and Sydney Basin	HU603: Rough-barked Apple – Silvertop Stringybark – Ribbon Gum shrub/grass open forest on hills of the southern Nandewar Bioregion
Exotic pasture	N/A	N/A	N/A	N/A	N/A	N/A



Vegetation types - north

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 4.1



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MOOLARBENCOAL

Vegetation types - south

Moolarben Coal Project - Stage 1 Optimisation Modification

Ecological assessment

Figure 4.2

i Shrubby White Box Forest

Shrubby White Box Forest in the study area is very similar to the vegetation type described by Ecovision Consulting (2008) from the MCP Stage 2 area. It occurs on mid to high slopes and in gullies of the study area, on siltstone and sand of the Triassic Narrabeen Group. It covers approximately 32 ha of the study area.

White Box is the dominant canopy species; however other eucalypts including Narrow-leaved Stringybark (*E. sparsifolia*) and Narrow-leaved Ironbark (*E. crebra*) are also present at the intergrade between this vegetation type and Ridgetop Blue-leaved Ironbark Grey Gum Forest (4.2.2iv).

This vegetation type has a shrubby understorey, and frequently contains Black Cypress Pine (*Callitris endlicheri*), Narrow-leaved Geebung (*Persoonia linearis*), Prickly Shaggy-pea (*Podolobium ilicifolium*), *Dillwynia juniperina, Dodonaea triangularis,* Blackthorn (*Bursaria spinosa*), Sifton Bush (*Cassinia arcuata*), White Sally (*Acacia floribunda*) and the occasional Kurrajong (*Brachychiton populneum*) (Photograph 4.1).

The ground layer is sparse, containing few species including Bamboo Grass (*Austrostipa verticillata*), Speargrass (*Austrostipa scabra*), Kidney Weed (*Dichondra repens*) and Rough Saw-sedge (*Gahnia aspera*).

This vegetation type was compared to Biometric vegetation types for the Hunter-Central Rivers CMA (DECC 2008a), and the Vegetation Information System (VIS) (OEH 2012d) and is closely aligned with the newly described community *HU824: White Box – Black Cypress Pine shrubby woodland of the Western Slopes.*

This vegetation type has not been entered into the Biometric Vegetation Type database (DECC 2008a), thus a vegetation type of 'best fit' was assigned. Accordingly, this community has been classified as *HU653: White Box – Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin* (DECC 2008a).

The condition was compared against the benchmark values for HU653. It is considered to be in poor to good condition because floristic diversity was low, the overstorey crown cover is greater than 25% of the lower benchmark limit and the groundcover is comprised of greater than 50% native species. This community is well represented in the Hunter-Central Rivers CMA area, and only 10% of its original distribution has been cleared (DECC 2008a).

Photograph 4.1 Shrubby White Box Forest

ii Grassy White Box Woodland

Grassy White Box Woodland is very similar to the vegetation type described by Ecovision Consulting (2008) in the MCP Stage 2 area. It occurs as derived grassland on Tertiary basalt and tholeiite at Carrs Gap between the proposed extension areas. It also occurs in woodland form on the southern boundary of the proposed Open Cut 1 extension area (Figure 4.1). Grassy White Box Woodland covers approximately 18 ha of the study area. The canopy of the woodland on the southern edge of the proposed Open Cut 1 extension occurs as a mix of White Box and Rough-barked Apple (Photograph 4.2), while the woodland form on the western border of the study area contains White Box (Photograph 4.2).

This vegetation type has a sparsely vegetated understorey, comprised of grasses *Rytidosperma monticola*, Bamboo Grass (*Austrostipa verticillata*), Snowgrass (*Poa sieberiana*) with occasional herbs and sedges including Tufted Bluebell (*Wahlenbergia communis*), Kidney Weed, Whiteroot (*Pratia purpurascens*), Spiny-headed Mat-Rush (*Lomandra longifolia*), and *Lomandra confertifolia* subsp. *similis*.

The derived grassland form is described in Ecovision Consulting (2008) as occurring on overcleared basalt caps with sparse White Box and Rough-barked Apple occurrences. It contained grassy herbaceous species and a few shrubs including Sifton Bush, *Acaena ovina*, Speargrass, *Dichelachne micrantha, Pimelea curviflora subsp. sericea, Rytidosperma racemosum*, Slender Tick-trefoil (*Desmodium varians*), Native Geranium (*Geranium solanderi*), Snowgrass, Trailing Speedwell (*Veronica plebia*), Smooth Darling-pea (*Swainsona galegifolia*), Kangaroo Grass (*Themeda australis*), Kidney Weed, Tufted Bluebell, *Glycine tabacina* and Swamp Dock (*Rumex brownii*) (Photograph 4.2). The derived grassland form occurs between the proposed extension areas, and on the edge of woodland on the southern edge of the proposed Open Cut 1 extension area.

Photograph 4.2 Grassy White Box Woodland (grassland form)

This community was compared to Biometric vegetation types for the Hunter-Central Rivers CMA (DECC 2008a), and is most closely aligned with *HU654: White Box – Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South.*

The woodland condition was compared against the benchmark values for HU654. It is considered to be in poor condition because floristic diversity was low, the overstorey crown cover is not less than 25% of the lower benchmark limit, the groundcover is comprised of greater than 50% native species (DECC 2008b). It is estimated that 90% of this woodland has been cleared in the Hunter-Central Rivers CMA area (DECC 2008a). It is also noted that substantial areas of Box Gum Woodland have been conserved in perpetuity, enhanced and re-established as a required by approvals for various mining and other projects.

iii Ridgetop Broad-leaved Ironbark – Black Cypress Pine woodland on shallow sands

Ridgetop Broad-leaved Ironbark (*E. fibrosa*) Woodland occurs on ridgetops of the study area on shallow to skeletal soils on siltstone and sand of the Triassic Narrabeen Group and covers approximately 16 ha of the study area.

The canopy is dominated by Blue-leaved Ironbark and the shrub layer is dominated by Black Cypress Pine with occasional Narrow-leaved Geebung (*Persoonia linearis*). One occurrence of the community contained six Slaty Gums (*E. dawsonii*). The understorey is sparsely vegetated and contains low shrubs and grasses including Sifton Bush, Dolly Bush (*Cassinia aculeata*), and Speargrass (*Austrostipa scabra*) (Photograph 4.3).

This community was compared to Biometric vegetation types for the Hunter-Central Rivers CMA (DECC 2008a), and is closely aligned with *HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin.*

The community's condition was compared against the benchmark values for HU552. It is considered to be generally in good condition because the floristic diversity was low, overstorey crown cover greater than 25% of the lower benchmark limit and the groundcover is comprised of greater than 50% native species. Some smaller areas of the community, such as that depicted in Photograph 4.3 are considered to be in poor condition due to logging. This community is well represented in the Hunter-Central Rivers CMA area, and is estimated that only 5% of this community has been cleared (DECC 2008a).

Photograph 4.3 Ridgetop Blue-leaved Ironbark – Black Cypress Pine on shallow sands

iv Ridgetop Broad-leaved Ironbark Grey Gum Forest

Ridgetop Broad-leaved Ironbark Grey Gum Forest occurs on ridgetops and in gullies on siltstone and sand of the Triassic Narrabeen Group, and is the dominant vegetation type in the study area, covering approximately 135 ha.

The canopy is comprised of Blue-leaved Ironbark, Grey Gum (*E. punctata*), Narrow-leaved Stringybark (*E. sparsifolia*) and Black Cypress Pine, and the occasional Rough-barked Apple (*Angophora floribunda*) and Red Stringybark (*E. macrorhyncha*) on steeper slopes. It has a rich shrubby understorey dominated by *Dillwynia juniperina* and Narrow-leaved Geebung, with other shrubs present including White Sally (*Acacia floribunda*), *Acacia leucolabia*, Native Cranberry (*Astroloma humifusum*), *Monotoca elliptica,* Sifton Bush, Dolly Bush, Prickly Shaggy Pea, *Pomax umbellatum, Sannantha cunninghamii,* Johnson's Grass Tree (*Xanthorrhoea johnsonii*) and *Macrozamia spiralis* (Photograph 4.4). Grasses are rare to absent in this vegetation type, with only Snowgrass recorded.

This community was compared to Biometric vegetation types for the Hunter-Central Rivers CMA (DECC 2008a), and was most closely aligned with *HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin.*

The community's condition was compared against the benchmark values for HU552. It is considered to be in good condition because the floristic diversity was low, overstorey crown cover greater than 25% of the lower benchmark limit and the groundcover is comprised of greater than 50% native species. This community is well represented in the Hunter-Central Rivers CMA area, and is estimated at only 5% cleared (DECC 2008a).

Photograph 4.4 Blue-leaved Ironbark Grey Gum Forest

v Rough-barked Apple Alluvial Woodland

This vegetation type was identified in the MCP Stage 1 study area (Moolarben Biota 2006). It occurs adjacent to Moolarben Creek, on the late Carboniferous Cockabutta Creek Sandstone Member Formation. It only covered 8 ha of the study area, the majority of its extent occurring adjacent to the study area.

The canopy is comprised solely of Rough-barked Apple. The shrub stratum is very sparse, with the occasional Sifton Bush. The understorey is comprised of grasses, herbs and a sedge including Short-haired Plumegrass (*Dichelachne micrantha*), Kangaroo Grass, Wallaby Grass, Wheat Grass (*Elymus scaber*), Brown's Lovegrass (*Eragrostis brownii*), Bidgee Widgee (*Acaena novae-zeelandiae*), Native Geranium, and Rough Saw-sedge (*Gahnia aspera*) (Photograph 4.5).

Introduced species had a moderate presence in this community, and included Plantain (*Plantago lanceolata*), Fleabane (*Conyza bonariensis*) and Catsear (*Hypochaeris radicata)*.

This community was compared to Biometric vegetation types for the Hunter-Central Rivers CMA (DECC 2008a), and is closely aligned with *HU605: Rough-barked apple grassy open forest on valley flats of the North Coast and Sydney Basin.*

The community's condition was compared against the benchmark values for HU605 (DECC 2008a). It is considered to be in poor to good condition because the floristic diversity was low, overstorey crown cover is greater than 25% of the lower benchmark limit and the groundcover is comprised of greater than 50% native species. It is estimated that approximately 80% of this community has been cleared in the Hunter-Central Rivers CMA area.

Photograph 4.5 Rough-barked Apple Alluvial Woodland

vi Rough-barked Apple – Cypress Pine Woodland on slopes

This vegetation type was not recorded in previous assessments of the area (Ecovision Consulting 2008; Moolarben Biota 2006). It occurs on footslopes and hills in the south of the study area, and is on the Cockabutta Creek Sandstone Member formation from the late Carboniferous. It covers approximately 40 ha of the study area.

The canopy is comprised of Black Cypress Pine and Rough-barked Apple (Photograph 4.6). Cut stumps of an ironbark species were observed, as such it has been assumed that ironbarks have been selectively removed from the community.

The midstorey has a diverse shrub layer and includes Scrub She-oaks (*Allocasuarina distyla*), Drooping She-oaks (*Allocasuarina verticillata*), White Sally, Narrow-leaved Geebung and Kurrajong. The groundlayer is dominated by Yellow Buttons (*Chrysocephalum semipapposum*) a mix of grasses, herbs and small shrubs including Blackthorn, Johnson's Grass Tree, Crinkle Bush (*Lomatia silaifolia*), Prickly Shaggy Pea, Pink Five-corners (*Styphelia triflora*) and Wallaby Grass. It also contains an infestation of the weed, Tree of Heaven (*Ailanthus altissima*).

This community was compared to Biometric vegetation types for the Hunter-Central Rivers CMA (DECC 2008a) and the VIS (OEH 2012d) and was most closely aligned with the newly described community, *HU870: Narrow-leaved Ironbark – Black Cypress Pine – Narrow-leaved Wattle shrub-grass open forest on sandstone slopes of the upper Hunter Valley and Sydney Basin.*

This vegetation type, has not been entered into the Biometric Vegetation Type database (DECC 2008a), thus a vegetation type of 'best fit' was assigned to assist in determining future offsetting requirements. Therefore, this community has been classified as *HU604: Rough-barked Apple – Silvertop Stringybark – Ribbon Gum shrub/grass open forest on hills of the southern Nandewar Bioregion.*

The woodland condition was compared against the benchmark values for HU604. It is considered to be in poor to good condition because the floristic diversity was low, the overstorey crown cover is greater than 25% of the lower benchmark limit and the groundcover is comprised of greater than 50% native species. It is estimated that 65% of this community has been cleared in the Hunter-Central Rivers CMA area (DECC 2008a).

Photograph 4.6 Rough-barked Apple – Cypress Pine Woodland on slopes

vii Exotic pasture

The south-western part of the study area contains exotic pasture that appears to have been cropped. This was evidenced by plow lines and the dominance of exotic species. This exotic community was comprised almost exclusively of Saffron Thistle (*Carthamus lanatus*) with occasional Catsear (shown in Photograph 4.7 and indicated by the red circle), Barley Grass (*Bromus* spp.) and Barley Grass (*Hordeum leporinum*). Exotic pasture covers approximately 11 ha of the study area.

Photograph 4.7 Exotic pasture

4.3.3 Noxious weeds

Tree of Heaven, Tiger Pear (*Opuntia aurantica*), Prickly Pear (*Opuntia stricta*) and *Opuntia elata* were recorded across the study area. These species are listed as Class 4 weeds in 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.

4.3.4 Fauna

i Habitat types and resources

a. Open forests on hillsides and ridges

Open forests on hillsides and ridges were the most diverse with respect to fauna habitats and fauna species recorded. They were characterised by canopy trees to 30 m in height with a shrubby midstorey. Recorded fauna habitats and resources included fallen timber, small embedded rocks, large rocky outcrops, low dense shrubs, flowering plants and tree hollows.

The open forests of the study area contain foraging and nesting resources for large parrots including the Sulfur-crested Cockatoo (*Cacatua galerita*), Galah (*Eopsaltria roseicapilla*), King Parrot (*Alisterus scapulatus*) and Yellow-tailed Black Cockatoo (*Calyptorhynchus funereus*).

Low dense shrubs present in this habitat type provide cover and nesting habitat for small insectivorous birds like the Superb Fairy Wren (*Malurus cyaneus*), frequently observed in this habitat type. Large patches of small embedded rocks and large rocky outcrops provide basking and shelter habitat for reptiles including the Jacky Lizard (*Amphibolurus muricatus*) and Common Death Adder (*Acanthopis antarcticus*), which were both observed basking in this habitat type. Large rocky outcrops also provide shelter habitat for cave-roosting microbats, with microbat scat identified at two sites.

Open forests on ridges provide resting habitat for the Eastern Grey Kangaroo (*Macropus giganteus*), Swamp Wallaby (*Wallabia bicolor*) and Red-necked Wallaby (*Macropus rufogriseus*), with many large resting patches and individuals observed, particularly in areas dominated by Black Cypress Pine.

Tracks through open forest and the ecotone with open agricultural lands provide hunting habitat for forest owls and insectivorous microbats including Chocolate Wattled Bat (*Chalinolobus morio*) and Gould's Wattled Bat (*Chalinolobus gouldii*) recorded in open forests on hillslopes and ridges.

Tree hollows provide denning opportunities for arboreal mammals including the Common Ringtail Possum (*Pseudocheirus peregrinus*) and Common Brushtail Possum (*Trichosurus vulpecula*) frequently observed in this habitat type. Large round and vertical hollows provide potential nesting habitat for owl and cockatoo species.

b. Footslope grassy woodlands

Footslope woodlands were less structurally diverse than open forest, and provide fewer fauna microhabitats. Footslope woodlands were characterised by a canopy of approximately 25 m in height, with a low (to 0.3 m height) grassy understorey. Footslope woodlands grade into exotic pasture and had disturbed edges. Fewer fauna species were recorded in this habitat type (28 species). Recorded habitats included tree perches, tree hollows and a grassy ground cover.

The open woodland structure favoured larger bird species including the Red Wattlebird (*Acanthochaera carunculata*), Pied Currawong (*Strepera graculina*) and Grey Shrike Thrush (*Colluricincla harmonica*), frequently observed perching and foraging in this habitat type.

This habitat type contained fewer hollows than open forests, offering limited habitat for arboreal marsupials and owls. One Brushtail Possum was observed foraging in this habitat type.

c. Riparian grassy woodland

Riparian woodland was recorded along Moolarben Creek, and was comprised of scattered Rough-barked Apple and a native grassy understorey. Habitats included a densely vegetated riparian zone, fallen timber, limited tree hollows, and open grassy areas. Thirty four fauna species were recorded in this habitat type.

The open grassland component of riparian woodland provides habitat for raptors including the Wedge-tailed Eagle (*Aquila audax*) and Brown Falcon (*Falco berigora*), observed hunting in this habitat type. Prey species including European Rabbits (*Oryctolagus cuniculus*) were also abundant. Macropods including the Swamp Wallaby, Eastern Grey Kangaroo and Red-necked Wallaby were also observed foraging in this habitat type.

The densely vegetated riparian zone and fallen timber provide habitat for the Red-bellied Black Snake (*Pseudechis porphyriacus*) and Eastern Snake-necked Turtle (*Chelodina longicollis*). The riparian zone and adjacent grassland provides shelter and foraging habitat for aquatic birds including the White-necked Heron (*Ardea pacifica*) and Masked Lapwing (*Vanellus miles novaehollandiae*).

Bird species favouring open habitats were also recorded in riparian woodland including the Welcome Swallow (*Hirundo neoxena*), Australian Magpie (*Gymnorhina tibicen*), Black-faced Woodswallow (*Artamus cinereus*) and Peaceful Dove (*Geopelia placida*). Two migratory bird species, the Channel-billed Cuckoo (*Scythops novaehollandiae*) and Common Koel (*Eudynamys scolopacea*) were also observed.

Hollows were scarce in this habitat type, limiting habitat for arboreal fauna. Only two Brushtail Possums were observed, and no owls were recorded in this area.

As discussed further in Section 7, the mine was designed to avoid disturbance to Moolarben Creek and its riparian zone.

d. Exotic pasture

Exotic pasture has a low open structure, with exotic grasses and forbs to 0.4 m height. The lowest number of fauna species (13) was recorded in this habitat type. Seeding pastures provide foraging habitat for granivorous birds including the Red-rumped Parrot (*Psephotus haemonotus*), Turquoise Parrot (*Neophema pulchella*), Double-barred Finch (*Taenopygia bichenovii*) and Diamond Firetail (*Stagnopleura guttata*). Several Lace Monitors (*Varanus varius*) were observed hunting in this habitat type. One Common Wombat (*Vombatus ursinus*) burrow entrance was found concealed in a dense patch of Saffron Thistle.

e. Water resources

There are no permanent water sources or dams for fauna in the study area. Moolarben Creek is located between 100 m and over 1 km west of the proposed extension areas, and contained little water at the time of survey. Targeted surveys were not undertaken in this area as there will be no direct impact to aquatic ecology (see Section 2.2.2i). Two frog species, the Eastern Dwarf Sedge Frog (*Litoria fallax*) and the Common Eastern Froglet (*Crinia signifera*) were heard calling from Moolarben Creek during the survey.

f. Tree hollows

Hollow-bearing trees mainly occurred on ridgelines and hillslopes of the study area. Mature trees have been largely removed from the lower slopes, evidenced by ringbarking and dead tree stumps. A variety of types were recorded, including:

- fissures, cracks and fire scars (basal hollows) for tree-dwelling microbats;
- small round hollows (approximately 5 centimetres (cm) diameter) for small parrots like the Red-rumped Parrot;
- medium-sized round hollows (10 – 20 cm diameter), suitable for arboreal mammals like the Common Brushtail and Common Ringtail Possums; and
- large round (approximately 30 cm diameter) and horizontal (approximately 10 x 30 cm) hollows suitable for forest owl and cockatoo nesting.

Smooth-barked species such as Grey Gum contained the highest number of hollows. Hollows were observed in Blue-leaved Ironbark and White Box trees, but in fewer numbers.

g. Fallen timber

The value to fauna of dead fallen wood or coarse woody debris (CWD) in Australian forest ecosystems is well known. 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).

CWD in the study area provides shelter and resources for a range of invertebrate species and insectivorous birds such as the Jacky Winter (*Microeca fascinans*) and the Short-beaked Echidna (*Tachyglossus aculeatus*), whose diggings were observed next to fallen timber. Common Wombat burrow entrances were also observed in large fallen hollow logs.

h. Rocky outcrops and bushrock

Outcropping occurs throughout the study area, providing small caves and crevices which afford shelter and nesting opportunities, particularly for birds and bats. 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 Eastern Cave 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 common throughout the study area, particularly associated with outcropping and hill slopes. Bush rock provides important resources, including shelter, foraging and nesting sites for snakes and lizards.

i. Dense shrubs

The open forests on hillslopes of the study area contained a dense shrub layer to 1.5 m in height. Small birds including the White-throated Gerygone (*Gerygone olivacea*), Brown Thornbill (*Acanthiza pusilla*), Yellow Thornbill (*Acanthiza nana*), Striated Thornbill (*Acanthiza lineata*), Weebill (*Smicronis brevirostris*) Spotted Pardalote (*Pardalotus punctatus*), Eastern Yellow Robin (*Eopsaltria australis*) and Superb Fairy Wren were observed in dense patches of Sifton Bush, White Sally, Narrow-leaved Geebung, Cherry Ballart, *Monotoca elliptica* and Prickly Shaggy Pea. These shrubs provide potential nesting habitat for the thornbill species recorded. Larger shrubs including Cherry Ballart provide diurnal roosting opportunities for forest owls.

j. Flowering and fruiting plants

Flowering trees and shrubs were recorded across the study area, providing foraging opportunities for a number of invertebrate and vertebrate fauna. White Box, a winter flowering species, occurs on hilly footslopes throughout the study area, providing foraging resources for fauna during this period when foraging resources are limited. No eucalypts were in flower at the time of survey. However, when flowering, eucalypts would provide nectar and seed resources for a number of parrot species in the study area including the King Parrot.

Mistletoes were observed in low numbers on eucalypts of the study area. These have been shown to be important for many species of birds, mainly honeyeaters, which feed at mistletoe flowers (Reid 1986). Mistletoes produce 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 also provide a food source for fauna species, with 33 bird species recorded feeding on mistletoe berries (Reid 1986).

Woody fruits are also available in the study area. Woody fruits from Black Cypress Pine, Forest Oaks provide foraging habitat for the Yellow-tailed Black Cockatoo.

The study area contained a number of wattle species and other seeding shrub species, which provide seed resources for fauna. In addition, native grass seeds would provide resources for grain-eating birds including the threatened Diamond Firetail, which was recorded in this habitat type.

ii Fauna species and regional importance

This section discusses the importance of fauna species in a regional context. A comprehensive regional assessment was undertaken for the bioregion adjoining the study area (Brigalow Belt South) (NPWS 2000), and an assessment was undertaken for species declining in the Kerrabee sub-region (Sattler and Creighton 2002). Species recorded were compared against their regional or sub-regional significance to indicate their importance in the study area. A complete list of the fauna recorded is provided at Appendix C.

a. Amphibians

Only two frog species, the Eastern Dwarf Sedge Frog (*Litoria fallax*) and the Common Eastern Froglet (*Crinia signifera*) were recorded in the study area. Neither of these are regionally significant species.

b. Reptiles

Five reptile species were recorded in the study area. One regionally significant reptile species, the Common Death Adder, was recorded in the study area. This species is reportedly rare in the adjoining Brigalow Belt South Bioregion (NPWS 2000).

c. Birds

Diurnally-active birds

Fifty three diurnally-active bird species were recorded in the study area. Two regionally significant diurnally-active bird species (the Turquoise Parrot and Common Koel) were recorded in the study area. The Turquoise Parrot is classified as declining in Kerrabee sub-region (Sattler and Creighton 2002) and rare in the Brigalow Belt South (NPWS 2000). The Common Koel is predicted to be on the edge of its distribution in the Brigalow Belt South Bioregion (NPWS 2000), which the study area adjoins.

Several observations of Emus (*Dromaius novaehollandiae*) and their scats were made during the survey. The local Emu population is considered regionally important as it may form part of the wild population in Goulburn River NP, the only wild population in the Sydney Basin Bioregion (NPWS 2003). The Emu is also considered to be declining in the NSW Sheep-Wheat Belt (Reid 1999).

Many species considered to be increasers in the NSW Sheep-Wheat Belt (Reid 1999) were recorded including the Nankeen Kestrel, Peaceful Dove, Galah, Sulfur-crested Cockatoo, Eastern Rosella, White-plumed Honeyeater, Spotted Turtle Dove, Willie Wagtail, Black-faced Cuckoo-shrike, Black-faced Woodswallow, Australian Magpie, Australian Raven, White-winged Chough, Australasian Pipit and Welcome Swallow.

A number of other diurnally-active birds considered to be declining by the same study (Reid 1999) were recorded in the area, including the Brown Treecreeper, Jacky Winter, Eastern Yellow Robin, Rufous Whistler, and Diamond Firetail.

Nocturnally-active birds

Three nocturnally-active bird species were recorded in the study area. Two of these, namely the Powerful Owl and Masked Owl, are classified as declining in Kerrabee IBRA sub-region (Sattler and Creighton 2002), and rare in the Brigalow Belt South Bioregion (NPWS 2000).

iii Arboreal and ground-dwelling mammals

Five arboreal mammal species were recorded in the study area. Two regionally significant mammal species for the adjoining subregion, the Common Brushtail Possum and Common Ringtail Possum were recorded in the study area. These species are classified as declining in Brigalow Belt South (NPWS 2000).

iv Microbats

Eleven microbat species were recorded in the study area. Two subregionally significant microbat species, the Eastern Bentwing Bat and Eastern Cave Bat, were recorded in the study area. These species are classified as declining in the Kerrabee subregion (Sattler and Creighton 2002). These species and the Chocolate Wattled Bat are on the edge of their distribution in the Brigalow Belt South Bioregion (NPWS 2000).

v Pest species

Four pest species were recorded in the study area. European Red Fox (*Vulpes vulpes*) and European Rabbit individuals, dens/warrens and scats were recorded across all habitat types. Photograph 4.8 shows a European Red Fox captured with a motion sensitive, white-light camera. It is noted that no native species were captured by the motion sensitive camera.

Although no Feral Pigs (*Sus scrofa*) were sighted, their scat and diggings were found throughout the open forest on ridges and hillslopes. Spotted Doves (*Streptopelia chinensis*) were frequently observed in exotic pasture, flying alongside the native Peaceful Dove.

Photograph 4.8 European Red Fox in footslope woodlands captured on motion-sensitive camera

4.3.5 SEPP 44 Koala Habitat Assessment

The study area is part of the Central Coast Koala Management Area. Three feed tree species listed on Schedule 2 of SEPP 44, White Box and Narrow-leaved Ironbark occur in the study area. Grassy White Box Woodland and Grey Gum Blue-leaved Ironbark Forest may provide potential Koala habitat under the SEPP definition (DECC 2008c).

4.3.6 Habitat linkages

The study area is part of a large regional corridor starting in the south at Munghorn Gap Nature Reserve, continuing through the study area north-east to Goulburn River NP (Figure 4.3). The corridor also travels south-east from Goulburn River NP to meet Blue Mountains NP. This corridor extends east toward the coast and is connected with Wollemi and Yengo NPs.

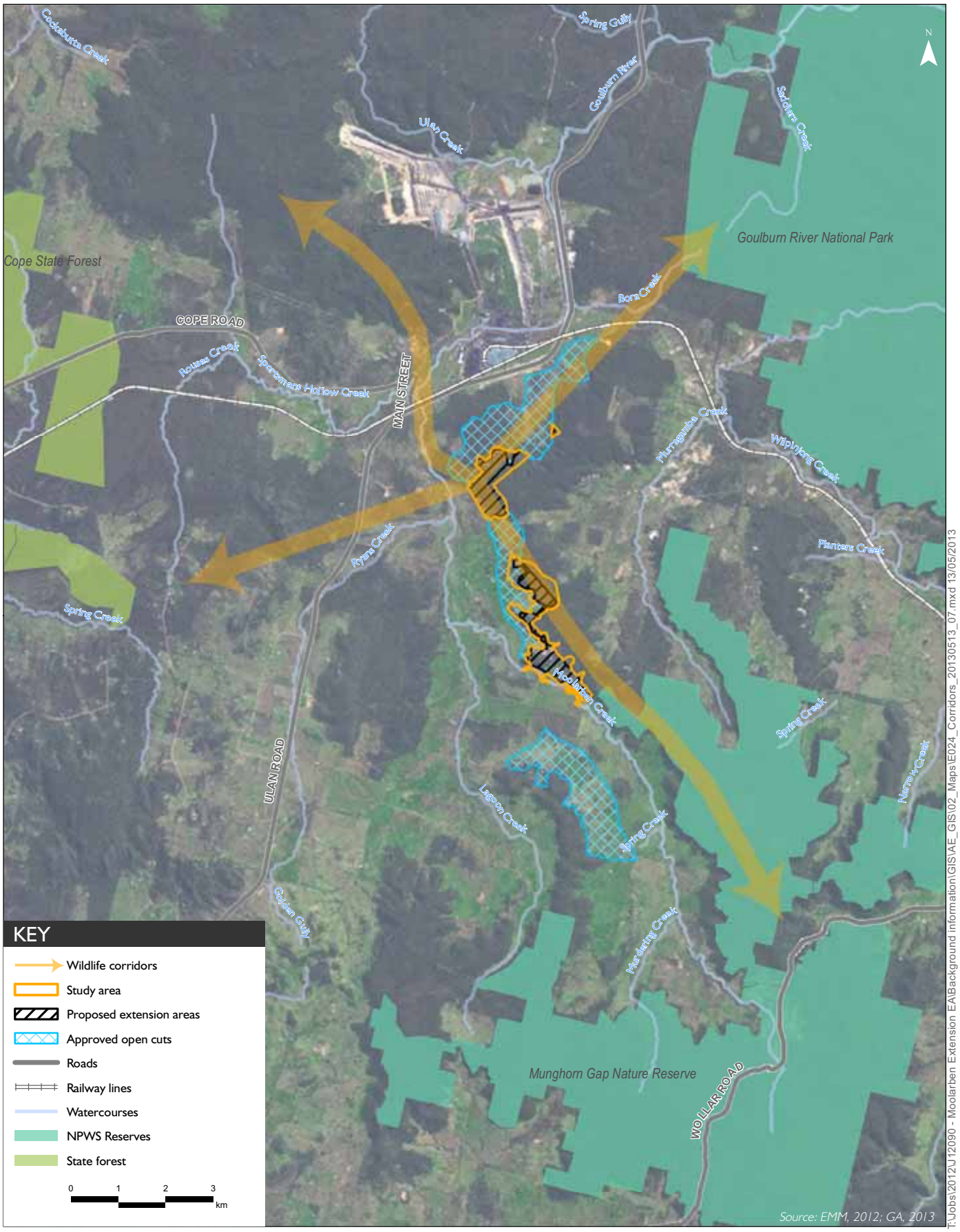
The study area is also part of a smaller local corridor extending north-west into unreserved native forest and woodland in Ulan, and extending south-west to Yarrawonga (Figure 4.3). These corridors would provide important linkages for rare and threatened species (discussed further in Section 5.3).

The study area is also part of the Mudgee-Munghorn Gap-Wollar important bird area. This area is one of the few places where the Regent Honeyeater is regularly observed, and one of only a few key breeding areas in NSW for the species (NPWS 2002).

The regional corridor that runs through the study area would provide habitat linkages for species that require large home ranges such as the Masked Owl and Powerful Owl, both recorded in the study area.

This corridor may also provide linkages for altitudinal or seasonal migrants including the Gang-gang Cockatoo, Eastern False Pipistrelle, Swift Parrot and Eastern Bentwing Bat.

As discussed further in Section 7, the mine design was modified as an outcome of risk assessment to ensure that habitat linkages were maintained.



Local and regional wildlife corridors

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 4.3

5 Conservation significance

5.1 Threatened ecological communities

One vegetation type in the study area, Grassy White Box Woodland meets the description of *White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community* under the NSW TSC Act and *White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland critically endangered ecological community* under the Commonwealth EPBC Act (shown on Figure 5.1). There are differences in the listing criteria for the community, thus they have been assessed separately in the following sections.

5.1.1 White Box Yellow Box Blakely's Red Gum Woodland

White Box Yellow Box Blakely's Red Gum Woodland is listed as an EEC under the TSC Act. It is found on relatively fertile soils on the tablelands and western slopes of NSW (DEC 2002). White Box Yellow Box Blakely's Red 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 2008a).

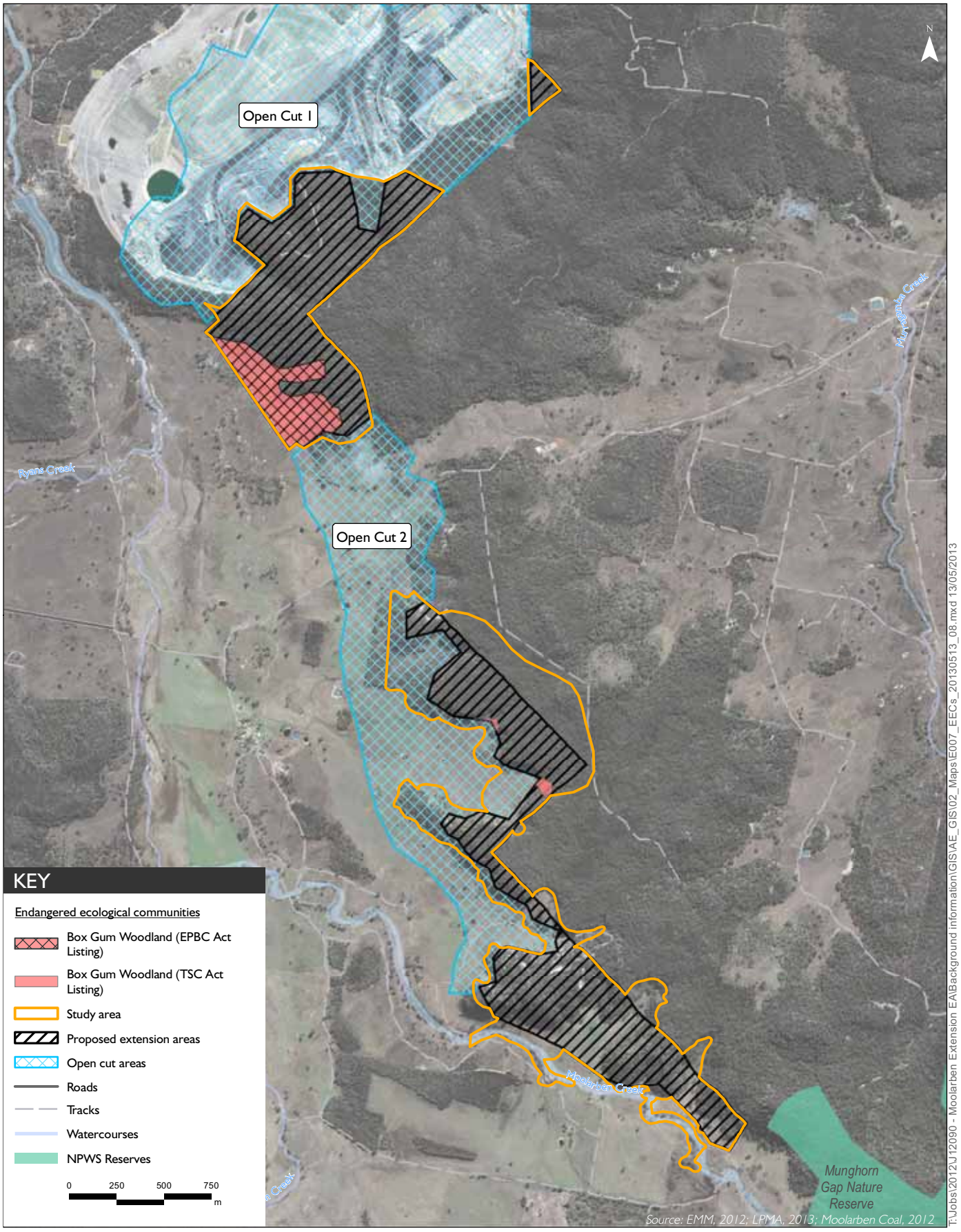
Disturbed remnants are considered to form part of the community, including those where either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration.

Using the NSW criteria for White Box Yellow Box Blakely's Red Gum Woodland and the Draft National Recovery Plan (DECCW 2010a), all occurrences and forms of Grassy White Box Woodland (Section 4.3.2ii) in the study area considered to represent the White Box Yellow Box Blakely's Red Gum Woodland EEC.

The total area of White Box Yellow Box Blakely's Red Gum Woodland EEC mapped within the study area is approximately 18 ha. General condition of Box Gum Woodland remnants in the study area varied with the level of tree clearing. It exists in three forms:

- a grassy woodland community on hilly footslopes with White Box as the only canopy species;
- a grassy woodland community adjacent to a basalt cap, with Rough-barked Apple and White Box as canopy co-dominants; and
- a derived grassland on a basalt cap (Section 4.3.2ii).

Shrubby White Box Woodland (Section 4.3.2i) was not considered to represent Box Gum Woodland because the understorey was dominated by shrubs, and not grasses. The determination for this community requires that the understorey is mainly grassy, and excludes shrubby remnants (NSWSC 2002).



Endangered ecological communities

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 5.1

5.1.2 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

White Box Yellow Box Blakely's Red Gum Grassy Woodland and DNG is listed as a CEEC under the EPBC Act. The EPBC Act criteria for the community are slightly different to the community listed under the TSC Act. Approximately 17.2 ha of this community is present in the study area.

This community 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 comprise:

- the most common overstorey species are/were White Box, Yellow Box or Blakely's Red Gum;
- a predominantly native understorey;
- patch size greater than 0.1 ha; and
- twelve or more native understorey species present (excluding grasses) with at least one important species OR a patch size greater than 2 ha (SEWPaC 2011d).

The different forms of Grassy White Box Woodland were assessed under the EPBC criteria to see if remnants qualified as the community under the EPBC Act.

Using a precautionary approach, Ecovision Consulting (2008) determined that the derived grassland form in the MCP Stage 2 area met the EPBC criteria for White Box Yellow Box Blakely's Red Gum Grassy Woodland and DNG, as it was thought to previously have contained White Box as a canopy species.

The White Box dominant woodland remnants do not meet the EPBC criteria as the patch size is less than 2 ha, and the understorey did not contain enough native species. Although the Rough-barked Apple/White Box Woodland form did not contain 12 or more native understorey species, the patch size is greater than 2 ha, therefore meets the EPBC criteria.

Shrubby White Box Woodland did not meet the EPBC criteria because the shrub cover was greater than 30% (DEH 2006).

5.2 Threatened flora species

Nineteen individuals of suspected Cannon's Stringybark (*Eucalyptus cannonii*), listed as vulnerable under both the TSC and EPBC Acts, were found in the proposed Open Cut 1 extension area. The species is also listed as declining in the Kerrabee subregion (Sattler and Creighton 2002). They occurred on the edge of a south-west facing slope at the intergrade between White Box Shrubby Woodland (Section 4.3.2i) and Ridgetop Broad-leaved Ironbark Cypress Pine Woodland on shallow sands (Section 4.3.2iii). Associated canopy species included White Box, Black Cypress Pine and the similar Red Stringybark (*Eucalyptus macrorhyncha*), while shrubs including *Dillwynia juniperina,* Rough-saw Sedge, and Currawang were also present. The underlying geology in this area is siltstone and sand of the Triassic Narrabeen Group.

Samples taken were reviewed by identification botanists at the Royal Botanic Gardens in Sydney. The identification botanists concluded that the samples collected were a hybrid of Cannon's Stringybark and Red Stringybark (*Eucalyptus macrorhyncha*). The hybrid is not recognised in the approved Commonwealth conservation advice for the species (DSEWPaC 2008) or the NSW Environmen Impact Assessment Guidelines (NPWS 2000), therefore is not assessed further in this report.

The study area contains potential habitat for a number of threatened flora species not detected during the survey. Based on the outcomes of the extensive literature review and surveys, it is considered likely that the Pine Donkey Orchid could occur in Cypress Pine, Ironbark and Box Gum Woodlands of the study area as it was recorded in similar habitat during the MCP Stage 1 assessment (Moolarben Biota 2006). Therefore, it has been conservatively assumed as present in these habitat types. Potential habitat also exists for the Scant Pomaderris in Shrubby White Box Forest, however, this species is readily detectable, and was not recorded during targeted surveys. Therefore, it is not considered likely to occur in the study area.

5.3 Threatened fauna species

i Amphibians

No threatened amphibian species were recorded in the study area. Amphibian habitat is limited to Moolarben Creek located between 100 m and over 1 km of the proposed extension areas.

ii Reptiles

No threatened reptiles were recorded in the study area. The Broad-headed Snake is moderately likely to occur in the study area, and take shelter under flat sandstone rocks in open forest on the ridgelines and hillslopes, and hollow trees for summer sheltering in this habitat type.

The Little Whip Snake and Pink-tailed Worm Lizard are moderately likely to occur in and adjacent to the study area, in the derived grasslands between the proposed extension areas, and the grassy understorey of footslope and riparian woodlands. Scattered, partially buried rocks are available in these habitat types, and would provide sheltering opportunities for these species if present.

iii Diurnally-active birds

Three diurnally-active threatened bird species were recorded in the study area. The Brown Treecreeper was observed gleaning insects in Ridgetop Broad-leaved Ironbark Grey Gum Woodland, while the Diamond Firetail and Turquoise Parrot were observed 50 m west of the study area in riparian woodland and exotic pasture.

Potential foraging evidence of the Glossy Black Cockatoo's presence, in the form of a chewed Black Cypress Pine cone was found in Grey Gum Blue-leaved Ironbark Woodland. These species are known to feed on cypress pines in the nearby Central West (pers.obs). This pine cone may have also been chewed by the Yellow-tailed Black Cockatoo, observed in the study area. The precautionary principle has been applied in this instance given the proximity of recent records and the presence of limited suitable habitat.

Despite not being recorded, a number of other threatened bird species have the potential to occur in the study area comprising:

- Black-chinned Honeyeater, likely to occur due to the abundance of recent nearby records (Moolarben Biota 2006; Ecovision Consulting 2008; Eremaea Birds 2012; Mount King Ecological Surveys 2005; Umwelt 2009), and the presence of White Box, stringybarks and ironbarks which are favoured food tree species;

- Grey-crowned Babbler, likely to occur due to previous local records (Moolarben Biota 2006; Ecovision Consulting 2008) in Box Gum Woodlands and ironbark-dominated forests;

- Flame Robin and Gang-gang Cockatoo (recorded by Moolarben Biota 2006 and Ecovision Consulting 2008), likely to occur in open forests, footslope woodlands and riparian woodlands winter months when birds are dispersing to lower altitude, drier habitats (NSWSC 2005; OEH 2012b);

- Painted Honeyeater (recorded by Moolarben Biota 2006 and Ecovision Consulting 2008), likely to occur in Grassy White Box Woodland and Shrubby White Box Forest containing mistletoes; and

- Regent Honeyeater, Swift Parrot and Varied Sittella, likely to occur in Grassy White Box Woodland and Shrubby White Box Forest due to the presence of White Box, a key eucalypt feed species. Grey Gum Ironbark Forest also represents potential habitat for the Varied Sittella. In addition, the Mudgee-Munghorn Gap-Wollar area is one of the few where the Regent Honeyeater is regularly observed and is considered to be one of only a few key Regent Honeyeater breeding areas in NSW (NPWS 2002).

The Black-breasted Buzzard, Spotted Harrier, Square-tailed Kite, Speckled Warbler, Scarlet Robin, Hooded Robin, Little Eagle and Little Lorikeet are also considered likely to occur in riparian woodlands adjacent to the proposed extension area as most of these species were recorded in the MCP Stage 1 assessment (Moolarben Biota 2006).

iv Nocturnal birds

Two threatened forest owl species, the Powerful Owl and Masked Owl, were observed hunting in Grey Gum Blue-leaved Ironbark Forest.

Although not recorded, the study area contains potential habitat for Barking Owl in ironbark-dominated forests on ridges where the same habitat features are offered as for the Powerful and Masked Owls.

v Non-flying mammals

No threatened non-flying mammal species were in the study area, nor was evidence of their presence (ie scats, scratches, feeding scars) recorded during targeted surveys. Limited potential habitat exists for the:

- Squirrel Glider in riparian and footslope woodlands where hollow trees are present for denning and foraging habitat is available;

- Spotted-tail Quoll on ridges containing rocky outcrops, and in gullies and creeks as movement corridors; and

- Koala in Grassy White Box Woodland, lower areas of Shrubby White Box Forest and Grey Gum Blue-leaved Ironbark Forest where White Box and Narrow-leaved Ironbark, favoured secondary and supplementary feed trees are present.

Therefore, the assessment concludes that threatened non-flying mammals have a very low likelihood of occurrence in the study area.

vi Flying mammals

Two threatened microbat species were recorded in the study area. The threatened Eastern Bentwing Bat and Eastern Cave Bat were recorded in open forest on a ridge. The Eastern Bentwing Bat was also recorded in footslope woodland. Cracks and crevices in rocky outcrops provide potential roosting habitat for these species. It is likely that the Eastern Cave Bat may be breeding in the area, evidenced by the open sandstone overhang, and large volume of microbat scat (Brad Law and Michael Pennay, *pers.comm.* 2012) (Photograph 5.1).

Photograph 5.1 Potential Eastern Cave Bat maternity site

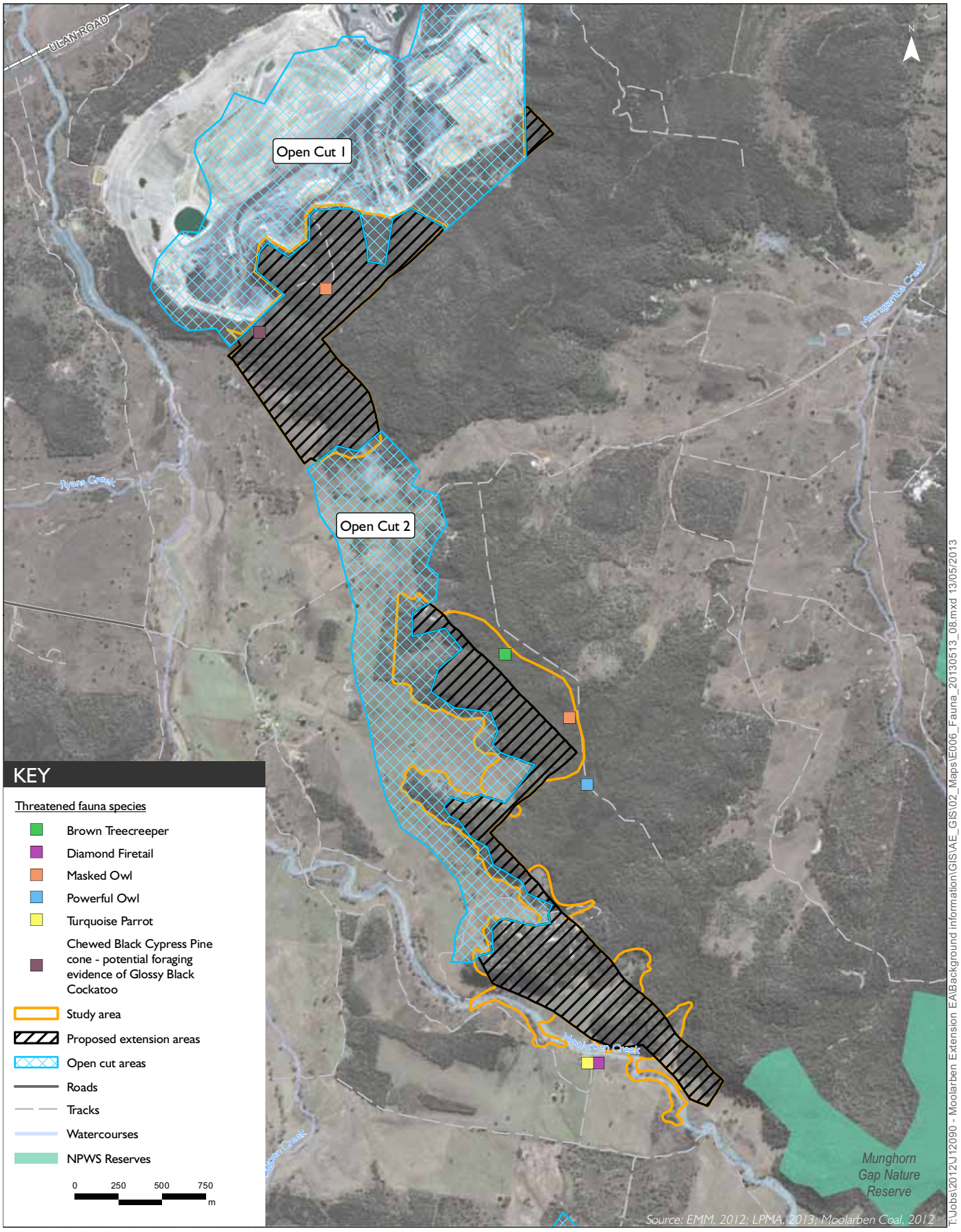
Although not recorded, the study area contains potential habitat for other threatened microbats previously recorded in the local area, comprising the:

- Large-eared Pied Bat, Little Bentwing Bat and Little Pied Bat in caves and crevices of rocky outcrops;
- Southern Long-eared Bat, in open forests and woodlands; and
- Yellow-bellied Sheathtail Bat, in open forest tree hollows on ridges and hillslopes, footslope woodlands and riparian woodlands. Foraging habitat is available in open areas over riparian woodland and adjacent exotic pasture.

These microbat species are considered likely to occur in the study area given their detection in previous ecological assessments (Ecovision 2008; Moolarben Biota 2006).

The following threatened species may also occur due to their detection at Wilpinjong (Mount King Ecological Surveys 2005) and the presence of suitable habitat:

- East-coast Freetail Bat in ironbark woodlands;
- Eastern False Pipistrelle, likely to occur in winter and autumn when individuals are dispersing to lower altitude, drier habitats; and
- Greater Broad-nosed Bat in open forest, footslope woodland and riparian woodland.



Threatened fauna species identified during EMM 2012 surveys

Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment

Figure 5.2

5.4 Threatened populations

No threatened populations were recorded in the study area.

Cymbidium canaliculatum was not recorded during targeted surveys on their favoured host tree species, White Box, and is therefore unlikely to occur.

5.4.1 SEPP 44 Koala Habitat Assessment

White Box and Narrow-leaved Ironbark were recorded in the study area, and are listed as important species in the Central Coast Koala Management Area (of which the study area is part).

While these tree species are present in the study area, Koalas were not recorded during the surveys. This species has been previously recorded at Ulan Coal Mine (Umwelt 2009), and is known from Munghorn Gap Nature Reserve (OEH 2012c).

No Koala faecal pellet plots were observed during plot surveys in suitable habitat. In addition, nocturnal call playback and spotlighting failed to identify any individuals within the study area.

For assessment purposes, and due to the presence of suitable habitat for this species, it is considered possible that Koalas may occur in low numbers in the study area. As it is part of a regional corridor (Section 4.3.6), the study area may represent a movement corridor for dispersal to Munghorn Gap Nature Reserve where this species has previously been recorded.

6 Impact assessment

This chapter assesses the likely impacts of the proposed modification on ecological values, with particular focus on impacts on threatened species and ecological communities recorded in, 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 impacts.

6.1 Impact assessment

6.1.1 Timing and duration

Under the proposed modification, Stage 1 operations will continue to 2033. The removal of vegetation and fauna habitat will occur progressively over the life of the operation, with rehabilitation occurring concurrent with this process.

Management of offsets for biodiversity outcomes will occur, subject to approval of the proposed modification, as soon as practicable after approval is granted. The biodiversity offsets will be managed in accordance with an offset area management plan, prepared for each of the offset properties (refer to Chapter 8).

6.1.2 Direct impacts

i Vegetation clearing

Approximately 171 ha of native vegetation and 7 ha of exotic pasture will be directly impacted by the proposed modification, with a total disturbance area of approximately 178 ha.

Native vegetation in the north of the study area is adjacent to an existing mine pit (Open Cut 1), and vegetation in the south is adjacent to agricultural land and an approved, but as yet, undeveloped mine pit. It is subject to edge effects including weed invasion and grazing. In addition, three disused hard rock quarries exist within areas of native vegetation on the western edge of the proposed extension areas.

Woodland and forest vegetation to be cleared represents less than 0.5% of the remnant forest and woodland outside of conservation areas in the Hunter-Central Rivers CMA (34,533 ha of woodland and 24,792 ha of forest (Somerville 2009b)).

Table 6.1 provides the area of each vegetation community that will be removed by the proposed modification, including the area of TECs that will be removed.

Table 6.1 Vegetation clearing

Vegetation type	Biometric vegetation type	Threatened ecological community	Area to be removed (ha)
Shrubby White Box Forest	HU653: White Box – Narrow-leaved Ironbark open forest on hills of the central Hunter Valley, Sydney Basin	-	13.3
Grassy White Box Woodland	HU654: White Box – Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South	White Box Yellow Box Blakely's Red Gum Woodland EEC (TSC Act listing)/White Box Yellow Box Blakely's Red Gum Grassy Woodland and DNG CEEC (EPBC Act listing)	17.2 (TSC Act listing) 16.5 (EPBC Act listing)
Ridgetop Broad-leaved Ironbark – Black Cypress Pine on shallow sands	HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin	-	14.3
Ridgetop Broad-leaved Ironbark Grey Gum Forest	HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin	-	96.8
Rough-barked Apple Alluvial Woodland	HU605: Rough-barked apple grassy open forest on valley flats of the North Coast and Sydney Basin	-	0.7
Rough-barked Apple – Cypress Pine Woodland on slopes	HU603: Rough-barked Apple – Silvertop Stringybark – Ribbon Gum shrub/grass open forest on hills of the southern Nandewar Bioregion	-	29.1
Exotic pasture	N/A	-	6.6
Total			**178**

Notes: 1. TEC – threatened ecological community

ii Loss of fauna habitat

Approximately 178 ha of forest, woodland and pasture representing fauna habitat will be removed from the proposed extension areas (Table 6.2). Of this total area, approximately 153.5 ha contains open forest on ridges and hillslopes. This habitat type provides resources for a range of common and threatened fauna and flora species with features including structural diversity, hollow-bearing trees, rocky outcrops and fallen timber.

Fourteen hectares of footslope grassy woodlands will be directly impacted by the proposed modification. However, this habitat type had a lower density of hollow-bearing trees within the study area. Small areas of riparian grassy woodlands (0.7 ha) and exotic pasture (6.6 ha) will also be removed, which contain habitat for threatened birds (Turquoise Parrot and Diamond Firetail).

Habitat features that will be removed include hollow-bearing trees and rocky outcrops. Measures to minimise adverse impacts will be undertaken in accordance with MCP's Landscape Management Plan (LMP) and include where practical salvage and relocation of large hollows identified during pre-clearance surveys. Impacts from the removal of these structural habitat features in the proposed extension areas require careful management, 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, Black-chinned Honeyeater, Diamond Firetail, East-coast Freetail Bat, Eastern Cave Bat, Greater Broad-nosed Bat, Hooded Robin, Large-eared Pied Bat, Little Pied Bat, Masked Owl, Painted Honeyeater, Powerful Owl, Barking Owl, Regent Honeyeater, Southern Long-eared Bat, Speckled Warbler, Varied Sittella and Yellow-bellied Sheathtail Bat were observed or have the potential to breed in the study area. Collectively, approximately 178 ha of potential threatened species breeding habitat will be removed over the life of the proposed modification. It is noted that removal of vegetation and habitat will occur progressively, and that rehabilitation will occur concurrent to this process.

Table 6.2 Fauna habitat removed for the proposed modification

Habitat type	Area to be cleared (ha)	Associated threatened fauna species
Open forests on hillsides and ridges	153.5	Brown Treecreeper, Black-chinned Honeyeater, East-coast Freetail Bat, Eastern Bentwing Bat, Eastern Cave Bat, Glossy Black-cockatoo, Greater Broadnosed Bat, Large-eared Pied Bat, Little Pied Bat, Masked Owl, Powerful Owl Varied Sittella and Yellow-bellied Sheathtail Bat
Footslope grassy woodlands	17.2	Eastern Bentwing Bat, Glossy Black-cockatoo, Hooded Robin , Painted Honeyeater, Regent Honeyeater, Southern Long-eared Bat, Speckled Warbler and Yellow-bellied Sheathtail Bat
Riparian grassy woodlands	0.7	Diamond Firetail and Turquoise Parrot, Southern Long-eared Bat, Speckled Warbler and Yellow-bellied Sheathtail Bat
Exotic pasture	6.6	Diamond Firetail, Turquoise Parrot and Yellow-bellied Sheathtail Bat
Total	**178**	**-**

iii Threatened species, populations and communities

One threatened flora species, six fauna species and one TEC listed under the TSC Act were identified in the study area. Of these species and communities, one TEC and one threatened flora species were also listed under the EPBC Act. An endangered population listed under the TSC Act was also recorded adjacent to 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 6.3. The results are summarised in Table 6.3. Significance assessments do not take account of the proposed offsets that will provide for a net biodiversity improvement (see Chapter 8).

Table 6.3 Summary of potential impacts to threatened species, populations and communities recorded, or likely to occur, in the study area

Threatened biodiversity	Conservation status		Recorded in the study area?	Impact description	Likely significance of impact after mitigation is applied
	TSC Act	EPBC Act			
Ecological communities					
White Box Yellow Box Blakely's Red Gum Woodland/White Box Yellow Box Blakely's Red Gum Grassy Woodland and DNG	E	CE	Yes	Removal of 17.2 ha (TSC Act) and 16.5 ha (EPBC Act)	Significant
Plant species					
Pine Donkey Orchid (*Diuris tricolor)*	V	-	No	Removal of potential habitat	Not significant
Scant Pomaderris (*Pomaderris queenslandica*)	E	-	No	Removal of potential habitat	Not significant
Silky Swainson Pea (*Swainsona sericea*)	V	-	No	Removal of potential habitat	Not significant
Plant populations					
River Red Gum (*E. camaldulensis*) population in the Hunter Catchment	E	-	No – recorded adjacent	Potential impacts from changes to the runoff surface area of the Moolarben Creek catchment area	Not significant
Reptiles					
Broad-headed Snake (*Hoplocephalus bitorquatus*)	V	-	No	Removal of potential habitat	Not significant
Little Whip Snake (*Suta flagellum*)	V	-	No	Removal of potential habitat	Not significant
Pink-tailed Worm Lizard (*Aprasia parapulchella*)	V	V	No	Removal of potential habitat	Not significant
Birds					
Barking Owl (*Ninox connivens*)	V	-	No	Removal of potential habitat	Not significant
Black-breasted Buzzard (*Hamirostra meanosternon*)	V	-	No	Removal of potential habitat	Not significant
Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)	V	-	No	Removal of potential habitat	Not significant
Brown Treecreeper (*Climacteris picumnus victoriae*)	V	-	Yes	Removal of approximately 90 ha of habitat	Significant
Diamond Firetail (*Stagonopleura guttata*)	V	-	Yes	Removal of approximately 47 ha of habitat	Not significant
Flame Robin (*Petroica multicolor*)	V	-	No	Removal of potential habitat	Not significant

Table 6.3 Summary of potential impacts to threatened species, populations and communities recorded, or likely to occur, in the study area

Threatened biodiversity	Conservation status		Recorded in the study area?	Impact description	Likely significance of impact after mitigation is applied
	TSC Act	EPBC Act			
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	V	-	No	Removal of potential habitat	Not significant
Gilbert's Whistler	V	-	No	Removal of approximately 13 ha of breeding and foraging habitat	Not significant
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	V	-	Yes	Removal of potential habitat	Not significant
Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)	V	-	No	Removal of potential habitat	Not significant
Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*)	V	-	No	Removal of potential habitat	Not significant
Little Eagle (*Hieraeetus morphnoides*)	V	-	No	Removal of potential habitat	Not significant
Little Lorikeet (*Glossopsitta pusilla*)	V	-	No	Removal of potential habitat	Not significant
Masked Owl (*Tyto novaehollandiae*)	V	-	Yes	Removal of approximately 133 ha of habitat	Not significant
Painted Honeyeater (*Grantiella picta*)	V	-	No	Removal of potential habitat	Not significant
Powerful Owl (*Ninox strenua*)	V	-	Yes	Removal of approximately 133 ha of habitat	Not significant
Regent Honeyeater (*Anthochaera phrygia*)	CE	E	No	Removal of approximately 11 ha of potential foraging habitat	Not significant
Scarlet Robin (*Petroica boodang*)	V	-	No	Removal of potential habitat	Not significant
Speckled Warbler (*Chthonicola saggitatus*)	V	-	No	Removal of potential habitat	Not significant
Spotted Harrier (*Circus assimilis*)	V	-	No	Removal of potential habitat	Not significant
Square-tailed Kite (*Lophoictinia isura*)	V	-	No	Removal of potential habitat	Not significant
Swift Parrot (*Lathamus discolor*)	E	E	No	Removal of potential habitat	Not significant
Turquoise Parrot (*Neophema pulchella*)	V	-	Yes	Removal of approximately 15 ha of habitat	Not significant

Table 6.3 Summary of potential impacts to threatened species, populations and communities recorded, or likely to occur, in the study area

Threatened biodiversity	Conservation status		Recorded in the study area?	Impact description	Likely significance of impact after mitigation is applied
	TSC Act	EPBC Act			
Varied Sittella (*Daphoenositta chrysoptera*)	V	-	No	Removal of potential habitat	Not significant
Mammals					
Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)	V	-	Yes	Removal of approximately 133 ha of habitat	Not significant
Eastern Cave Bat (*Vespadelus troughtoni*)	V	-	Yes	Removal of approximately 90 ha of habitat comprising 3km cliffline (potential breeding) and 90 ha of foraging habitat	Significant
East-coast Freetail Bat (*Mormopterus norfolkensis*)	V	-	No	Removal of potential habitat	Not significant
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V	-	No	Removal of potential habitat	Not significant
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V	-	No	Removal of potential habitat	Not significant
Koala (*Phascolarctos cinereus*)	V	V	No	Removal of potential habitat	Not significant
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	V	No	Removal of potential foraging habitat	Not significant
Little Bentwing Bat (*Miniopterus australis*)	V	-	No	Removal of potential habitat	Not significant
Little Pied Bat (*Chalinolobus picatus*)	V	-	No	Removal of potential habitat	Not significant
Southern Long-eared Bat (*Nyctophilus corbeni*)	V	V	No	Removal of potential habitat	Not significant
Spotted-tailed Quoll (*Dasyurus maculatus*)	V	E	No	Removal of potential habitat	Not significant
Squirrel Glider (*Petaurus norfolcensis*)	V	-	No	Removal of potential habitat	Not significant
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V	-	No	Removal of potential habitat	Not 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 from the proposed modification are likely to be significant for one TEC and two threatened fauna species (Table 6.3).

The White Box Yellow Box Blakely's Red Gum Woodland EEC that will be removed for the proposed modification represents approximately 10% of native vegetation in the proposed extension areas. While this is relatively small in comparison with the total area of vegetation to be removed, it is considered significant due to the status of this community in the region (estimated at 90% of woodland cleared). These impacts will be compensated for by revegetation activities in the proposed modification footprint and by offsets to provide a long-term improvement in the quality and quantity of this TEC in the region.

It is likely that the proposed modification will significantly impact, ie high risk of extinction of the local population (as defined by DECC 2007a) two TSC Act listed threatened fauna species, namely, the Brown Treecreeper and Eastern Cave Bat, both of which were recorded within the study area.

The Brown Treecreeper is a highly sedentary species. The proposed modification will remove 90 ha of known foraging and potential breeding (ie tree hollows) habitat for this species. Impacts to the Brown Treecreeper are considered likely to be significant due to the habitat removal and its highly sedentary nature.

The Eastern Cave Bat is associated with open forest on ridges of the study area, depending on habitat resources including caves within clifflines, a limiting factor in the locality. A potential Eastern Cave Bat maternity site was found in the study area, which will be removed for the proposed modification. Breeding habitat in rocky outcrops is considered to be a limiting factor in the locality. Known foraging habitat for the species will also be removed. In consideration of these factors, impacts to the Eastern Cave Bat are considered to be significant.

Progressive rehabilitation during mining will include replanting woodland habitat, the reinstatement of habitat features, such as rock salvaged during clearing. These measures aim to assist bird and bat species to maintain territories in the locality, by providing habitat features in the medium to long term.

While some impacts are expected for other threatened fauna species including diurnal birds (Black-chinned Honeyeater, Painted Honeyeater, Regent Honeyeater, Diamond Firetail, Gilbert's Whistler, Grey-crowned Babbler, Speckled Warbler, Hooded Robin and Gang-gang Cockatoo), forest owls (Barking Owl, Masked Owl and Powerful Owl), and microbats (Large-eared Pied Bat, Little Pied Bat, Eastern Bentwing Bat and Little Bentwing Bat) from the loss of potential habitat, these impacts are not considered to be significant. Local populations of the species are considered to comprise those present within the study area and connected native bushland and conservation reserves.

Habitat resources occur outside the disturbance footprint, with abundant similar habitat available in wooded areas to the east, and in the connected corridor with Goulburn River NP to the north, which is approximately 404 times the size of the proposed extension areas, and Munghorn Gap Nature Reserve to the south of the study area, which is approximately 34 times the size of the proposed extension areas. While connectivity is being retained with these areas, proposed offsets aim to improve the connectivity of local 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.

iv Migratory species

Three listed migratory are considered likely to occur in the study area, the Rainbow Bee-eater, Rufous Fantail and Regent Honeyeater. Assessments of the significance of potential impacts of the proposed modification were 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 6.4. No significant impact is anticipated for the Rainbow Bee-eater, Rufous Fantail and Regent Honeyeater.

Table 6.4 Summary of potential impact to migratory species

Species or community	Conservation status		Recorded in the study area?	Impact description	Outcome of Significance Assessment (mitigated) (Appendix B)
	TSC Act	EPBC Act			
Rainbow Bee-eater (*Merops ornatus*)	-	Mi	No	Removal of potential habitat	Not significant
Rufous Fantail (*Rhipidura rufifrons*)	-	Mi	No	Removal of potential habitat	Not significant
Regent Honeyeater	CE	E, Mi	No	Removal of 11 ha of potential foraging habitat	Not significant

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

v 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 and nineteen KTPs are currently listed under the TSC Act and EPBC Act, respectively. Table 6.5 lists the KTPs with the potential to be increased by the proposed modification. The table also summarises the likely impacts of the proposed modification on these KTPs.

Table 6.5 Key threatening processes and significance of threat

Key threatening process	Relevance to proposed modification
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	The catchment area of Moolarben Creek will only be reduced by 1.1% by the proposed modification (WRM 2013). Further, flooding behaviour is not expected to change following the development of the proposed extension areas (Worley Parsons 2006). Therefore, the proposed modification is unlikely to impact this KTP.
Bush rock removal	The proposed modification requires the removal of bush rock and rocky outcrops. Habitat features such as large logs and bush rock will be retained for use during rehabilitation. In addition, investigation into the replacement of roosting areas for threatened microbats within infrastructure (bridges and culverts) will occur in accordance with MCO's LMP.
Clearing of native vegetation	Approximately 171 ha of native vegetation will be cleared within the disturbance area. All native vegetation to be cleared will be rehabilitated in stages during the proposed modification.
Competition and grazing by the feral European Rabbit	While European Rabbits occur within the study area, their current impact appears to be minor. It is considered that the proposed modification will not significantly increase the level of this threat. Feral animal control will be undertaken for offset and rehabilitation areas in accordance with the LMP.
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	The Blue Mountains Region Pest Management Strategy (NPWS 2007) identifies this fungus in the greater Blue Mountains area of which the study area is part. It could be spread to the site from machinery and workers vehicles, shoes and tools if not managed. Appropriate controls will be included in the LMP to minimise the potential spread of this disease to and within the study area.
Ecological consequences of high frequency fires	Fires may be lit for training scenarios and hazard reduction burns, posing a risk to retained native vegetation. Bushfire management measures will continue to be implemented in accordance with the Bushfire Management Plan.

Table 6.5 Key threatening processes and significance of threat

Key threatening process	Relevance to proposed modification
Introduction and establishment of Exotic Rust Fungi of the order Uredinales pathogens 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 Australian Capital Territory (ACT) and western/inland regions on NSW. It is therefore considered a low risk for the proposed extension areas and as such no management is considered necessary.
Loss and/or degradation of sites used for hill-topping by butterflies	Butterfly species that 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 removed by the proposed modification, but rehabilitation areas will also create potential habitat in the long term. Therefore, no measures are considered warranted to manage this KTP.
Loss of hollow-bearing trees	Hollow-bearing trees are currently a limiting habitat feature within the study area. Although tree hollows are present in nearby conservation reserves and immediately adjacent remnant vegetation, it is likely that these are already occupied by hollow-dependent fauna. Accordingly, the loss of any hollow-bearing trees represents a substantial threat to local hollow-dependent fauna (OEH 2011). Management measures including pre-clearance processes and hollow replacement will continue to be implemented in accordance with the LMP.
Predation by the feral cat	No feral cats were observed during the survey, but are known to reside in the nearby Goulburn River NP (NPWS 2007) and, as such, are likely to enter the study area during the life of the proposed modification. Feral animal control will be undertaken within unmined areas during the mine life, rehabilitation areas and within offset areas in accordance with the LMP, to minimise these potential impacts.
Predation, habitat degradation, competition and disease transmission by feral pigs	Moderate 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 Goulburn River NP and Munghorn Gap Nature Reserve. Feral animal control will be undertaken in accordance with the LMP within unmined areas during the mine life, rehabilitation areas and within offset areas, minimising potential adverse impacts.
Removal of dead wood and dead trees	The proposed works will remove dead wood and trees from the proposed extension areas. As currently occurs, such habitat features will be collected during clearing works and reinstated to rehabilitated areas during the operation of the mine in accordance with the LMP.
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. However, as the study area 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. The annual contribution of greenhouse gas emissions from the proposed modification in comparison to the Australian greenhouse emissions for the period October 2011 to September 2012 is estimated to be approximately 0.016%. The estimated annual average Scope 1 greenhouse emissions for the proposed modification are approximately 4.2 times lower than the equivalent GHG emissions estimated at 0.38Mt CO_2-e for the approved Stage 1 Project. The estimated annual average Scope 1 greenhouse emissions for proposed modification are similar to the equivalent GHG emissions estimated at 0.1Mt CO_2-e for Stage 2. Therefore, potential loss of terrestrial climatic habitat from the proposed modification is negligible.

Table 6.5 Key threatening processes and significance of threat

Key threatening process	Relevance to proposed modification
Predation by European Red Fox	High activity levels were observed for foxes in the study area. They 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 ground-dwelling threatened mammals are likely to occur in the study area, it is unlikely that the fox would be significantly impacting on threatened species in the locality.
Psittacine Circoviral Disease affecting endangered psittacine species	Threatened species potentially threatened by this process in the study area includes the Turquoise Parrot. No disease-infected birds were recorded within the study area and, therefore, it is considered that no controls are required.

vi 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 White Box Yellow Box Blakely's Red Gum Woodland (DECCW 2010a) 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 2006), described in Section 5.1.1) should be considered critical to the survival of this ecological community.

The study area occurs within this region and consequently all remnant areas identified as White Box Yellow Box Blakely's Red Gum Woodland EEC are considered critical habitat under the draft recovery plan. Disturbed areas will be rehabilitated with species indicative of this community (see Section 7.2.2). As described in Chapter 8, areas of critical habitat for White Box Yellow Box Blakely's Red Gum Woodlands are contained within offset sites, where remnants of the community will be improved and protected.

vii Matters of National Environmental Significance

Twelve MNES were recorded or are considered likely to occur in the proposed extension areas, including one TEC, seven threatened fauna species and three migratory birds.

Of these 12 MNES, one MNES was considered to be significantly impacted by the proposed modification comprising approximately 16.5 ha of White Box Yellow Box Blakely's Red Gum Grassy Woodland and DNG.

6.1.3 Indirect impacts

This section provides information on indirect impacts including noise, fragmentation, impacts to conservation reserves and pest species. Other potential indirect impacts that are considered a very low risk are addressed in Table 6.5.

i Noise

There are no Commonwealth or NSW noise assessment criteria applicable to the protection of native fauna or MNSW threatened and migratory species. The proposed modification is adjacent to an existing mining area. Mine operations already emit noise in the study area, which has the ability to disrupt fauna behaviour. Less fauna activity (particularly for birds) was observed in the Open Cut 1 extension when compared with the proposed Open Cut 2 extension, which is yet to be developed. Nonetheless, noise impacts to fauna following the development of Open Cut 2 are not expected to increase greatly in the study area.

Avoidance behaviour is an anticipated reaction of local fauna to noise from the proposed modification. 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. Some fauna species may habituate to periodic noise disturbances in surrounding habitat.

Management of noise associated with the proposed modification will continue to be undertaken in accordance with MCO's Noise Management Plan.

Traffic levels and associated noise are not expected to increase from current operations, and as such, adverse ecological impacts are not expected.

ii Dust

The proposed extension will involve 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 study area.

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. Under targets set by the NSW Environmental Protection Agency, maximum monthly deposition rates of must not exceed 4 g/m^2/month. These targets will be continue to be monitored during construction and operation in accordance with the LMP.

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 (Saunders *et al*. 1991). A large (approximately 600 ha) connected patch of remnant vegetation occurs through the study area, connecting it to wooded and forested areas to the east, and a large regional corridor with Goulburn River NP and Munghorn Gap Nature Reserve. The proposed open cut extension areas are located on the western edge of this large patch of contiguous forest and woodland. Therefore, fragmentation is unlikely.

'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. These changed conditions can suit disturbance-tolerant species such as weeds, and an increase in edge also increases the chance of feral animals entering and using remnant vegetation (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 western edge of the study area is currently impacted by edge effects, where low-lying fertile land has been cleared for agriculture between steeper areas and where mining associated with Open Cut 1 has taken place.

Active ongoing rehabilitation works will be undertaken within these areas to create buffers to remnant vegetation patches.

iv Conservation reserves

There may be some impact to surrounding conservation reserves during gradual clearing of the proposed extension areas. Fauna may migrate from the proposed extension areas into surrounding conservation reserves, which may lead to competition for territory and habitat resources with resident fauna. Mitigation measures (Table 7.1) including the re-use of habitat features (ie hollow logs, rocks) will be implemented to minimise the likelihood of resource competition in surrounding conservation reserves.

v Pest species

Pest species including the European Red Fox and Rabbit may also be displaced following the gradual clearing of the proposed extension areas, and possibly migrate into surrounding conservation reserves to prey on native fauna. Mitigation measures (Table 7.1) including the feral animal management and control will be implemented to minimise the likelihood of migration into surrounding conservation reserves.

vi Impacts to water availability, quality and quantity

'The Drip', an important local seepage feature located to the north of the Goulburn River, represents the only significant seep/spring Groundwater Dependent Ecosystem within the locality, with vegetation reliant on this surface expression of groundwater clearly evident within the cliff line. 'The Drip' is located approximately 6 km to the north of the proposed extension areas. Scattered individuals of River Red Gums, known for their groundwater dependence, were recorded approximately 500 m west of the proposed Open Cut 2 extension area, along Moolarben Creek.

The groundwater impact assessment (AGE 2013) prepared for the proposed modification concluded that there would be negligible change in flows to surface water features including Moolarben Creek and no change to 'The Drip'. Therefore, there will be no impact on the River Red Gums along Moolarben Creek or vegetation supported by 'The Drip'.

The additional disturbance area associated with the proposed modification removes a small area of catchment draining to Moolarben Creek (WRM 2013). This removal of catchment has been compared with the overall Moolarben Creek catchment at this location, and only results in a 1.1% reduction in Moolarben Creek catchment area. This small reduction in catchment area will have a negligible impact on the flow characteristics of Moolarben Creek.

The proposed extension area is outside the extent of flooding and hence the proposed modification will have no additional impact on flood behaviour in Moolarben Creek.

There will be no change to discharge quality or quantity under the proposed modification.

Therefore, the proposed modification's potential impacts on water availability, quality and quantity will not adversely impact ecology.

6.1.4 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 and habitat values in the study area from the proposed modification may combine spatially and temporally to result in cumulative impacts locally and within the region.

The proposed modification is in the western coalfield of NSW. This coalfield includes three coal mines that include open cut operations: Moolarben, Ulan and Wilpinjong. Other smaller mineral mines occur, or are proposed within the region including a zirconium mine south of Dubbo. As noted in Section 1.3, the MCP Stage 2 application is currently being assessed by DP&I. If approved, Stage 2 will consist of one open cut pit, Open Cut 4, and two underground mines, Undergrounds 1 and 2. Approval is also sought for additional associated infrastructure.

Given the differences in the methods of assessment across studies, it is difficult to quantify the cumulative impacts across the MCP Stage 1, Wilpinjong and Ulan coal mines and the proposed MCP Stage 2. It is noted that quantitative information for Wilpinjong Coal Mine was not available.

Using the available information all projects result in a cumulative impact to 148 ha of Box Gum Woodland, through direct removal. If the MCP Stage 2 is approved, there may be cumulative impacts to vegetation and habitat from subsidence on ridgelines. Substantial offsets have been provided for both the Wilpinjong and Ulan Coal Mines and are proposed for the MCP Stage 2 project.

The proposed modification will contribute to the positive 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. Further, mined areas will be rehabilitated with native vegetation representative of the likely original communities, including areas indicative of Box Gum Woodland, and habitat for threatened birds and mammals.

7 Avoidance, mitigation and monitoring

Management of potential impacts have been addressed according to the hierarchy of avoid, mitigate then compensate. This section provides the avoidance and mitigation measures and an overview of proposed rehabilitation. The biodiversity offset strategy proposed to compensate for residual adverse impacts is provided in Chapter 8.

7.1 Avoidance

Avoidance measures for coal mines are difficult as resources are in fixed locations. Notwithstanding, ecological constraints were considered in the mine optimisation process. Avoidance measures considered in the mine design included:

- exclusion of Moolarben Creek from the proposed modification boundary to protect riparian zones and the habitats that these areas provide;
- modification of proposed extension area footprints to maintain connectivity between forested areas to the north and south of MCP and to ensure substantial vegetation is retained to the east. Rehabilitation will occur progressively as the mine develops to promote connectivity and provide additional habitat; and
- adoption of a two-stage gradual clearing protocol where non-habitat trees are cleared 24 hours prior to any habitat trees being cleared, to encourage fauna to move out of an area prior to impact.

These avoidance measures are considered to provide a substantial reduction in potential worst case ecological impacts.

7.2 Mitigation and monitoring

7.2.1 Measures

MCO's Environmental Management Strategy (EMS) provides the framework for environmental management at MCP. The EMS is supported by various management and monitoring plans required under MP05_0117. This includes the LMP that comprises three sub-plans, namely:

- rehabilitation and offset management plan;
- final void management plan; and
- mine closure plan.

The LMP also addresses Stage 1 EPBC approval's (EPBC 2007/3297) requirement for a rehabilitation and offset strategy.

The LMP includes a biodiversity mitigation strategy that aims to achieve a 'maintain and enhance' ecological outcome, resulting in a net positive biodiversity benefit in the post-developed landscape. The broad objectives of the strategy are to:

- avoid impacts on areas of high ecological value wherever practical;
- enhance local vegetation cover;

- increase utilisation of isolated vegetation remnants by local biodiversity such as woodland birds;
- improve connectivity between Munghorn Gap Nature Reserve and Goulburn River NP;
- improve connectivity between Dexter Mountain and Munghorn Gap Nature Reserve through revegetation and management; and
- secure the local conservation of EECs, their habitats and important local biodiversity.

The LMP details specific management goals, the means of achieving the abovementioned objectives, assessment criteria and monitoring requirements. MCO's Air Quality Management Plan (AQMP), Water Management Plan (WMP) and Noise Management Plan (NMP) are also relevant to the proposed modification, as they include measures to manage dust, erosion, sedimentation and noise. These plans will continue to be implemented under the proposed modification.

Measures that will be implemented to avoid and/or mitigate the potential impacts identified in Chapter 6 are provided in Table 7.1. It is noted that the majority of these are already included within the LMP. The LMP will be reviewed and updated as required to accommodate the proposed modification and mitigation measures listed below.

Table 7.1 Potential impacts and mitigation measures required

Potential impact	Mitigation measure
Vegetation clearing	
Gradual clearing of 171 ha of native vegetation.	• Implementation of MCO's Vegetation Clearance Protocol. This includes the delineation of areas to be cleared, pre-clearance surveys, management of impacts to fauna, and vegetation clearance procedures. • Implemenation of MCO's Ground Disturbance Permit to be approved by the Environment and Community Relations Manager as required under the LMP prior to the commencement of clearing activities.
Introduction of non-local plant stock.	• Use of native, locally sourced seed for propagation for rehabilitation activities where possible.
Disturbance of vegetation outside impact areas.	• Clear demarcation of clearing zones to restrict access. • Management for weeds, pest animals and restriction of access in revegetation/rehabilitation areas and those not disturbed by mine activities.
Dust impacts on vegetation reducing plant health.	• Implementation of dust minimisation and suppression measures detailed in the AQMP.

Table 7.1 Potential impacts and mitigation measures required

Potential impact	Mitigation measure
Gradual removal of 17.2 ha of White Box Yellow Box Blakely's Red Gum Woodland EEC (TSC Act listing) and 16.5 ha of White Box Yellow Box Blakely's Red Gum Grassy Woodland and DNG CEEC (EPBC Act listing) and broadly defined critical habitat	• Implementation of MCO's Vegetation Clearance Protocol under the LMP. • Rehabilitation of disturbed areas with species indicative of this community, in accordance with the LMP. • Inclusion of areas of critical habitat for this community in offset sites, where remnants of the community will be improved and protected.
Vegetation and habitat degradation from invasion of feral animals into remnant vegetation.	• Implementation of pest control in accordance with the LMP.
Loss of connectivity	• Promotion of connectivity between Munghorn Gap Nature Reserve and Goulburn River NP through revegetation and appropriate management, in accordance with the LMP.
Loss of fauna habitat	
Impacts to fauna species during clearing.	• Undertake pre-clearance surveys in accordance with MCO's Vegetation Clearance Protocol required under the LMP to identify trees, ground debris and caves 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.
Removal of identified threatened fauna habitat.	• Habitat features important to threatened fauna species for should be collected and stockpiled for reinstatement in rehabilitation areas in accordance with the LMP.
Loss of fauna habitat features within the landscape important to threatened fauna species.	• Habitat features such as large logs and rocks should be collected and stockpiled for re-use in rehabilitated areas, in accordance with the LMP.
Removal of hollow-bearing trees.	• Installation of nest boxes in accordance with the LMP to compensate for the loss of tree hollows.
Removal of rocky outcrops that provide roosting habitat for microbats.	• Update the LMP to include the investigation of artificial roosting structures for microbats to compensate for the loss of rocky outcrops.
Protected areas (NPWS estate)	
Impacts to protected areas from migration of feral animal populations from impact areas.	• Implementation of feral animal management measures in areas surrounding the disturbance areas in accordance with the LMP, and coordinate with NPWS to minimise impacts to protected areas in the locality.
Competition for territory and habitat resources from native fauna moving in from surrounding impact areas.	• Ongoing revegetation efforts will be implemented in accordance with the LMP to minimise the loss of habitat resources within the proposed extension areas.

Table 7.1 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.	• Implementation of weed invasion and dispersal prevention measures in and adjacent to the proposed extension areas in accordance with the LMP.
Feral animal invasion and spread into retained vegetation during clearing works.	• Implementation of feral animal management measures in the proposed extension and adjacent areas in accordance with the LMP.
Erosion and sedimentation	
Degradation of vegetation by erosion and sedimentation.	• Implementation of erosion and sediment control measures in accordance with the WMP.

7.2.2 Rehabilitation

MCO is committed to returning areas disturbed by mining operations to their pre-mining landuse or as otherwise agreement with relevant stakeholders. Rehabilitation at MCO is undertaken in accordance with a Mining Operations Plan (MOP) and the LMP. To date, a MOP has been prepared for Open Cut 1 only, the current mining area. A principal objective is to enhance vegetation cover and connectivity. Species will be chosen to improve faunal biodiversity and habitat. The approach to achieving its rehabilitation objectives, information on assessment criteria and monitoring program are detailed in the LMP and reinforced in the MOP.

Open Cut 1 will be principally rehabilitated to create Box Gum Woodlands and Sedimentary Ironbark Forests with stands of *Allocasurina spp.* Lands adjoining the northern part of Open Cut 2 and the haul road linking with Open Cut 1 that are under the control of MCO will also be revegetated to enhance vegetation cover and connectivity. A similar objective is proposed for the Open Cut 1 extension area which will be rehabilitated to Grassy White Box Woodlands and Broad-leaved Ironbark Forests.

The Box Gum Woodland mosaic will contain some areas of relatively dense tree and/or shrub cover, providing good shelter habitat and some areas of natural grassland. Species will be chosen to improve faunal biodiversity and habitat.

The Open Cut 1 extension area will be seeded with a combination of native perennial grasses, shrubs and woodland species consistent with those species found in the local area. Species selection will be designed to promote the development of forest and woodland with structured understorey, mid-storey and tree canopy coverage. This will increase overall biodiversity values and promote survival of these vegetation types in the post-mining landscape.

Open Cut 2 will be principally reinstated to agricultural land following mining. However, given the majority of the Open Cut 2 extension area is vegetated, and in accordance with MCO's commitment to creating long term habitat corridors, the majority of the extension area will be rehabilitated with native vegetation to develop habitats similar to the existing undisturbed environment. A small area in the south-western section will be restored to agricultural land.

8 Biodiversity offset strategy

8.1 Introduction

A Biodiversity Offset Strategy (BOS) was prepared by Eco Logical (ELA) to compensate for the unavoidable impacts to native vegetation and threatened species habitats from the proposed modification, as outlined in this chapter and given in full as Appendix D. The BOS includes a proposed Biodiversity Offset Package (BOP) which identifies the properties and provides a preliminary assessment of their ecological characteristics.

The BOS has been prepared to provide "*a comprehensive offset strategy to ensure that the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term*" in general recognition of the NSW Offsetting Principles (OEH 2008) and the Office of Environment Heritage (OEH) Interim Policy on assessing and offsetting impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure Projects (OEH 2011).

The BOS also considered the EBPC Act Offset Policy requires "*offset measures to be considered for residual impacts that cannot be mitigated to ensure the protection of MNES in perpetuity*" (SEWPaC 2012). A separate referral to SEWPaC is being prepared under the EPBC Act for impacts to matters of NES, specifically, but not limited to, 16.5 ha of White Box – Yellow Box – Blakely's Red Gum grassy woodland and DNG.

The proposed offset strategy has been designed to meet the principles of both the NSW and Commonwealth policies.

The OEH (2011) Policy uses a three-tiered approach to achieving offset outcomes. Tier 1 full "Improve or Maintain" outcome, Tier 2 "Negotiated No Net Loss" outcome and Tier 3 "Mitigated Loss" outcome. It is noted that a Tier 1 outcome is not possible for the proposed modification given the disturbance of 17.2 ha of the White Box Yellow Box Blakely's Red Gum Woodland which is a "red flag" community under the policy. The OEH (2011) Policy specifically acknowledges that proposals assessed as Major Projects under the EP&A Act do not have to meet the "maintain or improve" standard which is required under the Biobanking Scheme however, the impacts should be quantified using the Biobanking Assessment Methodology (BBAM) for benchmarking purposes. The approach taken by MCO is consistent with this policy. The BBAM was used to "inform" the quantum of offset required for the proposed modification, and whilst it is OEH's preference that a Tier 1 "maintain or improve" outcome is achieved, the policy provides a structured approach for assessing proposals that meet one or two alternative standards (Tier 2 "no net loss" and Tier 3 "mitigated loss"), which take into consideration the environmental, social and economic benefits provided by the proposed modification.

The BOS and proposed BOP provide:

- a "maintain or improve" quantification of the impacts of the proposed modification informed by the BBAM to guide the development of the offset strategy;
- offset properties to be permanently protected via an appropriate conservation mechanism such as registration of a Conservation Agreement under s.69B of the NPW Act or other equivalent measure, including possible transfer to the national parks estate subject to the agreement of the NSW Minister for the Environment, to ensure the protection, enhancement and conservation management of biodiversity values; and
- long term biodiversity management of these properties.

8.2 Proposed offset package

ELA investigated the availability and suitability of potential offset sites on behalf of MCO. This included identifying lands with appropriate conservation values in proximity to the MCP including land owned by MCO, land for sale or landowners who had expressed interest in managing their properties for conservation, identifying where these lands have potential to provide "like for like" vegetation and threatened species habitat (consistent with the provisions of the OEH's (2011) Policy, and where cost effective management can be implemented to improve the overall conservation value of the land).

Where possible, focus was directed to land adjacent to existing conservation areas including Goulburn River NP, Munghorn Gap Nature Reserve, approved Stage 1 and proposed Stage 2 offsets, thereby adding to the overall extent and connectivity of conserved land in the area. The approach also focused on increasing the strategic value of MCO's offsets for the MCP in its entirety.

Following extensive investigations the BOP was formed. Table 8.1 below lists the seven properties that comprise the BOP. All properties are either owned by MCO or are in process of being purchased. The locations of these properties, together with offset areas approved under Stage 1, proposed under Stage 2 and approved for other mines' in locality, are shown in Figure 8.1.

Table 8.1 Offset properties and areas of mapped native vegetation

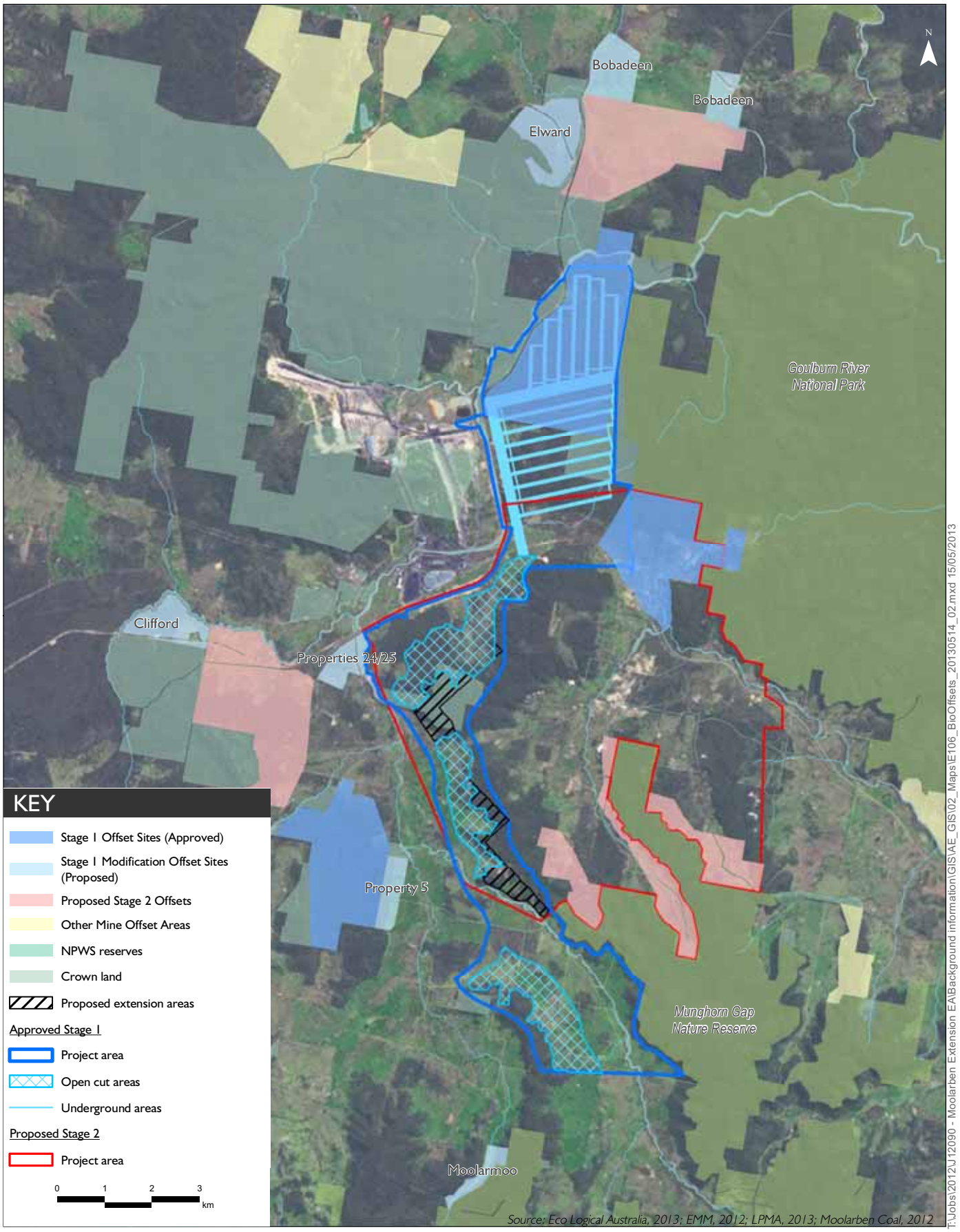
Property	Lot and DP	Area of mapped native vegetation (ha)
Clifford	Lot 288 DP 704081	102.23
Elward	Lot 84 DP 704077	170.77
Property #5	Lot 237 DP 755442	63.97
Properties #24 and #25	Lot 31 DP 633148, Lot 8 DP 626648	63.50
Bobadeen	Lot 5 DP 750736, Part Lot 1 DP 593639, Lot 1 DP 110465, Part Lot 6 DP 750736, Lot 5 DP 750750, Lot 2, 3, 4 and 5 DP 111560	184.15
Moolarmoo	Lots 184 and 221 DP 755442	44.49
Total		**629.11**

Combined, these seven properties provide a direct offset of 629 ha and an offset ratio of 3.67:1 (Offset: Impact). It is noted that areas of highly disturbed or poor quality vegetation, including areas of DNG have been excluded from the offset area calculations due to the risks and time delays associated with enhancing these areas.

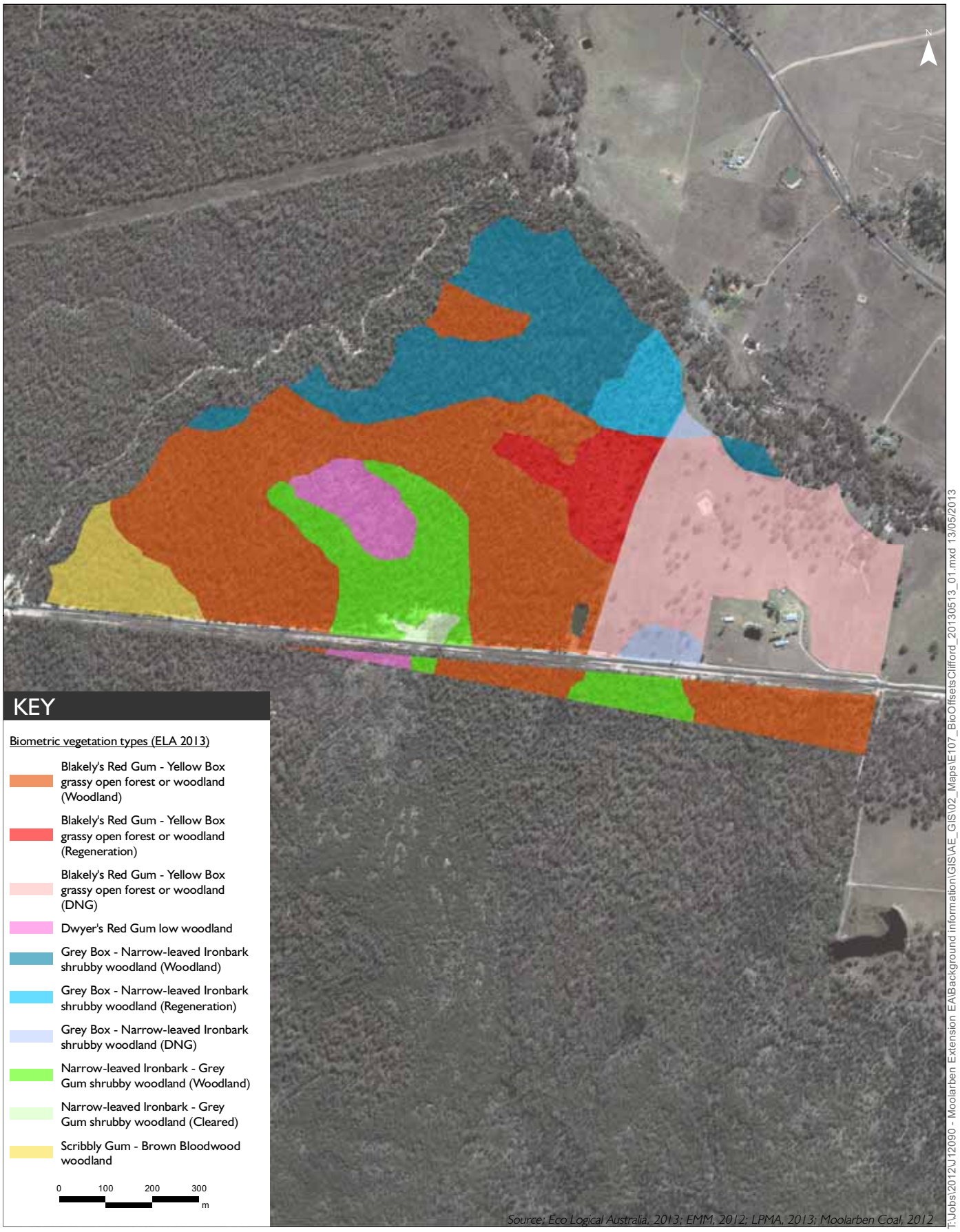
Figures 8.2 to 8.7 show the mapped vegetation types at each of the offset properties.

A comparison of the mapped vegetation types with those being impacted and the threatened species habitat has been undertaken in accordance with the Offset Principles and Major Projects Offset Policy (OEH 2008, 2011). Each property has the appropriate vegetation types, area, threatened species habitats and also contribute to regional conservation priorities and landscape connectivity (Table 2 of of Appendix D).

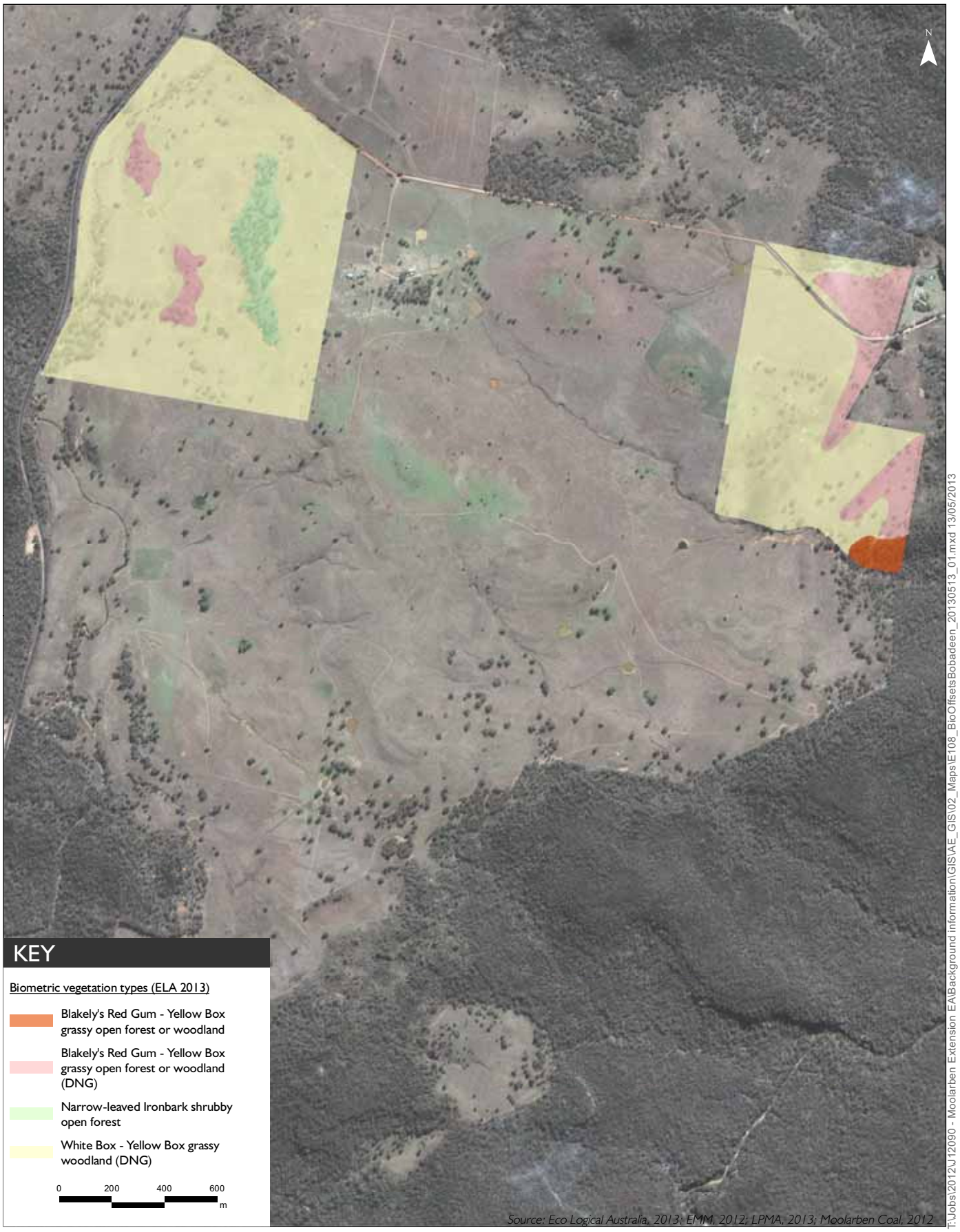
Of the 629 ha of mapped vegetation, it is all in moderate-good biometric condition, including approximately 250 ha of DNG and all but 4.17 ha provides "matching/like for like" or "better" conservation values.



Existing and proposed offset areas
Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assesment
Figure 8.1



Mapped vegetation of the Clifford property
Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment
Figure 8.2



EMM

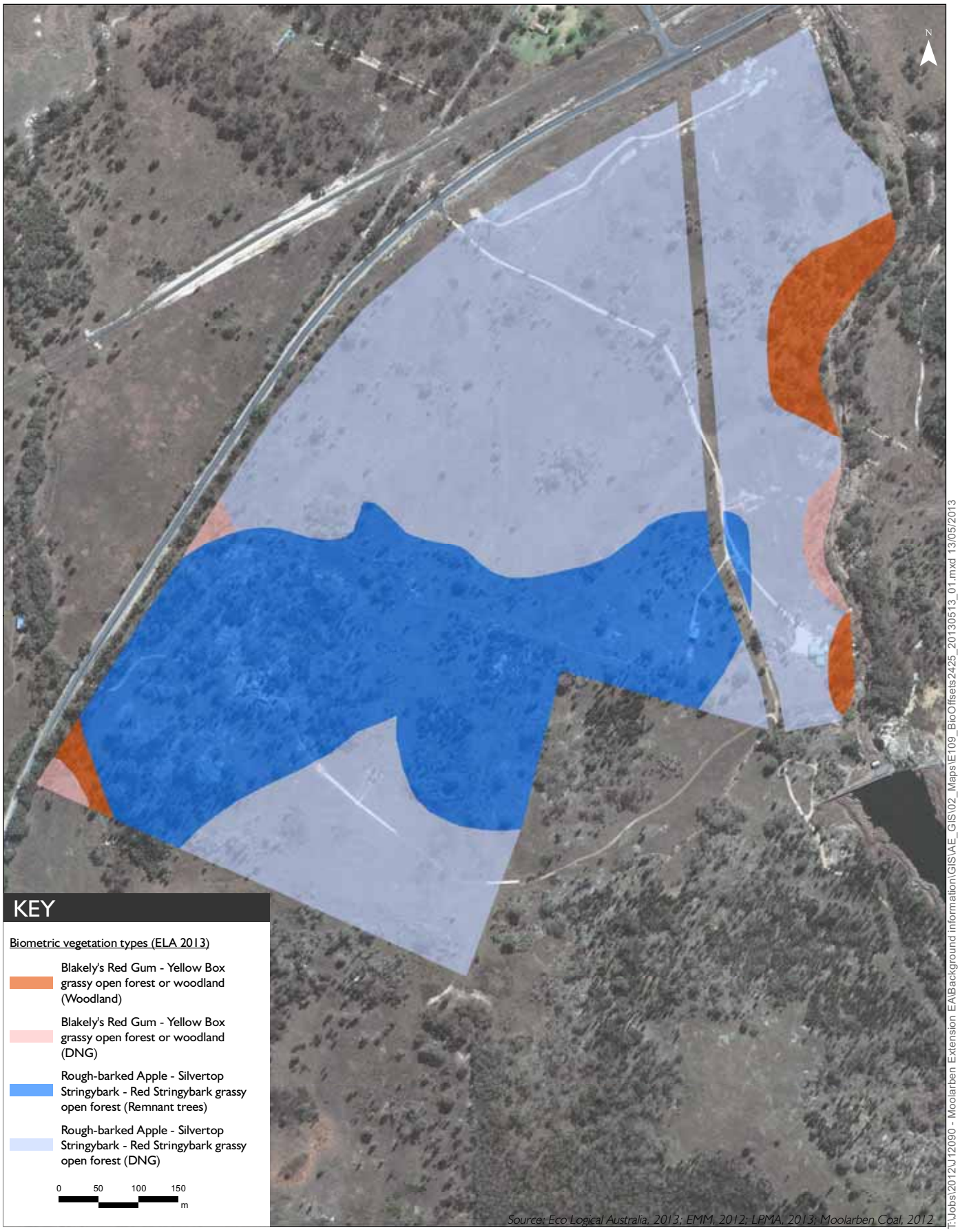
MOOLARBENCOAL

Mapped vegetation of the Bobadeen property

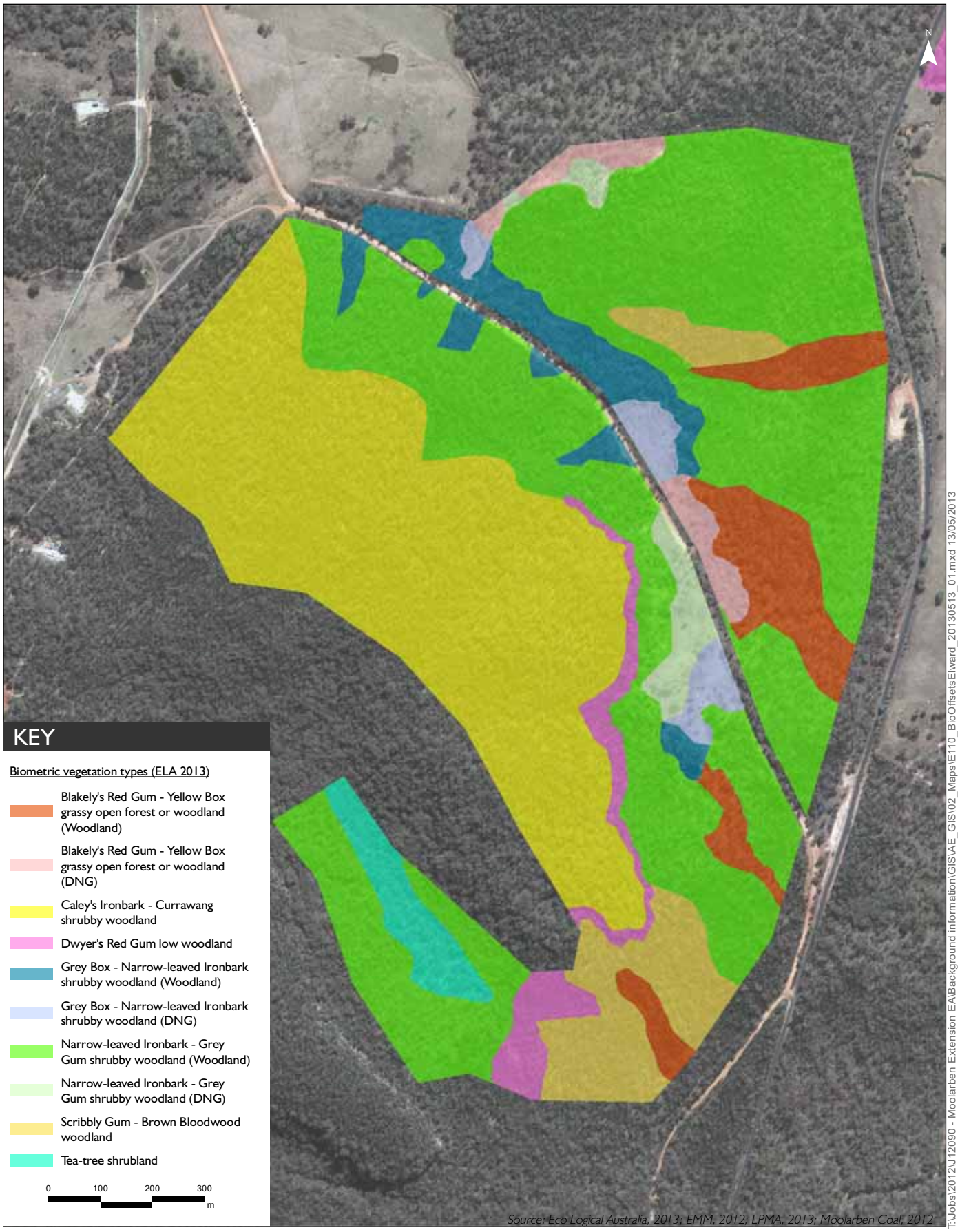
Moolarben Coal Project - Stage 1 Optimisation Modification

Ecological assessment

Figure 8.3



Mapped vegetation of properties number 24 and 25
Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment
Figure 8.4



EMM

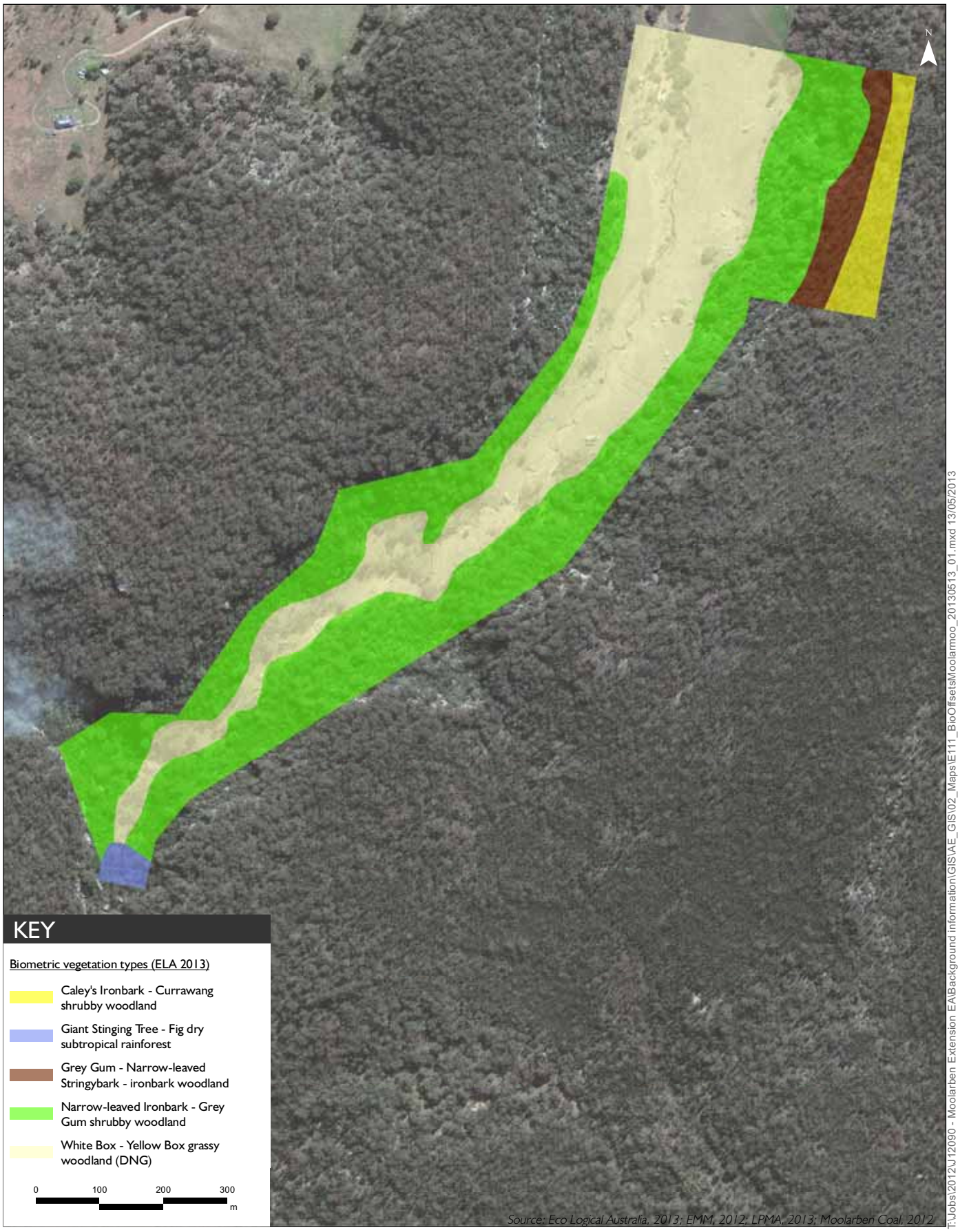
MOOLARBENCOAL

Mapped vegetation of the Elward property

Moolarben Coal Project - Stage 1 Optimisation Modification

Ecological assessment

Figure 8.5



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EMM

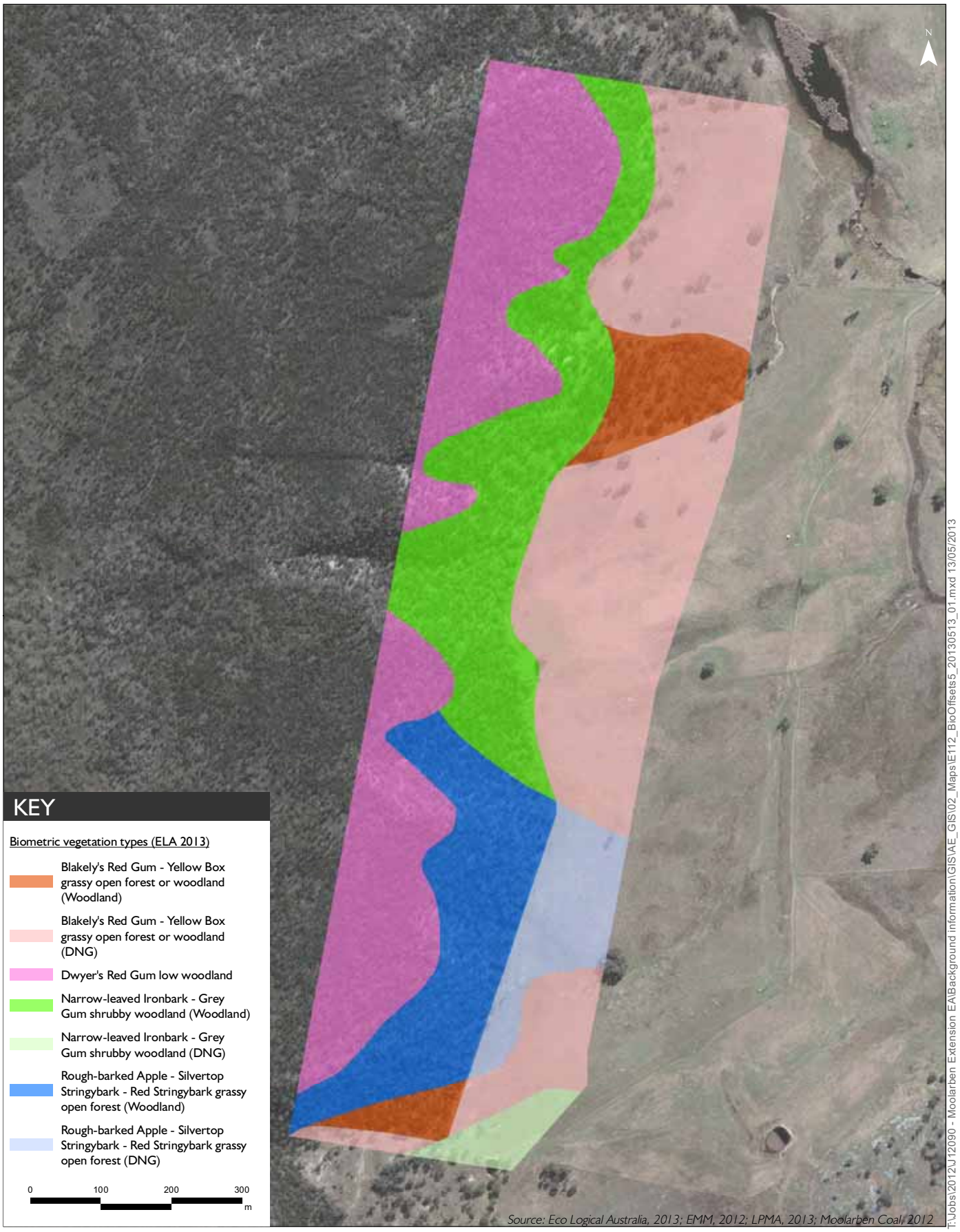
MOOLARBENCOAL

Mapped vegetation of the Moolarmoo property

Moolarben Coal Project - Stage 1 Optimisation Modification

Ecological assessment

Figure 8.6



Mapped vegetation of property number 5
Moolarben Coal Project - Stage 1 Optimisation Modification
Ecological assessment
Figure 8.7

In particular, the properties include 330 ha of equivalent vegetation types to the 17.2 ha of White Box – Yellow Box grassy woodland being impacted including 154 ha of White Box –Yellow box grassy woodland and 144 ha of Blakely's Red Gum – Yellow Box – grassy woodland (equivalent to the NSW and Commonwealth listed Box Gum Woodland) providing an offset ratio of 19:1 for impacts to this EEC.

In addition, the preliminary fauna assessment undertaken by ELA at each of the proposed offset properties (Table 4 and Appendix B) has confirmed records (or potential habitat) for each of the impacted threatened fauna species and confirmed and potential habitat for various other threatened fauna species.

As per the commitments in Section 10.5.3, a Rehabilitation and Offset Management Plan (ROMP) will be prepared to guide the management, monitoring and reporting of the effectiveness of the offset areas.

The BOP significantly exceeds a Tier 3 "mitigated loss" outcome (almost double) and meet 66% of a Tier 2 "no net loss" outcome.

8.3 Commitments

The BOS and BOP is MCO's biodiversity offset commitment for the proposed modification. In accordance with the BOS, MCO will:

- prepare and register a conservation covenant under Section 69B of the NPW Act (or equivalent conservation protection measure including the option to transfer land to the Minister for the Environment with agreement) to cover all seven properties referred to in Section 2 and Table 5 to provide long term protection of the offset areas following approval of the proposed modification;

  (Note: should any of the nominated properties not be available for long term conservation protection, alternative offset sites of equivalent area and biodiversity values required by this BOS will be identified, and secured for long term conservation protection)

- undertake a detailed flora and fauna inventory and mapping of the vegetation types and threatened species present on each offset property and identify the management issues to prepare a ROMP for the total offset package as a whole (with incorporation into the Stage 1 ROMP);

- prepare a ROMP that includes each property and clearly outlines the responsible parties for the implementation of the plan, the works required to improve and maintain the biodiversity values (including but not restricted to fire management, weed and feral animal control, erosion and sediment control, restrictions on access, revegetation), performance criteria and a reporting and monitoring program. The management plan will be prepared by MCO and reviewed by an appropriately qualified and experienced ecologist and will be incorporated into a single management plan covering the already approved Stage 1 offsets;

- implement the management actions specific to each property and provide an annual report on the implementation of the plan and the results (changes in biodiversity values) to the DP&I/OEH and SEWPaC;

- provide adequate funds to implement the management plan on an annual basis; and

- arrange for the independent review of the adequacy and implementation of the conservation management plans every three years.

9 Conclusion

Numerous ecological studies have been undertaken within the study area and surrounds. These studies have enabled ecological risks to be incorporated into the mine design for the proposed modification, limiting its potential adverse impacts.

Previous studies were supplemented by detailed surveys of the areas with the potential to be directly and indirectly impacted by the proposed modification.

The proposed modification requires the progressive removal of approximately 171 ha of native vegetation and 7 ha of exotic pasture, with a total impact area of approximately 178 ha. This includes 17.2 ha of the White Box Yellow Box Blakely's Red Gum Woodland which is listed as an EEC under the TSC Act and is inclusive of 16.5 ha of the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is listed as a CEEC under the EPBC Act.

Native vegetation in the north of the study area is adjacent to an existing mine pit, and vegetation in the south is adjacent to agricultural land and an approved, but as yet, undeveloped mine pit. It is subject to edge effects including weed invasion and grazing. In addition, three disused hard rock quarries exist within areas of native vegetation on the western edge of the proposed extension areas.

The overall removal of vegetation and fauna habitat is considered to be minor within the regional context. Open forest and woodland to be cleared and then re-established represents less than 0.5% of the remnant forest and woodland outside of conservation areas in the Hunter-Central Rivers CMA.

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 species, populations and communities that were recorded, or are likely to occur in the study area. The proposed modification is likely to result in significant impacts to some threatened biodiversity after mitigation has been applied. These comprised:

- a TEC (White Box Yellow Box Blakely's Red Gum Woodland EEC (TSC Act listing) and White Box Yellow Box Blakely's Red Gum Grassy Woodland and DNG (EPBC Act listing));
- a threatened bird (Brown Treecreeper); and
- a threatened cave-roosting microbat (Eastern Cave Bat).

Management of potential impacts have been addressed according to the hierarchy of avoid, mitigate then compensate. Avoidance measures principally related to the modification of the mine design to be offset from the Moolarben Creek riparian zone and to ensure connectivity between forested areas to the north and south was maintained. Mitigation includes implementation of measures to prevent adverse impacts to fauna during progressive clearing, maximisation of seed collection where practical and restoration and enhancement of fauna habitat.

Proposed extension areas will be rehabilitated for biodiversity outcomes, with vegetation predominately comprising Grassy White Box Woodlands and Broad-leaved Ironbark Forests, with a principle objective of enhancing vegetation cover and connectivity. Species will be chosen to improve faunal biodiversity and habitat.

Habitat resources occur outside the disturbance footprint, with abundant similar habitat available in wooded areas to the east, and in the connected corridor with Goulburn River NP to the north, which is approximately 404 times the size of the proposed extension areas, and Munghorn Gap Nature Reserve to the south of the study area, which is approximately 34 times the size of the proposed extension areas. While connectivity is being retained with these areas, proposed offsets aim to improve the connectivity of local 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.

A BOS and BOP have been prepared to compensate for unavoidable residual impacts. The BOP comprises seven strategically located properties that will be permanently protected via an appropriate conservation mechanism and managed for conservation outcomes. The BOP accords with both NSW and Commonwealth offsetting principles and achieves a maintain or improve biodiversity outcome.

As with vegetation disturbance, rehabilitation will take place progressively as mining progresses. It is also noted that offsets will be conserved and enhanced for biodiversity outcomes as soon as practical, subject to the proposed modification's approval.

The proposed avoidance, mitigation and compensation measures will provide for a net positive biodiversity outcome.

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Glossary of terms and acronyms

Acronyms

Acronym	Expansion
ABS	Australasian Bat Society
ACT	Australian Capital Territory
AQMP	air quality management plan
asl	above sea level
BBAM	biodiversity assessment methodology
BOP	biodiversity offset package
BOS	biodiversity offset strategy
CE	critically endangered species
CEEC	critically endangered ecological community
Cm	centimetre
CMA	catchment management authority
CWD	coarse woody debris
DEC	former Department of Environment and Conservation (now the Office of Environment and Heritage
DECC	former Department of Environment and Climate Change (now the Office of Environment and Heritage
DECCW	former Department of Environment, Climate Change and Water (now the Office of Environment and Heritage)
DEH	former Department of Environment and Heritage (now Department of Sustainability, Environment, Populations and Communities)
DITR	Department of Industry, Tourism and Resources
DLWC	Department of Water and Land Conservation (now the Office of Water)
DNG	derived native grassland
DP&I	Department of Planning and Infrastructure
E	endangered species
EA	environmental assessment
ELP	Eco Logical
EEC	endangered ecological community
EMM	EMGA Mitchell McLennan Pty Limited
EMS	environmental management strategy
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	NSW Environmental Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GIS	geographic information systems
GPS	global positioning system
ha	hectares
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	kilometre
KTP	key threatening processes listed under the TSC Act or EPBC Act

Glossary of terms and acronyms

Acronyms

Acronym	Expansion
LMP	Landscape Management Plan
m	metres
MCP	Moolarben Coal Project
MCO	Moolarben Coal Operations Pty Limited
Mi	migratory
MNES	Matters of National Environmental Significance listed under the EPBC Act
MOP	mining operations plan
Mtpa	million tonnes per annum
NMP	noise management plan
NP	national park
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NSWSC	New South Wales Scientific Committee
OEH	Office of Environment and Heritage
offset strategy	strategy prepared to offset impacts after avoidance and mitigation have been applied
ROM	run of mine
ROMP	rehabilitation and offset management plan
SAT	spot assessment technique
SEPP 44	*State Environment Planning Policy 44: Koala Habitat Protection*
SEWPAC	Department of Sustainability, Environment, Populations and Communities
SM2 bat detector	an ultrasonic microphone used to record microbat calls
TEC	threatened ecological community
TSC Act	*Threatened Species Conservation Act 1995*
TSSC	Commonwealth Threatened Species Scientific Committee
V	vulnerable species
WMP	water management plan

Appendix A

Threatened species likelihood of occurrence

A.1 Likelihood of occurrence for threatened species

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Plant species						
Ausfeld's Wattle	NPWS Atlas	V	-	Recorded at Ulan Coal Mine (Umwelt 2009). Occurs in the Mudgee - Ulan - Gulgong area, mostly on flat ground in remnant roadside patches of woodland with White Box *(Eucalyptus albens*), Blakely's Red Gum *(E. blakelyi*) and Native Cypress Pines *(Callitris* spp.), with an understorey dominated by *Cassinia* spp. and grasses (OEH 2012b).	Not recorded, despite targeted searches in suitable habitat.	No
Cannon's Stringybark	NPWS Atlas	V	V	Recorded in the MCP Stage 1 area (Moolarben Biota 2006) and at Ulan Coal Mine (Umwelt 2009). Occurs in association with *Eucalyptus sparsifolia* and *Angophora floribunda*. The altitude range of *Eucalyptus cannonii* is from about 460 m to 1040 m. Within the range, the species appears to tolerate most situations except the valley floors (OEH 2012b).	19 individuals of a Cannon's Stringybark/Red Stringybark hybrid were collected. No individuals detected.	No
Sandy Hollow Commersonia *Commersonia rosea*	SPRAT	E	E	Sandy Hollow Commersonia occupies relatively small areas at its known sites and has a total population of less than 200 plants. The species is known from four populations in the Sandy Hollow district of the upper Hunter Valley, NSW. The four localities (Pikes Gap, Giants Creek, Peberdys Road and Boodles Creek) fall within an 8 km radius of Sandy Hollow, within the Central Western Slopes of NSW. Sandy Hollow Commersonia occurs on skeletal sandy soils in scrub or heath vegetation with occasional emergents of *Eucalyptus crebra, Callitris endlicheri or Eucalyptus caleyi* subsp. *caleyi* (SEWPaC 2012b).	Unlikely to occur given restrictions in its distribution.	No
Denman Pomaderris *Pomaderris reperta*	SPRAT	CE	CE	Denman Pomaderris has been recorded from a small number of sites along a single ridgeline near Denman in the upper Hunter Valley (Muswellbrook local government area). Denman Pomaderris occupies woodland in association with *Eucalyptus crebra, E. blakelyi*, *Notelaea microcarpa*, and *Allocasuarina littoralis*. It is associated with sandy loam soils on sandstone or conglomerate (SEWPaC 2012b).	Unlikely to occur given restrictions in its distribution.	No

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Hoary Sunray	Umwelt (2009)	-	E	Recorded at Ulan Coal Mine (Umwelt 2009). The Hoary Sunray occurs at relatively high elevations in woodland and open forest communities, in an area roughly bounded by Goulburn, Albury and Bega. The species has been recorded in the Yass Valley, Tumut, Upper Lachlan, Snowy River and Galong. The species is known from the South Eastern Highlands, Australian Alps and Sydney Basin bioregions. Herbarium records indicate that the taxa once occurred more widely in inland NSW, near Cobar, Dubbo, Lithgow, Moss Vale and Delegate. Occurs in association with Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*), Red Box (*E. polyanthemos*), Brittle Gum (*E. mannifera*) or Snow Gum (*E. pauciflora*) (SEWPaC 2012b).	Unlikely to occur due to absence of associated species.	No
Homoranthus darwinioides	NPWS Atlas	V	V	Recorded at Ulan Coal Mine (Umwelt 2009) and the proposed Cobbora Coal Mine (EMM 2012). Grows in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand. Associated species include *Callitris endlicheri, Eucalyptus crebra, E. dwyeri, E. rossii, Melaleuca uncinata, Calytrix tetragona,* and *Allocasuarina* spp. (OEH 2012b).	Unlikely to occur due to the absence of suitable gravely sandy soils.	No
Kennedia retrorsa	SPRAT	V	V	Last recorded from the eastern part of Goulburn River NP in 1999. Believed to be restricted to the Mount Dangar area and the adjacent Goulburn River catchment, within the Muswellbrook and adjacent Merriwa local government areas. Sites occur within Goulburn River and Wollemi National Parks and nearby private land (SEWPaC 2012b).	Unlikely to occur due to its restricted distribution.	No
Lasiopetalum longistamineum	SPRAT	V	V	The distribution of the species is restricted to a small region on the central-western slopes of NSW; in the Gungal–Mt Dangar area between Merriwa and Muswellbrook (SEWPaC 2012b).	Unlikely to occur due to its restricted distribution.	No
Ozothamnus tesselatus	NPWS Atlas	V	-	Recorded from Goulburn River National Park in 1990 (Australian Government 2012). Restricted to a few locations in an east-west zone south of Bunnan and between west Bylong and east Ravensworth. Grows in eucalypt woodland (OEH 2012b).	Unlikely to occur as targeted surveys in suitable habitat failed to detect the species.	No

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Pine Donkey Orchid *Diuris tricolor*	NPWS Atlas	V	-	Recorded in the MCP Stage 1 area (Moolarben Biota 2006) at Ulan Coal Mine (Umwelt 2009) and to the south-west of the study area. The Pine Donkey Orchid grows in sclerophyll forest among grass, often with Cypress Pine or Ironbarks. It is found in sandy soils, either on flats or small rises. The understorey is often grassy with herbaceous plants such as Bulbine species. Flowers from September to November or generally spring (OEH 2012b).	**High likelihood due to occurrence of Cypress Pine and Ironbark woodland within the study area.**	**Yes**
Pokolbin Mallee (*Eucalyptus pumila*)	SPRAT	V	V	Currently known only from a single population west of Pokolbin in the Hunter Valley. Historical records also exist for Wyong and Sandy Hollow, however, has not been recorded recently in these areas. The single known population occupies north-west-facing slopes derived from sandstone. Present as a mid-canopy species to a height of 6 m within dry sclerophyll woodland which has a canopy comprising *Eucalyptus fibrosa, Callitris endlicheri* and, to a lesser extent, *Corymbia maculata* (OEH 2012b).	Unlikely to occur due to its restricted distribution.	No
Prostanthera discolor	SPRAT	V	V	Restricted to only a few localities from Bylong to the Baerami Valley within the Rylstone and Muswellbrook local government areas. Grows in dry sclerophyll forest in the side gullies of main creeklines, often on rocky or well-drained alluvial substrates (OEH 2012b).	Unlikely to occur due to its restricted distribution.	No
Scant Pomaderris	Ecovision Consulting (2008)	E	-	Recorded in the MCP Stage 2 (Ecovision Consulting 2008). It is found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks (OEH 2012B). Little is known of its habitat requirements, although it has been found on sandstone soils in the Hunter region (OEH 2012b).	**Moderate likelihood in Shrubby White Box Forest given the proximity of previous records.**	**Yes**
Silky Swainson-pea *Swainsona sericea*	NPWS Atlas	V	-	Recorded between Gulgong and Ulan in 1983. Found in Box Gum Woodland. Sometimes found in association with cypress-pines *Callitris* spp. This species regenerates from seed after fire and is sensitive to agriculture, grazing, weed invasion and road works (OEH 2012b).	No known populations exist in the Hunter-Central Rivers CMA (NSWSC 2008b).	No
Singleton Mint Bush *Prostanthera cineolifera*	SPRAT	V	V	Restricted to only a few localities near Walcha, Scone, Cessnock and St Albans. Grows in open woodlands on exposed sandstone ridges (OEH 2012b).	Unlikely to occur due to its restricted distribution.	No
Small Purple Pea *Swainsona recta*	SPRAT	E	E	The closest record is 50km away in Mudgee. Before European settlement Small Purple-pea occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum *Eucalyptus blakelyi*, Yellow Box *E. melliodora*, Candlebark Gum *E. rubida* and Long-leaf Box *E. goniocalyx* (OEH 2012b).	Unlikely to occur due to lack of proximal records and canopy species.	No

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
White-flowered Wax Plant *Cynanchum elegans*	SPRAT	E	E	Known from Goulburn River NP (NPWS 2003). The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree *Leptospermum laevigatum* – Coastal Banksia *Banksia integrifolia subsp. integrifolia* coastal scrub; Forest Red Gum *Eucalyptus tereticornis* aligned open forest and woodland; Spotted Gum *Corymbia maculata* aligned open forest and woodland; and Bracelet Honeymyrtle *Melaleuca armillaris* scrub to open scrub (OEH 2012b).	Unlikely to occur due to absence of suitable habitat and associated species.	No
Wollemi Mint Bush *Prostranthera cryptandroides* subsp. *cryptandroides*	SPRAT	V	V	Distributed between Lithgow and Sandy Hollow on the NSW central west slopes, central tablelands and western parts of the central coast botanical regions. An additional record exists for the northern tablelands near Tenterfield. Known from Wollemi NP and Gardens of Stone NP. Associated communities include: Narrabeen Rocky Heath, Narrabeen Acacia Woodland, Narrabeen Exposed Woodland; Open Heath of *Calytrix tetragona, Leptospermum parviflorum*and *Isopogon dawsonii*; and Open Scrubland of *Eucalyptus dwyeri, Baeckea densifolia, Dillwynia floribunda, Aotus ericoides* and *Hemigenia cunefolia* (OEH 2012b).	Not recorded. Unlikely to occur due to absence of associated communities.	No
Plant populations						
Acacia pendula population in the Hunter Catchment	NPWS Online	E	-	The species occurs on the western slopes, western plains and far western plains of NSW, and south into Victoria and north into Queensland. This Hunter population is known to occur naturally as far east as Warkworth, and extends northwest to Muswellbrook and to the west of Muswellbrook at Wybong. Only recorded to date at six locations: Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. These locations occur within the Muswellbrook and Singleton Local Government Areas, with the population potentially also occurring within the Mid-Western Regional and Upper Hunter LGA's (OEH 2012b).	Not recorded. Unlikely to occur due to its restricted distribution.	No

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Cymbidium canaliculatum population in the Hunter Catchment	NPWS Online	E	-	Known from Goulburn River NP (OEH 2012b). Typically grows in the hollows, fissures, trunks and forks of trees in dry sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor. Within the Hunter Catchment, *Cymbidium canaliculatum* is most commonly found in White Box dominated woodlands (including those dominated by the intergrade with Grey Box), much of which may constitute the endangered ecological community (EEC) 'White Box Yellow Box Blakely's Red Gum Woodland'. It has been found, less commonly, to grow on Slaty Gum,, Narrow-leaved Ironbark, Grey Box and Rough-barked Apple (OEH 2012b).	Not recorded during targeted surveys, therefore unlikely to occur.	No
River Red Gum population in the Hunter Catchment	NPWS Atlas	E	-	Recorded from Goulburn River NP in 1970. May occur with *Eucalyptus tereticornis*, *Eucalyptus melliodora*, *Casuarina cunninghamiana* subsp. *cunninghamiana* and *Angophora floribunda.* Prior to European settlement, it is likely that the species formed extensive stands of woodland and open woodland on the major floodplains of the Hunter and Goulburn rivers, especially in areas where water impoundment occurs after flood. Since settlement, most of the floodplains have been cleared of woody vegetation. Flood mitigation works now prevent most minor floods from inundating floodplains. These flow changes, coupled with the clearing of native vegetation, have greatly reduced the extent of habitat favourable to the River Red Gum in the Hunter catchment (OEH 2012b).	**Scattered individuals recorded 500 m west of the study area along a drainage line.**	**Yes**
Amphibians						
Giant Barred Frog *Mixophyes iteratus*	NPWS Atlas	E	E	This species has been recorded from the Kerrabee sub-region, but the location has been withheld. The Southern Barred Frog occurs in uplands and lowlands in rainforest and wet sclerophyll forest, including farmland. Populations have been found in disturbed areas with vegetated riparian strips on cattle farms and in regenerated logged areas. Many sites where the Southern Barred Frog is known to occur are the lower reaches of streams which have been affected by major disturbances such as clearing, timber harvesting and urban development in their headwaters (SEWPaC 2012b).	Unlikely to occur due to unsuitable habitat.	No

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Reptiles						
Broad-headed Snake	NPWS (2003)	E	V	Known from Goulburn River NP (NPWS 2003). This species is nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer. Feeds mostly on geckos and small skinks; will also eat frogs and small mammals occasionally. Females produce four to 12 live young from January to March, which is a relatively low level of fecundity (OEH 2012b).	**Moderate likelihood of occurrence.**	**Yes**
Little Whip Snake	NPWS Atlas	V	-	Recorded in Cooks Gap in 2000. This species occurs in Natural Temperate Grasslands and grassy woodlands. Also occurs in secondary grasslands derived from clearing of woodlands. Found on well drained hillsides, mostly associated with scattered loose rocks. Most specimens have been found under rocks or logs lying on, or partially embedded in the soil (OEH 2012b).	Unlikely to occur due to the absence of scattered loose rocks. Rocks are embedded on hillslides of the study area.	No.
Pink-tailed Worm Lizard	NPWS Online	V	V	Recorded at Goulburn River NP in 2000. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites (OEH 2012b).	Unlikely to occur due to the absence of scattered loose rocks. Rocks are embedded in the study area.	No.
Birds						
Barking Owl	NPWS Atlas	V	-	Recorded at Ulan Coal Mine (Umwelt 2009). Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland (Morcombe, 2000). Preferentially hunts small arboreal mammals such as Squirrel Gliders and Ringtail Possums, but when loss of tree hollows decreases these prey populations it becomes more reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits. Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6,000 ha, with 2,000 ha being more typical in NSW habitats (OEH 2012b).	**Likely to occur in Ironbark woodlands.**	**Yes**
Black-breasted Buzzard	NPWS Atlas	V	-	Recorded at Ulan Coal Mine (Umwelt 2009). Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands. Breeds from August to October near water in a tall tree (OEH 2012b).	**Moderate potential to breed in timbered drainage lines adjacent to the study area.**	**Yes**

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Black-chinned Honeyeater (eastern subspecies)	NPWS Atlas	V	-	Recorded in MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Ulan Coal Mine (Umwelt 2009), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark, White Box, Inland Grey Box, and Yellow Box. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. Large home ranges of at least 5 ha (OEH 2012b).	**Likely to occur due to the presence of White Box, stringybarks and ironbarks.**	**Yes**
Blue-billed Duck *Oxyura australis*	NPWS Atlas	V	-	Recorded at Ulan Coal Mine (Umwelt 2009). Recorded north of the study area in Goulburn River NP. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation (OEH 2012b).	Unlikely to occur due to the absence of suitable habitat.	No
Brown Treecreeper	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012) Wilpinjong Coal Mine (Mount King Ecological Surveys 2005), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. Fallen timber is an important habitat component for foraging; with hollows in standing dead or live trees and tree stumps essential for nesting (OEH 2012b).	**Recorded in Ridgetop Blue-leaved Ironbark Grey Gum Woodland**	**Yes**
Bush Stone-curlew	NPWS Atlas	E	-	Recorded at Ulan Coal Mine (Umwelt 2009) and in Cope SF. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber (OEH 2012b, DEC 2006).	Low likelihood of occurrence in woodlands as the species is sedentary, and was not detected during targeted surveys.	No
Diamond Firetail	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Found in grassy eucalypt woodlands, including Box-Gum Woodlands. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season) (OEH 2012b).	**Recorded to the west of the study area. The western edge of the study area represents potential habitat.**	**Yes**

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Flame Robin	NPWS Atlas	V	-	Recorded at Ulan Coal Mine (Umwelt 2009). Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. In winter lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. Birds forage from low perches, from which they pounce onto small invertebrates which they take from the ground or off tree trunks, logs and other coarse woody debris (OEH 2012b).	**Moderate likelihood in the winter months when birds disperse to grassy woodlands.**	**Yes**
Gang-gang Cockatoo	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008) and Ulan Coal Mine (Umwelt 2009). Several records exist from 2004 in Munghorn Gap Nature Reserve, south east of the study area. In summer, the Gang-gang Cockatoo occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, the Gang-gang Cockatoo occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas (NSWSC 2005).	**Moderate likelihood to occur during winter.**	**Yes**
Glossy Black-Cockatoo	NPWS Atlas	V	-	Recorded in MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005) and Ulan Coal Mine (Umwelt 2009). Numerous records exist from Goulburn River NP and Cope SF. Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m asl in which stands of She-oak species, particularly Black She-oak (*Allocasuarina littoralis*) occurs. Depends on large hollow-bearing eucalypts for nest sites (OEH 2012b).	**Foraging evidence recorded (chewed Black Cypress Pine cone).**	**Yes**
Grey-crowned Babbler (eastern subspecies)	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008) and Ulan Coal Mine (Umwelt 2009). Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Territories range from one to fifty hectares (usually around ten hectares) and are defended all year (OEH 2012b).	**High likelihood of occurrence in Grassy White Box Woodlands and riparian woodland.**	**Yes**

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Hooded Robin	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season (OEH 2012b).	**Likely to occur on western edge of study area bordering agricultural land.**	**Yes**
Little Eagle	NPWS Atlas	V	-	Recorded at Munghorn Gap Nature Reserve in 2001 (Eremaea Birds 2012) and Ulan Coal Mine in 2004 (OEH 2012c). Occupies open eucalypt forest, woodland or open woodland. She-oak or acacia woodlands and riparian woodlands of interior NSW are also used (OEH 2012b).	**Moderate likelihood in timbered drainage lines adjacent to study area.**	**Yes**
Little Lorikeet	NPWS Atlas	V	-	Recorded at Moolarben biodiversity offset sites (EcoLogical 2012), Ulan Coal Mine (Umwelt 2009) and has a moderate reporting rate (41%) at Munghorn Gap Nature Reserve (Eremaea Birds 2012). Scattered records exist from Goulburn River NP. Forages primarily in the canopy of open *Eucalyptus* forest and woodland, yet also finds food in *Angophora, Melaleuca* and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs. Nests in proximity to feeding areas in hollows using nesting sites repeatedly for decades (OEH 2012b).	**Moderate likelihood in timbered drainage lines adjacent to study area.**	**Yes**
Magpie Goose *Anseranas semipalmata*	Umwelt (2009)	V	-	Recorded at Ulan Coal Mine (Umwelt 2009). Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges (OEH 2012b).	Unlikely to occur due to the lack of suitable wetlands.	No

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Malleefowl *Leipoa ocellata*	NPWS Atlas	E	V	Recorded in Goulburn River NP in 1989. Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Less frequently found in other eucalypt woodlands, such as Inland Grey Box or Ironbark with thick understorey, or in other woodlands dominated by native Cypress Pine species. Prefers areas of light sandy to sandy loam soils and habitats with a dense but discontinuous canopy and dense and diverse shrub and herb layers (OEH 2012b).	Unlikely to occur due to unsuitable habitat.	No
Masked Owl	NPWS Atlas	V	-	Recorded at Wilpinjong Coal Mine (Mount King Ecological Surveys 2005). Lives in dry eucalypt forests and woodlands from sea level to 1,100 m. It is a forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1,000 hectares. This species roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting (OEH 2012b).	**Recorded in Ridgetop Blue-leaved Ironbark Grey Gum Woodland.**	**Yes**
Painted Honeyeater	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005) and Ulan Coal Mine (Umwelt 2009). It is nomadic and occurs at low densities throughout its range in Box-Gum and Box-Ironbark forests feeding on fruit and insects of mistletoes (genus Amyema). The species nests in spring to autumn on the inland slopes of the Great Diving Range in NSW (OEH 2012b).	**High likelihood of occurrence in Box Gum Woodland containing mistletoes.**	**Yes**
Pied Honeyeater *Certhionyx variegates*	NPWS Atlas	V	-	One record exists from Munghorn Gap Nature Reserve in 1991 (OEH 2012c). This species is widespread throughout acacia, mallee and spinifex scrubs of arid and semi-arid Australia. Occasionally occurs further east, on the slopes and plains and the Hunter Valley, typically during periods of drought (OEH 2012b).	Unlikely to occur. The survey was in a dry period and this species was not recorded.	No
Pink Robin *Petroica rodinogaster*	NPWS Atlas	V	-	Recorded from Munghorn Gap Nature Reserve in 1991. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies (OEH 2012b).	Unlikely to occur due to absence of suitable habitat.	No

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Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Powerful Owl	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008) and Ulan Coal Mine (Umwelt 2009). The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Black She-oak *Allocasuarina littoralis*, Rough-barked Apple *Angorphora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old (OEH 2012b).	**Recorded in Ridgetop Blue-leaved Ironbark Grey Gum Woodland.**	**Yes**
Rainbow Bee-eater	SPRAT	-	Mi	Recorded at Moolarben biodiversity offset sites (EcoLogical 2012) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). The Rainbow Bee-eater occurs in open woodlands and shrublands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Birdlife Australia 2012).	**Likely to occur in the study area.**	**Yes**
Regent Honeyeater	NPWS Atlas	CE	E	Recorded at Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve with a low reporting rate (14%) (Eremaea Birds 2012) and east of Cope SF. This species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum and White Box (OEH 2012b).	**High likelihood of occurrence due to presence of key eucalypt species (White Box).**	**Yes**
Rufous Fantail	SPRAT	-	Mi	The Rufous Fantail is migratory, being virtually absent from south-east Australia in winter. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including Spotted Gum (*Eucalyptus maculata*), Yellow Box (*E. melliodora*), ironbarks or stringybarks, often with a shrubby or heath understorey. They are also recorded from parks and gardens when on passage (SEWPaC 2012b).	**Likely to occur in the study area when on passage.**	**Yes**
Scarlet Robin	NPWS Atlas	V	-	Recorded at Moolarben biodiversity offset sites (EcoLogical 2012). Scarlet Robins live in dry eucalypt forests and woodlands with an open and grassy understorey with few scattered shrubs. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat (OEH 2012b).	**Moderate likelihood to occur on western edge of study area bordering agricultural land.**	**Yes**

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Speckled Warbler	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008) and Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Typical habitat includes scattered native tussock grasses with a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area (OEH 2012b).	**High likelihood to occur in footslope and riparian woodlands.**	**Yes**
Spotted Harrier	NPWS Atlas	V	-	Recorded at Ulan Coal Mine in 2008 (OEH 2012c). Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. Preys on terrestrial mammals (eg rodents), birds and reptile, occasionally insects and rarely carrion (OEH 2012b).	**Moderate likelihood in riparian woodland of study area.**	**Yes**
Square-tailed Kite	NPWS Atlas	V	-	Recorded in MCP Stage 2 area (Ecovision Consulting 2008), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005), Ulan Coal Mine (Umwelt 2009) and Goulburn River NP (NPWS 2003). Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Appears to occupy large hunting ranges of more than 100 km^2. This species is a specialist hunter of passerine birds and honeyeaters (OEH 2012b).	**Moderate likelihood in timbered drainage lines adjacent to study area.**	**Yes**
Swift Parrot	NPWS Atlas	E	E	Recorded at Ulan Coal Mine (Umwelt 2009) and 10 km north of Cope in 2005 (). Found in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Mugga Ironbark and White Box. Commonly used lerp infested trees include Inland Grey Box (OEH 2012b).	**High likelihood to occur in winter due to the presence of White Box.**	**Yes**
Turquoise Parrot	NPWS Atlas	V	-	Recorded at Ulan Coal Mine (Umwelt 2009), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter (OEH 2012b).	**Recorded in riparian woodland and exotic pasture of study area.**	**Yes**

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Varied Sittella	NPWS Atlas	V	-	Recorded at Moolarben biodiversity offset sites (EcoLogical 2012), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy (OEH 2012b).	**High likelihood due to presence of rough and smooth barked trees including Grey Gum, Rough-barked Apple and White Box.**	**Yes**
White-fronted Chat *Epthianura albifrons*	NPWS Atlas	V	-	Last recorded from Munghorn Gap Nature Reserve in 2002 (OEH 2012c). This species is found in damp open habitats. Inland, the White-fronted Chat is often observed in open grassy plains, saltlakes and saltpans that are along the margins of rivers and waterways (NSWSC 2010).	Unlikely to occur due to unsuitable habitat.	No
White-throated Needletail	SPRAT	-	Mi	Recorded south of Munghorn Gap Nature Reserve in 2010 (Australian Government 2012). In Australia, the White-throated Needletail is almost exclusively aerial, only perching on tree tops in extremely hot or cold weather (SEWPaC 2012b).	Unlikely to use the study area on a frequent basis.	No
Mammals						
Brush-tailed Rock-wallaby	NPWS Atlas	E	V	Recorded at Ulan Coal Mine (Umwelt 2009) and last recorded at Goulburn River NP where it was last recorded in 2009 (OEH 2012c). Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Highly territorial and have strong site fidelity with an average home range size of about 15 ha (OEH 2012b).	Unlikely as rocky outcrops and cliffs are not large and complex enough, or isolated from foxes.	No
Eastern Bentwing-bat	NPWS Atlas	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012) and Ulan Coal Mine (Umwelt 2009). Occurs in dry sclerophyll forest, open woodland and open grasslands (Churchill 2008). Roosts in caves but also uses manmade structures such as disused mine tunnels and road culverts. This species is known to intermittently use the nearby Wellington Caves as roosting habitat (DECCW 2010b).	**Recorded on ultrasonic detector in open forest on ridges and hillslopes.**	**Yes**

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Eastern Cave Bat	Umwelt (2009)	V	-	Recorded at Ulan Coal Mine (Umwelt 2009) and in Goulburn River NP. Inhabits tropical mixed woodlands and dry sclerophyll forest. Roosts in caves or large rock overhangs. This species has been observed foraging over vegetation and creeks (Churchill 2008).	**Recorded on ultrasonic detector in open forest on ridges and hillslopes.**	**Yes**
East-coast Freetail Bat	Greg Richards and Associates (2005)	V	-	Recorded at Wilpinjong Coal Mine (Greg Richards and Associates 2005). Inhabits dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roosts in tree hollows, under bark and in man-made structures.	**Moderate potential to occur in ironbark woodlands.**	**Yes**
Eastern False Pipistrelle	NPWS Atlas	V	-	Recorded at Moolarben biodiversity offset sites (EcoLogical 2012) and Wilpinjong Coal Mine (Greg Richards and Associates 2005). Occurs in moist habitats with trees taller than 20 m, and roosts in eucalypt hollows, loose bark on trees, and in buildings. Hunts flying insects above or just below the tree canopy (Churchill 2008). In the cooler months (autumn and winter) young and adults can disperse to open woodlands at lower altitudes. (Churchill 2008). They prefer to forage along tracks, creeks and rivers.	**Moderate potential to occur in winter and autumn when this species disperses to open woodlands at lower altitudes.**	**Yes**
Greater Broad-nosed Bat	NPWS Online	V	-	Recorded at Moolarben biodiversity offset sites (EcoLogical 2012). The Greater Broadnosed Bat occupies a variety of habitats including moist gullies in mature coastal forest, rainforest, open woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree-lined creeks in open areas. Found from sea level to 1200 m altitude, and are strongly associated with areas with mild winters and annual rainfall over 600 mm (Churchill 2008).	**Moderate potential to occur in open forest, footslope woodland and riparian woodland given the proximity of recent records and suitable habitat.**	**Yes**
Koala	NPWS Atlas	V	V	Recorded at Ulan Coal Mine (Umwelt 2009) and from Munghorn Gap Nature Reserve in 2009 (OEH 2012c). Secondary feed trees within the area include White Box, and supplementary food species include Narrow-leaved Stringybark and Cannon's Stringybark. (SEPP 44, DECC 2008c).	**Moderate likelihood to occur on western edge of study area in White Box.**	**Yes**

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Large-eared Pied Bat	NPWS Atlas	V	V	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Greg Richards and Associates 2005) and Ulan Coal Mine (Umwelt 2009). This species roosts in caves and crevices in cliffs and mines, preferring the twilight areas not far from the entrance. Males can roost alone or in small groups in winter during torpor. Females form maternity colonies from November to February in the roof domes of sandstone caves (Churchill 2008). Most frequently associated with Box Gum Woodlands or creek flats (DECC 2007b).	**Highly likely to occur in the study area due to presence of sandstone escarpments and with crevices and caves.**	**Yes**
Little Bentwing Bat	EcoLogical (2012) and Greg Richards and Associates (2005)	V	-	Recorded at Moolarben biodiversity offset sites (EcoLogical 2012) and Wilpinjong Coal Mine (Greg Richards and Associates 2005). Little Bentwing Bats occur in well-timbered areas including rainforest, vine, thicket, wet and dry sclerophyll forests (Churchill 2008).	**Moderate likelihood of occurrence in ironbark/stringybark woodlands.**	**Yes**
Little Pied Bat	NPWS Online	V	-	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012) and Ulan Coal Mine (Umwelt 2009). This species roosts in trees, caves, abandoned mines and buildings, most containing fewer than 10 individuals. Selected roost sites in caves are usually warm and dry, but can tolerate temperatures of up to 40^{o}C. Tree roosts have been found in *Casuarina, Callitris,* and large eucalypts that have dead limbs (Churchill 2008).	**Potential to roost in caves in rocky outcrops, or tree hollows in open forest and woodland.**	**Yes**
New Holland Mouse *Pseudomys novaehollandiae*	NPWS (2003)	-	V	Known from Goulburn River NP (NPWS 2003). The New Holland Mouse has been found from coastal areas and up to 100 km inland on sandstone country. The species has been recorded from sea level up to around 900 m above sea level (Menkhorst et al. 2008). Across the species' range, the New Holland Mouse is known to inhabit the following types of habitat open heathland, open woodland with a heathland understorey and vegetated sand dunes (SEWPaC 2012b).	Unlikely to occur due to the absence of suitable habitat.	No
Southern Long-eared Bat	NPWS Atlas	V	V	Recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008) and Ulan Coal Mine (Umwelt 2009). Roosts in hollows of live trees which are also used as maternity sites. Forages up to 3 km away from the roost (Churchill 2008). This species is most abundant where the vegetation has a canopy and a dense cluttered understorey layer. Most common in box, ironbark and cypress open forests of inland northern NSW. Highly manoeuvrable and forages in forest gaps (Churchill 2008).	**High likelihood of occurrence throughout study area.**	**Yes**

Table A.1 Threatened species recorded or with the potential to occur within 30km of the study area

Species	Source	Status		Record details and habitat requirements	Likelihood of occurrence	Further assessment required?
		TSC Act	EPBC Act			
Southern Myotis *Myotis macropus*	Umwelt (2009)	V	-	Recorded at Ulan Coal Mine (Umwelt 2009). Southern Myotis have a strong association with streams and permanent waterways, most frequently at low elevations in flat or undulating country and usually in vegetated areas (Churchill 2008).	Unlikely to occur due to absence of suitable habitat.	No
Spotted-tailed Quoll (mainland population)	NPWS Atlas	V	E	Recorded south of Munghorn Gap Nature Reserve in 2000 (OEH 2012c). Utilises a range of habitats including open forest and open woodland. Commonly associated with gullies, rocky escarpments and outcrops (Belcher 2000; Belcher *et al*. 2001). The spotted-tailed quoll shelters during the day in dens located in caves, among rocks, hollow logs; low tree hollows and burrows (Edgar and Belcher 1995; Belcher and Darrant 2006). Spotted-tailed quolls are solitary, with females defending exclusive home range territories (600–1,000 ha), whereas males have larger and undefended home ranges, which overlap a number of female home ranges (2,000–4,500 has) (Belcher 2000; Belcher and Darrant 2004).	**Moderate likelihood to occur due to suitable habitat being present along gullies and rocky escarpments.**	**Yes**
Squirrel Glider	NPWS Atlas	V	-	Recorded in the MCP Stage 1 area (Moolarben Biota 2006) and at Ulan Coal Mine (Umwelt 2009) and Wilpinjong Coal Mine (Mount King Ecological Surveys 2005). The Squirrel Glider has been recorded from mixed species box woodland and open forest dominated by species such as Grey Box, White box and Yellow Box (Menkhorst et al. 1999). Squirrel Gliders are often seen in linear reserves of remnant vegetation along roadsides or stream reserves. An important component of the habitat at sites where the species has been regularly recorded is the presence of many large, old trees containing suitable hollows for nesting and refuge. Dead trees are also known to be used as den sites (Menkhorst 1995).	**Moderate likelihood to occur in White Box Woodland on western edge of study area.**	**Yes**
Yellow-bellied Sheathtail-bat	NPWS Online	V	-	Recorded in the MCP Stage 1 area (Moolarben Biota 2006) and at Wilpinjong Coal Mine (Greg Richards and Associates 2005). This species roosts in large tree hollows, and has also been found in the abandoned nests of Sugar Gliders *(Petaurus brevipes).* Occurs in a range of habitats from wet and dry sclerophyll forest to open woodland, Acacia shrubland, mallee, grasslands and desert (Churchill 2008).	**Likely to occur given the proximity of recent records and suitable habitat.**	**Yes**

Appendix B

Assessments of significance

B.1 Significant impact criteria in accordance with the TSC Act

Section 5A of the EP&A Act provides the criteria that must be considered in the assessment of the significance of potential impacts on all threatened species listed under the TSC Act. Assessment of Significance (known as the seven-part test) is made up of the following seven questions:

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

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

3. In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

    a) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

    b) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

4. In relation to the habitat of a threatened species, population or ecological community:

    a) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

    b) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action;

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

5. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

6. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

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

Assessments of significance are undertaken in accordance with *Threatened species assessment guidelines: The assessment of significance* (DEC 2007a).

B.1.1 Assessments of significance

Species requiring additional assessment as identified in Appendix A, communities identified in Section 5.1.1 and which are listed as threatened under the TSC Act were assessed using the seven-part test. Seven-part tests have been prepared in accordance with the criteria presented in Section B.1. Assessments have been undertaken for guilds of species or communities which have similar habitat requirements. The results of tests have been tabulated for ease of reading and are presented in the following sections. It is noted that the assessments include mitigation, however, exclude offsets required as a result of the potential residual ecological impacts.

i Threatened Ecological Communities: White Box Yellow Box Blakely's Red Gum Woodland

White Box Yellow Box Blakely's Red Gum Woodland is listed as an endangered ecological community under the NSW TSC Act, and as a critically endangered ecological community under the Commonwealth EPBC Act.

The TEC occurs in three forms in and adjacent to the study area: derived grassland, woodland dominated by White Box, and woodland where White Box and Rough-barked Apple co-dominate. The derived grassland form, adjacent to the study area, occurs on a basalt cap. The Rough-barked Apple/White Box Woodland form occurs on a ridge underlain by sandstone, while the White Box dominated form occurs on footslopes and is also underlain by sandstone.

Approximately 17.2 ha of the TEC will be removed from the proposed extension areas. Additional areas of these communities occur outside the disturbance footprint.

An assessment of impact has been completed to assess potential impacts of the proposed modification on this TEC (Table B.1).

Table B.1 Assessment of impact for White Box Yellow Box Blakely's Red Gum Woodland TEC

Criteria	Discussion
1: life cycle of threatened species	This question refers to threatened species, therefore is not relevant to the assessment.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to the assessment.
3: EEC extent of removal and modification	This TEC has been heavily cleared in the Hunter-Central Rivers CMA (90 % cleared since 1750 (DECC 2008a)). Within the study area, White Box Yellow Box Blakely's Red Gum Woodland is restricted to hillsides and the footslopes. Due to its restricted distribution in the study area, there is potential for the local occurrence of this community to be placed at a localised risk of extinction. An area of derived grassland occurs between the two proposed active mining areas, and may be subject to indirect impacts such as an increase in dust and weed spread. The proposed modification will result in the removal of approximately 17.2 ha of White Box Yellow Box Blakely's Red Gum Woodland. Given the level of clearing in the CMA and its restricted distribution in the study area, the removal of these areas of woodland could have an adverse effect on the extent of the community, potentially placing it at risk of extinction in the locality. However, the proponent has committed to rehabilitate this community and conserve nearby areas outside the proposed extension areas in the long term. Potential indirect impacts of the proposed modification that could cause modification of this community include the introduction or spread of weeds. To minimise these potential impacts rehabilitation, weed control and monitoring will be implemented as part of the proposed modification.

Table B.1 Assessment of impact for White Box Yellow Box Blakely's Red Gum Woodland TEC

Criteria	Discussion
4: habitat removal, fragmentation, isolation and importance	The proposed modification will remove 17.2 ha of White Box Yellow Box Blakely's Red Gum Woodland. Where mining areas are developed, remnants will be separated by greater distances than they are currently. In addition, changes in land use, from grazing (native pasture) to mining, could further isolate ground cover species such as native grasses and forbs. MCO's LMP will be implemented to minimise the potential impacts of fragmentation during the life of the mine. Progressive rehabilitation will reconnect woodland areas, including where these areas are currently isolated. The proponent has also made a commitment to reinstate these areas, providing a net benefit. This TEC has suffered a large amount of clearing from surrounding mining projects (Moolarben Stage 1, Ulan and Wilpinjong) and in the Hunter-Central Rivers CMA. Any remnant habitat patches are therefore considered important. Some remnants of this community occur to the east of the study area, predominantly along low-lying parts of Murragamba Road. Where these are appropriately managed into the future (eg weed control) it is considered unlikely that the long term survival of the communities would be placed at risk of extinction as a result of the proposed modification.
5: critical habitat	Critical habitat under the TSC Act has not been declared for the TEC. However, the draft recovery plan for White Box Yellow Box Blakely's Red Gum Woodland identifies all habitat where this community occurs as critical habitat (DECCW, 2010a) and, therefore, 17.2 ha of critical habitat will be directly impacted by the proposed modification.
6: consistency with recovery or threat abatement plans	Recovery objectives for White Box Yellow Box Blakely's Red Gum Woodland focus on the achievement of 'no net loss', increasing connectivity and restoring sites (DECCW 2010a). As the proposed modification will remove this vegetation type, it is not considered consistent with the recovery plan. The LMP will aim to reduce the impact of removal by replanting with species characteristic of this community, providing a net benefit in the long term.
7: key threatening processes	The proposed modification constitutes the key threatening process (KTP) 'clearing of native vegetation'. A revegetation strategy will be outlined in the LMP to minimise the impacts of this KTP within the locality. Vegetation clearance and disturbance in and surrounding TEC areas will be minimised where possible during detailed design and mitigation in accordance with the LMP. Potential infection of native plants by *Phytophthora cinnamomi* is also a KTP of relevance. However, the LMP will include hygiene protocols to reduce the risk of infection of plants by *P. cinnamomi*, and therefore impacts are considered to be minor.
Conclusion	The proposed modification could result in significant impacts to White Box Yellow Box Blakely's Red Gum Woodland because: • it removes 17.2 ha from the study area; • it impacts on identified, but not listed, critical habitat for White Box Yellow Box Blakely's Red Gum Woodland; • it further fragments and isolates known TEC remnants; and • it is not consistent with the recovery plan. However, it is noted that the proponent has made a commitment in the LMP to restore this community.

ii Threatened flora: Pine Donkey Orchid

The Pine Donkey Orchid is listed as a vulnerable species under the TSC Act. It grows in sclerophyll forest among grass, often with Cypress Pine or ironbarks. It is found in sandy soils, either on flats or small rises. The understorey is often grassy with herbaceous plants such as Bulbine species. The species flowers generally in spring (OEH 2012b).

The *Diuris* genus of orchids is thought to have evolved to mimic pea shrubs (Fabaceae) in order to attract insect pollinators. Yellow and brown donkey orchids in Australia are pollinated by colletid bees (belonging to the family Colletidae). The loss or reduction in habitat for these native bees may reduce pollinators available to pollinate *Diuris* orchids. In Australia native bees are experiencing decreasing areas of habitat, and must coexist with introduced honey bees as the clearing of large expanses of native vegetation on private land has also meant that bee keepers have required access to Crown Lands such as State Forests and in some states, National Parks, to produce honey. Understanding of the impacts of these actions and consequences for native Australian bees is limited, because specific studies addressing these issues are few in number, and knowledge of the biology and ecology of native Australian bees is generally lacking (Indsto 2009).

The Pine Donkey Orchid has not been recorded in the study area, however, it has been recorded in the MCP Stage 1 project area during the flowering period (Moolarben Biota 2006) adjacent to the Open Cut 1 extension, at the Ulan Coal Mine (Umwelt 2009) and to the south-west of the study area. It could occur in the derived grassland form of White Box Yellow Box Blakely's Red Gum Woodland in the study area. An assessment of impact criteria under Part 5a of the EP&A Act has been completed for the Pine Donkey Orchid (Table B.2).

Table B.2 Assessment of impact criteria for Pine Donkey Orchid

Criteria	Discussion
1: life cycle of threatened species	The proposed modification will not result in the removal of any known individuals from the study area. However, potential habitat exists within the ironbark and Cypress Pine woodlands of the study area. Life cycle of flora species can be affected in the following main ways: • impacts to pollination (internal mechanisms or impacts to pollinators) – the Pine Donkey Orchid is probably pollinated by native bees. The proposed modification has the potential to remove habitat of native bee pollinators from the study area, which could reduce the number of pollinators in the area, leading to a potential reduction in pollination of the orchid; • ability of the plant to produce flowers – the proposed modification is not expected to affect the ability of individual plants to produce flowers, this is more likely to be affected by other environmental factors such as rainfall; • ability of the plant to produce and set seed – the proposed modification could impact the habitat of pollinators, which could impact on the number of individuals being pollinated, leading to a reduction in seed setting; • ability to germinate – the germination requirements of this species are not known; and • ability of seedlings to grow – the proposed modification could produce levels of dust which could affect photosynthesis capabilities, but being a narrow-leaved orchid it is not known the degree to which the species would rely on this for growth, compared to reliance on mycorrhizal fungi.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.

Table B.2 Assessment of impact criteria for Pine Donkey Orchid

Criteria	Discussion
4: habitat removal, fragmentation, isolation and importance	Potential habitat for the Pine Donkey Orchid within the study area occurs as White Box Yellow Box Blakely's Red Gum Woodland, which will be removed for the proposed modification. Modification of remaining potential habitat adjacent to the study area could occur through indirect impacts such as increased dust levels and edge effects, including weed invasion. As the species occurrence has not been confirmed in the study area due to surveys being undertaken after the flowering period, the extent of habitat removal or isolation of the habitat is unknown. The wider locality is not considered to be an important area for the species, as they were only found in low numbers (two individuals) during detailed surveys for MCP Stage 1. Surveys will be undertaken prior to clearing to identify any individuals in the proposed extension areas, with appropriate management actions taken to minimise potential impacts to the species if found. The proposed modification will result in some areas of potential habitat being isolated from others by greater distances than they are currently, or by changed land uses.
5: critical habitat	Critical habitat has not been declared for this species.
6: consistency with recovery or threat abatement plans	The proposed modification is not considered to be consistent with the recovery of the species because 14 ha of potential habitat for the species will be removed. This will be mitigated by commitments in the LMP to rehabilitate disturbed areas for biodiversity outcomes.
7: key threatening processes	The proposed modification constitutes the KTP 'clearing of native vegetation'. A revegetation strategy will be outlined in the LMP to minimise this KTP. It could also increase the impact of habitat degradation by feral pigs. However, ongoing mitigation at the study area during the life of the mine will include feral animal management which should reduce the potential impacts to habitat from feral pigs.
Conclusion	The proposed modification is considered unlikely to result in significant impacts to the Pine Donkey Orchid because: • the species has not been recorded from the proposed extension areas, therefore only represents potential habitat for the species; • the wider locality is not considered to be an important area for the species, with low numbers previously recorded; • surveys to detect the species in the proposed extension areas will be undertaken prior to clearing, with appropriate management actions taken if detected; and • rehabilitation of disturbed areas will occur in line with the LMP.

iii Threatened flora: Scant Pomaderris

Scant Pomaderris is listed as an endangered species under the TSC Act. The species is a shrub 2–3 m high of the family Rhamnaceae. It is found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks (OEH 2012b). Little is known of its habitat requirements, although it has been found on sandstone soils in the Hunter region (OEH 2012b).

This species was recorded in the MCP Stage 2 area in sheltered forest (Ecovision Consulting 2008). This shrub species was not recorded within the study area. Potential habitat exists in Shrubby White Box Forest of the study area. Potential habitat was not common across the study area and distribution of the species would not be extensive, if it did occur.

It is likely that insects pollinate *Pomaderris* species. There are no specific details available on pollination vectors available for the species.

An assessment of impact criteria under Part 5A of the EP&A Act for has been completed for the Scant Pomaderris (Table B.3).

Table B.3 Assessment of impact criteria for Scant Pomaderris

Criteria	Discussion
1: life cycle of threatened species	The proposed modification will not result in the removal of any known individuals from the study area. However, potential habitat exists within some forested areas. Life cycle of flora species can be affected in the following main ways: • impacts to pollination (internal mechanisms or impacts to pollinators) – Scant Pomaderris is probably pollinated by insects. If there are no species-specific pollinators it is considered unlikely that the proposed modification would impact on the pollination of the species by insects; • ability of the plant to produce flowers – the proposed modification is not expected to affect the ability of individual plants to produce flowers, this is more likely to be affected by other environmental factors such as rainfall; • ability of the plant to produce and set seed – the proposed modification is not expected to impact the ability of the species to produce and set seed; • ability to germinate – the germination requirements of this species are not known; and • ability of seedlings to grow – the proposed modification could increase dust levels in the locality which could affect photosynthesis capabilities and growth of seedlings and adult plants. The proposed modification will not remove known habitat or individuals of this species and is unlikely to impact pollinators. It is therefore considered unlikely to affect the life cycle of the Scant Pomaderris such that a local population would be placed at risk of extinction.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.

Table B.3 Assessment of impact criteria for Scant Pomaderris

Criteria	Discussion
4: habitat removal, fragmentation, isolation and importance	The proposed modification will not remove known habitat or individuals of this species and is unlikely to impact pollinators. Potential habitat for the species occurs in sheltered forest, which is not common within the study area. Given that this species was not identified within the study area, it is considered unlikely that the proposed modification will have an adverse effect. The proposed modification is unlikely to fragment potential habitat for the Scant Pomaderris, as potential habitat occurs to the east of impact areas. If the species was to occur within the study area, existing habitat would be considered important, as the records would be near or at the south-eastern extent of the distribution of the species.
5: critical habitat	Critical habitat has not been declared for this species.
6: consistency with recovery or threat abatement plans	The proposed modification is considered consistent with the recovery of the species because: • it will not remove any known individuals; • it avoids known habitat for the species; and • ongoing mitigation across the study area during the life of the mine will include feral animal management which will reduce the potential impacts to habitat from feral pigs.
7: key threatening processes	The proposed modification constitutes the KTP 'clearing of native vegetation'. The revegetation strategy outlined in the LMP will minimise this KTP. It could also increase the impact of the following KTPs by increasing pressures on retained habitat: • competition and habitat degradation by feral goats; and • habitat degradation by feral pigs. However, ongoing mitigation at the study area during the life of the mine will include feral animal management which should reduce the potential impacts to habitat from feral pigs.
Conclusion	The proposed modification is not expected to result in significant impacts to the Scant Pomaderris because: • it will not remove individuals of the species; • the known individuals outside the study are will not be affected; and • retained vegetation will be managed under the LMP.

iv Endangered population: River Red Gums in the Hunter Valley

An endangered population of River Red Gums is listed in the Hunter Valley. Scattered River Red Gums were recorded west of the study area, along Moolarben Creek. The population exists in a highly disturbed state, as scattered trees with an exotic understorey.

An assessment of impact criteria has been completed to assess potential impacts of the proposed modification on the endangered population (Table B.4).

Table B.4 Assessment of impact criteria for River Red Gums in the Hunter Catchment

Criteria	Discussion
1: life cycle of threatened species	This question addresses threatened species, therefore is not relevant to this assessment.
2: life cycle of endangered population	River Red Gums require flooding as a trigger for germination. Dense stands of young plants appear over extensive areas after floods (CSIRO 2004). Open cut mining will only reduce the Moolarben Creek catchment area by 1.1% (WRM 2013). The proposed extension areas are also outside the extent of flooding and hence the proposed modification will have no additional impact on flood behaviour in Moolarben Creek up to the 100 year ARI flood event (Worley Parsons 2006). Therefore, the proposed modification is highly unlikely to affect the germination of River Red Gums.
3: EEC extent of removal and modification	This question refers to TECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	The proposed modification will not remove or fragment River Red Gums as they occur outside the impact area. River Red Gums have a very restricted distribution in the Hunter Catchment, as is the population is only estimated to cover 100 ha, when 20,000 ha existed prior to European settlement (OEH 2012b). Given the population's restricted distribution, its occurrence is of high importance.
5: critical habitat	Critical habitat under the TSC Act has not been declared for the endangered population.
6: consistency with recovery or threat abatement plans	This endangered population does not currently have recovery plans, or any priority recovery actions. Therefore, the proposed activity does not interfere with planned recovery actions.
7: key threatening processes	The proposed activity has the potential to impact upon the KTP 'alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. As stated above, the proposed modification will have no impact on the flood behaviour of Moolarben Creek, therefore, will not impact on this KTP.
Conclusion	The proposed activity is unlikely to cause significant impacts to the endangered population of River Red Gums in the Hunter Valley for the following reasons: • the closest population is located more than 500 m from proposed extension areas on Moolarben Creek; • the reduction in the creek's catchment area is minimal (1.1%); • no changes in flooding regimes are expected; and • there will be no reduction in germination rates.

v Threatened reptiles: Broad-headed Snake

The Broad-headed Snake is listed as an endangered species under the TSC Act, and a vulnerable species under the EPBC Act. It has not been recorded within the study area. It is known from Goulburn River NP (NPWS 2003).

The Broad-headed Snake is nocturnal, sheltering by day in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. This species moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer (Newell and Goldingay 2005). It feeds mostly on geckos and small skinks; but will occasionally eat frogs and small mammals. Females produce four to 12 live young from January to March, which is a relatively low level of fecundity (OEH 2012b).

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts to the Broad-headed Snake (Table B.5).

Table B.5 Assessment of impact criteria for the Broad-headed Snake

Criteria	Discussion
1: life cycle of threatened species	The proposed modification will remove potential breeding habitat (hollow-bearing trees) on escarpments, limiting recruitment of the species within the study area, should the species occur.
2 : life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to the assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to the assessment.
4: habitat removal, fragmentation, isolation and importance	90 hectares of potential habitat (Ridgeline Broad-leaved Ironbark Grey Gum Forest) will be removed by the proposed modification. Habitat will not be fragmented by the proposed modification as it is located on the edge of a large tract of bushland. Given that this species was not identified within the study area during targeted surveys, it is considered unlikely that this will have an adverse affect on the species. If the species does occur in the study area, the potential habitat being removed would be important to the species as a shelter and breeding resource. It is noted, however, that much larger areas of potential habitat exist to the north, east and south of the study area.
5: critical habitat	Critical habitat has not been declared for this species.
6: consistency with recovery or threat abatement plans	There is no recovery plan or threat abatement plan for the Broad-headed Snake. High priority recovery actions identified for the species focus upon protection of high priority known habitat areas. The study area is unlikely to be a high priority area, as no individuals of the species were recorded.
7: key threatening processes	The proposed modification may contribute to the increase of three KTPs that affect this species: 'clearing of native vegetation', 'loss of hollow bearing trees' and 'removal of bushrock'. The LMP includes measures to retain salvaged hollows and bushrock to compensate for the loss of these habitat features, and a revegetation program will be implemented as part of the proposed modification.

Table B.5 Assessment of impact criteria for the Broad-headed Snake

Criteria	Discussion
Conclusion	The proposed modification is not expected to result in significant impacts to the Broad-headed Snake as: • the species has a low likelihood of occurrence as it was not detected during targeted survey; and • the LMP details measures to compensate for the loss of hollow-bearing trees and rock shelter sites.

vi Forest owls: Barking Owl, Masked Owl and Powerful Owl

The **Barking Owl** is listed as a vulnerable species under the TSC Act. It was not recorded during the current survey, but was recorded at Ulan Coal Mine in 2009 (Umwelt 2009). Potential roosting habitat for the Barking Owl within the study area occurs as canopy species with dense foliage including Cherry Ballart, Black Cypress Pine and Scrub She-oak. Nesting habitat within the study area occurs as tree hollows (in living or dead trees where hollows measure greater than 20 cm diameter and are greater than 4 m above the ground in Ironbark (OEH 2012b). No evidence (ie pellets, owl wash) was observed in the study area, therefore, it is unlikely to breed in the study area. These areas also provide a favoured prey species, the Common Ringtail Possum. In addition, wooded areas, and grassland up to 250 m from wooded areas also provide foraging habitat for this species (OEH 2012b). Ridgetop Blue-leaved Ironbark Grey Gum Woodlands represent potential habitat for this species.

The **Masked Owl** is listed as a vulnerable species under the TSC Act. The Masked Owl roosts in trees, crevices in cliffs or caves and sometimes in buildings (OEH 2012B). Nesting occurs in trees with hollows of greater than 40 cm in diameter (OEH 2012b), in cliffs or caves. Breeding is irregular and unpredictable for the Masked Owl, occurring from late summer to spring but mostly March to July (DEC 2006). The Masked Owl was recorded in Ridgetop Blue-leaved Ironbark Woodland. Potential sheltering and foraging habitat is available in the study area, particularly in this vegetation type which contained the highest density of prey habitat, prey species and trees with dense foliage. However, no evidence (ie pellets, owl wash) was observed in the study area, therefore it is unlikely to breed in the study area.

The **Powerful Owl** is listed as a vulnerable species under the TSC Act. It was recorded in Ridgetop Blue-leaved Ironbark Grey Gum Woodland in the study area. Potential breeding and foraging habitat for the Powerful Owl is available within the study area in eucalypt woodlands. However, no evidence (ie pellets, owl wash) was observed in the study area, therefore it is unlikely to breed in the study area. Tree species recorded within the study area and in which the species is known to roost include Rough-barked Apple, Cherry Ballart and a number of eucalypt species. The Powerful Owl requires large tree hollows (at least 0.5 m deep) for nesting (trees with diameter at breast height of 80-240 cm) (DEC 2006). A number of potentially suitable breeding hollows were recorded within the study area, particularly in Grey Gums.

The 'local' population of these threatened owl species is considered to comprise those individuals present in the study area, and large expanses of connected native bushland and conservation reserves. The study area is considered to represent a small part of these species large home ranges.

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the proposed modification to forest owls (Table B.6).

Table B.6 Assessment of impact criteria for forest owls

Criteria	Discussion
1: life cycle of threatened species	Areas of vegetation containing large hollow-bearing trees, which are potential breeding resources for these species, will be removed for the proposed modification. This could limit recruitment of species and displace breeding pairs. Owls may be deterred from breeding in areas immediately adjacent to the study area which will be retained, due to increased noise, light and dust. The study area is considered to represent a small component of the threatened owl's home ranges (up to 6,000 ha for the Barking Owl (OEH 2012b)). As connectivity to large expanses of native bushland and conservation reserves will be retained, these owls will have access to alternative breeding sites and partners outside the study area. Therefore, the removal of this breeding habitat is not expected to impact the species such that they would decline.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	The proposed modification will result in the removal of 133 ha of woodland representing known foraging and roosting habitat and likely breeding habitat for Masked and Powerful Owls, and potential habitat for the Barking Owl. The proposed modification is unlikely to fragment habitat for the species, as a large vegetated corridor to the east will be retained, maintaining linkages to conservation reserves including Goulburn River NP in the north and Munghorn Gap NR in the south, allowing them to access alternative foraging and breeding habitat. The study area is considered to represent a small component of the threatened owls home ranges, which would extend into connected native bushland east of the study area and nearby conservation reserves. Therefore, habitat removal for these species is not expected to cause the local population to decline.
5: critical habitat	Critical habitat has not been declared for any of these species.
6: consistency with recovery or threat abatement plans	A recovery plan is in place for the Masked Owl and Powerful Owl (DEC 2006). Two recovery objectives are applicable to the proposed modification: • 'ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment process'; and • 'minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat'. The proposed modification is consistent with the first objective, however does not meet the second. However, MCO has committed to maintaining and improving connectivity to surrounding conservation reserves, and rehabilitating areas disturbed by the proposed modification, minimising this impact. Priority actions for the Barking Owl focus on increasing knowledge of the species requirements, and to incorporate consideration of habitat as a high priority in the assessment of property for reserve establishment. The proposed modification does not interfere with these objectives.

Table B.6 Assessment of impact criteria for forest owls

Criteria	Discussion
7: key threatening processes	The proposed modification may contribute to the increase of the following KTPs: • 'clearing of native vegetation'; and • 'loss of hollow bearing trees'. Measures will be included in the LMP to minimise these KTPs. However, owls require old growth features (ie large trees with hollows) to persist, and there will be a lag time in the development of these features in rehabilitation areas, rendering them unsuitable for owls for 120 - 200 years (DEC 2006). Nest boxes will be placed in suitable locations for owls. Measures to promote the return of fauna to the rehabilitation areas will be addressed in the LMP to minimise impacts.
Conclusion	The proposed modification is not expected to result in significant impacts to the Barking Owl, Powerful Owl and Masked Owl as: • the study area represents a small component of their large home ranges; and • connectivity will be retained to large expanses of native bushland and conservation reserves, providing alternative areas of habitat within their home ranges.

vii Raptors: Black-breasted Buzzard, Little Eagle, Spotted Harrier, Square-tailed Kite

The **Black-breasted Buzzard** is listed as a vulnerable species under the TSC Act. It was not recorded within the study area. It was last recorded in 2009 at Ulan Coal Mine, directly north of the study area. Potential breeding habitat for the species exists in riparian woodlands adjacent to the study area. Potential hunting habitat is also present over grassland and sparsely timbered woodlands. This species breeds from August to October near water in a tall tree. The stick nest is large and flat and lined with green leaves. Normally two eggs are laid (OEH 2012b).

The **Little Eagle** is listed as a vulnerable species under the TSC Act. It was not recorded within the study area. It was last recorded from Munghorn Gap Nature Reserve in 2001 (Eremaea Birds 2012), and Ulan Coal Mine in 2004 (OEH 2012c). It has the potential to occur in riparian woodlands 50 m west of the study area. Potential nesting habitat is present in tall living trees. This species lays two or three eggs during spring, and young fledge in early summer (OEH 2012b).

The **Spotted Harrier** is listed as a vulnerable species under the TSC Act. It was not recorded within the study area. It was last recorded at Ulan Coal Mine in 2008 (OEH 2012c). There is potential for the species to occur in riparian woodland 50 m west of the study area, and derived grassland between the two proposed extension areas. This species builds a stick nest in a tree and lays eggs in spring (or sometimes autumn). The young remain in the nest for several months (OEH 2012b).

The **Square-tailed Kite** is listed as a vulnerable species under the TSC Act. It was not recorded within the study area. It was recorded in the proposed MCP Stage 2 area (west of the study area) (Ecovision Consulting 2008), at Wilpinjong Coal Mine (Mount King Ecological Surveys 2005), at Ulan Coal Mine (Umwelt 2009) and Goulburn River NP (NPWS 2003). Potential habitat exists in riparian woodland 50 m west of the study area. Breeding for this species is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs (OEH 2012b).

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the proposed modification to raptors (Table B.7).

Table B.7 Assessment of impact criteria for raptors

Criteria	Discussion
1: life cycle of threatened species	Potential breeding habitat for threatened raptors occurs to the west of the study area in riparian woodland. The proposed modification avoids these areas, and as such no direct impacts to potential breeding habitat are expected. Given that no threatened raptors, or their nests were recorded within the study area, and that similar habitats for these species are available across the locality and the region, the proposed modification is unlikely to affect the life cycles of viable local populations of these species such that they would be placed at risk of extinction.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	No raptor habitat will be removed for the proposed modification. It is unlikely to increase the level of habitat fragmentation, as the habitat occurs along Moolarben Creek, avoided by the proposed modification. Given that threatened raptors have not been recorded within the study area, the importance of the habitat within the local area is considered to be low for all species.
5: critical habitat	Critical habitat has not been declared for any of these threatened waterbirds.
6: consistency with recovery or threat abatement plans	The threatened raptors assessed here do not have recovery plans, threat abatement plans or priority action statements. Recovery actions identified for the species generally focus on the protection of nesting habitat along watercourses and in woodland (OEH 2012b). Mitigation measures, including the minimisation of vegetation clearing during staged clearing works and the demarcation of clearing boundaries, will be undertaken to minimise risk of impacts to these areas.
7: key threatening processes	The proposed modification constitutes 'clearing of native vegetation', a KTP. Clearing will be avoided by the proposed modification in riparian woodland (potential raptor habitat), therefore it is unlikely to increase the operation of this KTP.
Conclusion	The proposed modification is not expected to result in significant impacts to threatened raptors as: • the species have a low likelihood of occurrence due to non-detection during targeted surveys; • direct and indirect impacts to breeding habitat will be largely avoided; and • potential breeding and foraging habitat will be retained along Moolarben Creek.

viii Threatened Honeyeaters: Black-chinned Honeyeater, Painted Honeyeater and Regent Honeyeater

The **Black-chinned Honeyeater** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was recorded in the proposed MCP Stage 2 area (Ecovision Consulting 2008), at Ulan Coal Mine (Umwelt 2009), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). This species inhabits woodlands dominated by box and ironbark eucalypts, especially White Box (OEH 2012b). Potential habitat is present in Grassy White Box Woodland and Shrubby White Box Forest.

The **Painted Honeyeater** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was recorded in the proposed MCP Stage 2 area (Ecovision Consulting 2008), at Ulan Coal Mine (Umwelt 2009) and Wilpinjong Coal Mine (Mount King Ecological Surveys 2005). Potential foraging and nesting habitat is present for this species in Grassy White Box Woodland and Ridgetop Blue-leaved Ironbark Grey Gum Woodland containing mistletoes in the study area. This species nests from spring to autumn in a small nest within the outer canopy of drooping eucalypts, She-oak, Paperbark or Mistletoe branches (OEH 2012b).

The **Regent Honeyeater** is listed as a critically endangered species under the TSC Act. It was not recorded in the study area. However, it has been recorded at Ulan Coal Mine (Umwelt 2009), Munghorn Gap Nature Reserve with a 14% reporting rate (Eremaea Birds 2012), and east of Cope State Forest. The Mudgee-Wollar area has also been identified as an important area for the species (Birdlife International 2012, NPWS 2002).

Potential foraging habitat is present for this species in Grassy White Box Woodland and Ridgetop Blue-leaved Ironbark Grey Gum Woodland that contain large numbers of mature trees, high canopy cover and mistletoes. Key eucalypt feed species including White Box are present in the study area. Red Stringybark, Rough-barked Apple and Mistletoes are also present as a foraging resource for this species (OEH 2012b) in the study area.

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the proposed modification to threatened honeyeaters (Table B.8).

Table B.8 Assessment of impact criteria for threatened honeyeaters

Criteria	Discussion
1: life cycle of threatened species	The study area is part of an important area for the Regent Honeyeater (NPWS 2002, Birdlife International 2012). White Box, an important feed species (Menkhorst, Schedvin and Geering 1999) is present on the western footslopes of the study area. It is therefore likely that the study area may represent potential foraging habitat for the Regent Honeyeater. Evidence of foraging or breeding has not been recorded in the study area, but has been recorded at Munghorn Gap Nature Reserve, south of the study area. Potential breeding habitat is present for the Black-chinned and Painted Honeyeaters in woodlands of the study area.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.

Table B.8 Assessment of impact criteria for threatened honeyeaters

Criteria	Discussion
4: habitat removal, fragmentation, isolation and importance	Twenty nine ha of woodland, which constitutes potential habitat for the Black-chinned Honeyeater and Painted Honeyeater will be removed for the proposed modification. Eleven ha of woodland habitat containing White Box, a Regent Honeyeater feed species, will also be removed for the proposed modification. The proposed modification is unlikely to fragment habitat, as it is located on the western edge of a large tract of bushland. Given the decline of woodland bird species in recent years, woodland habitat in the study area is considered important to honeyeaters, particularly the Regent Honeyeater.
5: critical habitat	Critical habitat has not been declared for any of these bird species.
6: consistency with recovery or threat abatement plans	Various recovery strategies to maintain and improve priority habitats are contained in the recovery plans for the Regent Honeyeater (Menkhorst *et al.* 1999). Although the Black-chinned and Painted Honeyeaters do not have recovery plans, proposed recovery actions are similar to the Regent Honeyeater. The proposed modification is not consistent with the recovery strategies as it removes potential breeding habitat for the species, which could be considered a priority habitat.
7: key threatening processes	The proposed modification is likely to constitute and increase the operation 'clearing of native vegetation'. The LMP will detail measures to minimise this KTP.
Conclusion	The proposed modification is not expected to result in significant impacts to the Regent Honeyeater as: • a small area (11 ha) of foraging habitat will be removed; • the species was not detected in the study area during detailed ecological surveys; • clearing will be progressive; and • disturbed areas will be progressively rehabilitated to woodland that contains White Box, an important feed species. The proposed modification is not expected to result in significant impacts to the Black-chinned Honeyeater or the Painted Honeyeater as these species are highly mobile and could utilise the large expanse of native bushland that the study area is connected to for breeding and foraging habitat.

ix Threatened hollow-dependent woodland birds: Brown Treecreeper, Glossy Black-Cockatoo, Swift Parrot, Little Lorikeet, and Turquoise Parrot

The **Brown Treecreeper** is listed as a vulnerable species under the TSC Act. It was recorded in the study area in Ridgetop Blue-leaved Ironbark Grey Gum Woodland. Habitat is present for this species in this vegetation type, Grassy White Box Woodland and Shrubby White Box Forest. Fallen timber is available in these vegetation types for foraging habitat. Hollows for nesting are available in standing dead or live trees and tree stumps (OEH 2012b), particularly in the open forests on hillslopes. The local population of Brown Treecreepers is considered to be those individuals present in the study area, given their highly sedentary nature.

The **Glossy Black-cockatoo** is listed as a vulnerable species under the TSC Act. Potential foraging evidence (a chewed Black Cypress Pine cone) was recorded in Ridgetop Blue-leaved Ironbark Grey Gum Woodland. Limited foraging habitat is present for this species in this vegetation type, and in Rough-barked Apple – Cypress Pine Woodland on slopes. Potential nesting habitat occurs in tree hollows of the study area, but as this habitat is not close to an important foraging area, they are unlikely to breed in the study area.

The **Turquoise Parrot** is listed as a vulnerable species under the TSC Act. It was recorded west of the study area in Riparian Woodland. Habitat for this species is present at the ecotone between riparian woodland and cleared agricultural land. Nesting habitat is available in tree hollows, logs and old fence posts. The Turquoise Parrot breeds from August to December (OEH 2012b).

The **Little Lorikeet** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It has been recorded from Moolarben biodiversity offset sites (EcoLogical 2012), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands and on the western slopes have been recorded in remnant woodland patches and roadside vegetation and riparian corridors which are generally favoured. Nest hollows are located at heights of between 2 m and 15 m, mostly in smooth-barked eucalypts, especially Manna Gum, Blakely's Red Gum and Tumbledown Gum. Hollow openings are very small, approximately 3 cm in diameter (OEH 2012B). It has high site fidelity with nesting areas, which are usually in proximity to feeding areas. However, nomadic movements, following food availability are common (OEH 2012B). Potential foraging habitat is present in riparian woodland west of the study area. Breeding habitat is absent as the riparian woodland is characterised by a rough-barked tree species, Rough-barked Apple.

The **Swift Parrot** is listed as an endangered species under the TSC Act. Surveys were undertaken outside of winter when this species would be present in the study area. This species was recorded at Ulan Coal Mine (Umwelt 2009) and recorded 10 km north of Cope in 2005. Potential winter foraging habitat for this species is available throughout the study area. White Box, an important winter food resource, occurs in the study area. The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland (OEH 2012B).

The local populations of the Glossy Black-Cockatoo, Turquoise Parrot, Little Lorikeet and Swift Parrot are considered to be those individuals present in the study area, and large expanses of connected native bushland and conservation reserves given their highly mobile nature.

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the proposed modification to hollow-dependent woodland birds (Table B.9).

Table B.9 Assessment of impact criteria for hollow-dependent woodland birds

Criteria	Discussion
1: life cycle of threatened species	Of the species assessed here, the study area only contains potential breeding habitat for the Brown Treecreeper. Brown Treecreepers, which were recorded during the survey, are known to be sedentary, and, as such may to breed in the study area where suitable tree hollows occur. Given the Brown Treecreeper's sedentary nature, a reduction in breeding habitat and foraging resources may cause the local population to decline, through declines in offspring recruitment and survivorship.
2 : life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	Ninety ha of known foraging and potential breeding habitat for the Brown Treecreeper will be removed for the proposed modification. Thirty ha of limited, potential foraging habitat will be removed for the Glossy Black-cockatoo and Swift Parrot. Known foraging habitat for the Turquoise Parrot and potential foraging habitat for the Little Lorikeet in riparian woodlands will be avoided. The proposed modification is unlikely to fragment habitat for hollow-dependent woodland birds as it is on the western edge of a large vegetated area. Habitat in the study area is considered important to the local Brown Treecreeper population, given their sedentary nature. Habitat is not considered to be important for the Glossy Black-cockatoo due to the restricted distribution of She-oaks in the study area. The study area is considered to contain winter foraging habitat for the Swift Parrot as it was recorded nearby at Ulan, and contains White Box, an important winter-flowering resource for the species. However, the study area is connected to a large tract of bushland to the east, and two conservation reserves that contain available foraging habitat measuring approximately 72,000 and 6,000 ha, respectively. Therefore, it is unlikely to impact the survival of the species in the locality. Turquoise Parrot habitat occurs to the west of the study area, and will be protected and rehabilitated through implementation of measures in the LMP. Additionally, other areas of habitat available in surrounding conservation areas (Goulburn River NP and Munghorn Gap Nature Reserve) provide suitable habitat for these species.
5: critical habitat	Critical habitat has not been declared for these species.
6: consistency with recovery or threat abatement plans	Various recovery strategies to maintain and improve priority habitats are contained in the recovery plans for these species. Measures to revegetate and reconnect habitat linkages will be included in the LMP to minimise the risk of habitat degradation.
7: key threatening processes	The proposed modification is likely to constitute and increase the operation 'clearing of native vegetation'. The LMP will detail measures to minimise this KTP.

Table B.9 Assessment of impact criteria for hollow-dependent woodland birds

Criteria	Discussion
Conclusion	The proposed modification is not expected to result in significant impacts to the Glossy Black-cockatoo, Turquoise Parrot, Little Lorikeet and the Swift Parrot as: • breeding habitat is absent from the study area; and • the study area contains very limited foraging habitat for the Glossy Black-cockatoo; • known foraging habitat for the Turquoise Parrot and potential foraging habitat for the Little Lorikeet will be avoided, and the area will be protected and rehabilitated through implementing measures in the LMP; and • the Swift Parrot does not breed in the area, and is a highly mobile species that could utilise other suitable habitats in the surrounding area. Impacts may be significant for the local population of Brown Treecreeper as it is highly sedentary and the study area contains known foraging and potential breeding habitat.

x Nest-building woodland birds: Diamond Firetail, Gilbert's Whistler, Grey-crowned Babbler, Speckled Warbler and Varied Sittella

The **Diamond Firetail** is listed as a vulnerable species under the TSC Act. It was recorded to the west of the proposed modification in riparian woodland. It has also been recorded in the proposed MCP Stage 2 area (Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Mount King Ecological Surveys) and at Munghorn Gap Nature Reserve (Eremaea Birds 2012). Foraging and breeding habitat is present in the grassy woodlands of the study area. This species is largely sedentary and forms small colonies to breed between August and January (OEH 2012b). The Diamond Firetail was observed adjacent to the proposed modification during this time and is likely to be breeding in suitable habitat.

Gilbert's Whister is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. However, it was previously recorded in the MCP Stage 1 area (Moolarben Biota 2006). Foraging habitat is available in the study area on or near the ground in shrub thickets and in tops of small trees. This species breeds between August and November, and builds a nest up to 6 m above the ground in the fork of a tree or dense shrubs (OEH 2012b).

The **Grey-crowned Babbler** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It has previously been recorded nearby in the proposed MCP Stage 2 area (Ecovision Consulting 2008) and Ulan Coal Mine (Umwelt 2009). Foraging habitat for this species is available in areas of fallen timber or grassy understorey. This species breeds between July and February (OEH 2012B). Potential habitat is present in Grassy White Box Woodlands in the study area and riparian woodland adjacent to the proposed extension areas.

The **Speckled Warbler** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was recorded in the proposed MCP Stage 2 area (Ecovision Consulting 2008) and Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Speckled Warblers inhabit woodlands with a grassy understorey, often on ridges or gullies. The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. They forage on the ground and in the understorey for arthropods and seeds. Home ranges vary from 6-12 ha (OEH 2012b). Potential habitat exists in footslope and riparian woodlands of the study area.

The **Varied Sittella** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was recently recorded at the Moolarben biodiversity offset sites (EcoLogical 2012), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). The Varied Sittella is sedentary and inhabits eucalypt forests and woodlands, especially rough-barked species, mature smooth-barked gums with dead branches, mallee and wattle woodland. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the tree canopy. It often re-uses the same fork or tree in successive years. Potential habitat occurs in the study area where smooth barked trees including Grey Gum, and rough-barked species including White Box and Rough-barked Apple occur.

The local populations of these threatened bird species is considered to be those individuals present in the study area, and the large contiguous corridor of native bushland, extending into nearby conservation reserves.

An assessment of impact criteria under Part 5A of the EP&A Act has been completed to assess potential impacts to other woodland birds in the study area (Table B.10).

Table B.10 Assessment of impact criteria for nest-building woodland birds

Criteria	Discussion
1: life cycle of threatened species	The Diamond Firetail was recorded west of the proposed modification. They are known to be sedentary species, and the study area contains suitable habitat, so the species may breed in the study area. The Speckled Warbler and Varied Sittella were recorded nearby, and suitable habitat also exists. These are also sedentary species, and may breed in the area. Gilbert's Whistler was not recorded in the study area during the survey, however, potential breeding habitat is present in shrubby forests. Forty seven ha of potential breeding habitat for these species will be removed. Local populations of these species are considered to be those present within the study area and the large vegetated corridor that connects with nearby conservation reserves. As connectivity will be maintained, these species will have access to alternative breeding habitats outside the study area. Therefore, impacts to these species life cycle are not expected to result in a decline in local populations. No breeding or roosting evidence of Grey-crowned Babblers was observed in the study area, therefore, breeding is unlikely to be adversely affected.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.

Table B.10 Assessment of impact criteria for nest-building woodland birds

Criteria	Discussion
4: habitat removal, fragmentation, isolation and importance	Forty seven ha of potential breeding habitat for the Diamond Firetail, Speckled Warbler and Varied Sittella will be removed for the proposed modification. Approximately 13 ha of potential breeding habitat for Gilbert's Whistler will also be removed. Fourteen ha of potential foraging habitat for the Grey-crowned Babbler will also be removed. The proposed modification is unlikely to fragment habitat for nest-building birds as connectivity to surrounding areas of bushland and conservation reserves will be maintained. Given the decline of woodland bird species in recent years, habitat in the study area is considered important to the Diamond Firetail, Speckled Warbler and Varied Sittella. However, large expanses of suitable habitat area are available surrounding the study area, therefore impacts from its loss will be minimised. Further, MCO is committed to the rehabilitation of disturbed areas in accordance with the LMP. Habitat is not considered to be important to the Grey-crowned Babbler as no individuals or their roosts/nests were recorded in the study area.
5: critical habitat	Critical habitat has not been declared for any of these woodland birds.
6: consistency with recovery or threat abatement plans	Various recovery strategies to maintain and improve priority habitats are contained in the recovery plans for these species. In general, the clearing of known and potential habitat is inconsistent with the recovery of these species. Measures to rehabilitate habitat will continue to be implemented in accordance with the LMP.
7: key threatening processes	The proposed modification is likely to constitute and increase the operation of 'clearing of native vegetation' and 'removal of dead wood and dead trees'. The LMP will detail measures to minimise these KTPs.
Conclusion	The proposed modification is not expected to result in significant impacts to the Diamond Firetail, Gilbert's Whistler, Speckled Warbler and Varied Sittella as: • the local population of these species extends outside the study area to connecting bushland and conservation reserves; • connectivity will be maintained, allowing these species to access alternative habitats; and • measures to improve and rehabilitate habitat will continue to be implemented in accordance with the LMP. The proposed modification is not expected to result in significant impacts to Grey-crowned Babbler as the species' likelihood of occurrence in the study area is low due to non-detection of nests/roosting sites during targeted surveys.

xi Threatened Robins: Flame Robin, Hooded Robin and Scarlet Robin

The **Hooded Robin** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It has been recently recorded nearby in the MCP Stage 2 area (Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Mount King Ecological Surveys 2005), Ulan Coal Mine (Umwelt 2009) and Munghorn Gap Nature Reserve (Eremaea Birds 2012). Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season (OEH 2012B). Potential habitat is present in riparian woodlands of the study area, adjacent to cleared agricultural land. The local population of this species is considered to comprise those individuals present in the study area and in large tracts of contiguous bushland that link with nearby conservation reserves.

The **Scarlet Robin** and **Flame Robin** are listed as vulnerable species under the TSC Act. These species were not recorded in the study area. The Scarlet Robin was recorded at the Moolarben biodiversity offset sites (EcoLogical 2012), while the Flame Robin was recorded at Ulan Coal Mine (Umwelt 2009). Potential winter foraging habitat is available for these species in open forests on ridges, footslope woodlands and riparian woodlands. Tree trunks, logs and other coarse woody debris are also available for perching/foraging habitat (OEH 2012b), particularly in open forests on ridges.

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the proposed modification to robins (Table B.11).

Table B.11 Assessment of impact criteria for robins

Criteria	Discussion
1: life cycle of threatened species	Scarlet and Flame Robins are unlikely to breed within the study area as they prefer to breed in upland, tall moist forests. Therefore, the proposed modification will not impact on the lifecycle of these species. If present, it is likely that the Hooded Robin would breed in the study area. Some potential breeding habitat will be removed (open forests on ridges and footslope woodlands), and some will be retained (riparian woodland) by the proposed modification. In the areas which will be retained, birds will be subject to an intermittent increase in noise, light and dust. This may cause birds to be deterred from breeding in these areas. Measures to reduce these potential impacts will continue to be implemented as part of the relevant management plans. As the local population extends outside the study area to large contiguous bushland and surrounding conservation reserves, and the maintenance of connectivity to these areas, Hooded Robins in the study area will be able to access alternative breeding habitats.
2 : life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to the assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to the assessment.
4: habitat removal, fragmentation, isolation and importance	Woodland representing potential foraging habitat for the robins, and potential breeding habitat for the Hooded Robin will be removed for the proposed modification. The proposed modification will not fragment habitat for these species as connectivity will be maintained with surrounding areas of native bushland and conservation reserves. Given the decline of woodland bird species in recent years, habitat in the study area is considered important to the Hooded Robin. However, the importance of this habitat is reduced by the wide availability of surrounding and connected suitable habitat. Habitat in the study area is not considered critical to the survival of the Flame and Scarlet Robins as they are unlikely to breed in the area, and alternative suitable foraging habitat is abundant in the surrounding area.

Table B.11 Assessment of impact criteria for robins

Criteria	Discussion
5: critical habitat	Critical habitat has not been declared for any of these robin species.
6: consistency with recovery or threat abatement plans	Various recovery strategies to maintain and improve priority habitats are contained in the recovery plans for these species. In general, the clearing of habitat is inconsistent with the recovery of these species. Progressive rehabilitation will be undertaken in accordance with the LMP to achieve positive biodiversity and habitat outcomes.
7: key threatening processes	The proposed modification is likely to constitute and increase the operation of KTPs that woodland birds are subject to including 'clearing of native vegetation'. The LMP will detail measures to minimise this KTP.
Conclusion	The proposed modification is not expected to result in significant impacts to the Hooded Robin as: • the local population of the species extends outside the study area; and • connectivity will be maintained to large expanses of native bushland and conservation reserves, therefore the Hooded Robin will be able to access alternative breeding habitat. The proposed modification is not expected to result in significant impacts to the Scarlet Robin and Flame Robin as they do not breed in the area, and large areas of alternative and suitable foraging habitat occur in the local area.

xii Gang-gang Cockatoo

The **Gang-gang Cockatoo** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was previously recorded in the proposed MCP Stage 1 and 2 study areas (Moolarben Biota 2006; Ecovision Consulting 2008) and at Ulan Coal Mine (Umwelt 2009). Several records exist from 2004 in Munghorn Gap Nature Reserve, south east of the study area. As such, it may occur in the study area where suitable habitat is present.

Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season (OEH 2012b). It is likely that the study area provides winter foraging and breeding habitat for this species, due to the presence of box and ironbark eucalypt species, wattles in the understorey of open forests, and suitable tree hollows. Goulburn River NP, directly north of the study area, is the northern limit of this species distribution in the area.

An assessment of impact criteria under Part 5a of the EP& A Act has been completed to assess potential impacts of the proposed modification to threatened robins (Table B.11).

Table B.12 Assessment of impact criteria for the Gang-gang Cockatoo

Criteria	Discussion
1: life cycle of threatened species	The Gang-gang Cockatoo is an altitudinal migrant, spending spring and summer in tall montane forests, and migrating to lower altitude, drier woodlands in winter. This species breeds from spring to summer in tall montane forests, therefore would not breed in the lower altitude, drier woodlands of the study area. As such, the breeding cycle of this species is unlikely to be affected. The removal of potential wintering habitat in the study area may reduce the availability of foraging and shelter habitat for the species during this part of its life cycle. Surrounding conservation reserves (Goulburn River NP and Munghorn Gap Nature Reserve) provide suitable wintering habitat for this species, minimising the scale of this impact.
2 : life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	One hundred and thirty three ha of potential wintering habitat for the Gang-gang Cockatoo will be removed for the proposed modification. Habitat fragmentation is unlikely for this highly mobile species (NSWSC 2008c), as the proposed modification removes the western edge of a large tract of bushland. Given its location on the species' northern distributional limit in the area, the study area may contain important wintering habitat for the Gang-gang Cockatoo.
5: critical habitat	Critical habitat has not been declared for any of these bird species.
6: consistency with recovery or threat abatement plans	Various recovery strategies to maintain and improve priority habitats are contained in the recovery plans for these species. In general, the clearing of potential habitat is inconsistent with the recovery of these species. Measures to rehabilitate habitat will be included in the LMP.
7: key threatening processes	The proposed modification is likely to constitute an increase in the operation of KTPs that woodland birds are subject to including 'clearing of native vegetation'. The LMP will detail measures to minimise this KTP.
Conclusion	The proposed modification is not expected to result in significant impacts on the Gang-gang Cockatoo as: • it does not breed in the study area; • it is a highly mobile species; and • surrounding bushland and conservation reserves provide large expanses of bushland that contain suitable habitat for the species.

xiii Threatened cave-roosting bats: Eastern Bentwing Bat, Eastern Cave Bat, Large-eared Pied Bat and Little Bentwing Bat

The **Eastern Bentwing Bat** is listed as a vulnerable species under the TSC Act. It was recorded in open forests on ridgelines of the study area. Habitat (non-breeding) is present for this species in eucalypt woodland and open grasslands (Churchill 2008). This species migrates to maternity roosts in limestone caves in October and gives birth from December to January. Females leave maternity sites in March to seek out cold caves for winter hibernation. Eastern Bentwing Bats roost in other caves and road culverts for the remainder of the year. Within the study area, roosting habitat is available in crevices and cracks of rocky outcrops.

The **Eastern Cave Bat** is listed as a vulnerable species under the TSC Act. It was recorded in open forests on ridges in the study area. It was also recorded at Ulan Coal Mine (Umwelt 2009) and Goulburn River NP (OEH 2012a). Potential roosting habitat is available for the species in crevices and overhangs in rocky outcrops and in boulder piles. Potential foraging habitat is available in open forests, footslope woodlands and riparian woodlands (Churchill 2008). Little is known of this species' reproductive habits. Pregnant females have been captured in October, and lactating females have been observed in December. Maternity colonies have been found in sandstone caves and also under corrugated iron rooves (Churchill 2008).

The **Large-eared Pied Bat** is listed as a vulnerable species under the TSC Act and EPBC Act. It was not recorded in the study area. It was recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012), Wilpinjong Coal Mine (Greg Richards and Associates 2005) and Ulan Coal Mine (Umwelt 2009), therefore is likely to occur in the study area where suitable habitat is present. Roosting habitat for this species is available in crevices and overhangs in sandstone rocky outcrops. Potential foraging habitat is present in Box Gum Woodlands and creek flats (DECC 2007b), but would also be present in open forest on ridgelines. Males can roost alone or in small groups during torpor in winter. Females form maternity colonies from November to February in the roof domes of sandstone caves. Females show high fidelity to maternity caves (Churchill 2008).

The **Little Bentwing Bat** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It has previously been recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012), and Ulan Coal Mine (Umwelt 2009), and as such is likely to occur in the study area where suitable habitat is present. Potential roosting habitat exists in cracks and crevices in rocky outcrops, and potential foraging habitat is present in open forests and woodlands. Like the Eastern Bentwing Bat, this species breeds outside the study area.

Given these species high dispersal capability, the 'local population' is considered to be those potentially present in the study area, in connected habitats to the east, and in connected conservation lands in the north and south (Goulburn River NP and Munghorn Gap Nature Reserve).

An assessment of impact criteria under Part 5a of the EP& A Act has been completed to assess potential impacts of the proposed modification to threatened cave-roosting bats (Table B.13).

Table B.13 Assessment of impact criteria for the threatened cave-roosting bats

Criteria	Discussion
1: life cycle of threatened species	Potential breeding habitat for the Eastern Cave Bat may be impacted by the proposed modification. A potential maternity site of this species was located within the study area. Removal of this area may affect breeding success, limit recruitment and decrease the local population size in the long-term as breeding habitat and caves are a limiting factor in the locality. Sandstone escarpments are not a widespread feature in the study area, therefore it is not considered to contain breeding habitat for the Large-eared Pied Bat. Indirect impacts such as vibration and night light may also interrupt these species and affect breeding success in the study area. Habitat feature retention and re-use for during rehabilitation will be undertaken in accordance with the LMP. The Eastern and Little Bentwing Bats breed in domed limestone caves outside the study area, and as such their breeding cycle will not be affected.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	Foraging habitat is widely distributed in the study area, with sheltering habitat and potential breeding habitat occurring in more restricted areas, only on ridgelines in open forest. Approximately 104 ha of suitable foraging habitat for these species and approximately 3 km of ridgeline containing potential breeding habitat for the Eastern Cave Bat will be removed for the proposed modification. Habitat fragmentation is unlikely for these highly mobile species, as the proposed modification only removes the western edge of a large tract of bushland. The study area does not contain large areas of sandstone escarpment, therefore is not considered important to the Large-eared Pied Bat. The study area may represent important habitat for the Eastern Cave Bat as a potential breeding maternity site was found, and they were recorded in the study area. It is likely that the study area only represents transient habitat for the Eastern and Little Bentwing Bats, that breed outside the area (Churchill 2008) and are likely to winter on the coast (DECC 2007b).
5: critical habitat	Critical habitat has not been declared for any of these threatened bat species.
6: consistency with recovery or threat abatement plans	The main objective for the Large-eared Pied Bat in the Action Plan for Australian Bats is to protect known roost sites (Environment Australia 1999). The proposed modification will not remove known or potential roost sites, therefore is consistent with the strategy. Priority actions (OEH 2012b) for the Eastern Cave Bat, Little Bentwing Bat and Eastern Bentwing Bat focus on research, monitoring, awareness and conservation. As known habitat for the Eastern Cave Bat and Eastern Bentwing Bat, and potential habitat for the Little Bentwing Bat and Large-eared Pied Bat will be removed, the proposed modification is inconsistent with recovery actions for the species. However, rehabilitation will be undertaken to achieve positive outcomes for these species, in accordance with the LMP.
7: key threatening processes	The proposed modification is likely to constitute and increase the operation of 'clearing of native vegetation'. Measures will continue to be implemented in accordance with the LMP to limit the invasion and spread of feral animals through the study area to minimise the potential impacts of this KTP.

Table B.13 Assessment of impact criteria for the threatened cave-roosting bats

Criteria	Discussion
Conclusion	The proposed modification may result in significant impacts to the Eastern Cave Bat as: • it removes a large area of known and potential foraging habitat; • it removes 3 km of cliffline, representing potential breeding and roosting habitat, a limiting factor in the locality; and • it is not consistent with the recovery plan for the species. The proposed modification is not expected to result in significant impacts to the Large-eared Pied Bat as: • they were not recorded in the study area; and • the study area does not contain large areas of sandstone escarpments that would support breeding habitat for the species. The proposed modification is not expected to result in significant impacts to the Eastern Bentwing Bat and Little Bentwing Bat as: • they breed outside the study area; and • they are highly mobile species that utilise different habitat areas at different times of the year.

xiv Tree-roosting bats: East-coast Freetail Bat, Eastern False Pipistrelle, Greater Broadnosed Bat, Little Pied Bat, Southern Long-eared Bat and Yellow-bellied Sheathtail Bat

The **East-coast Freetail Bat** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. This species roosts in tree hollows, and usually in hollow spouts of large mature trees. They hunt on the wing in forest gaps (Churchill 2008). It was previously recorded at Wilpinjong Coal Mine (Greg Richards and Associates 2005), and is expected to occur in the study area where suitable habitat exists. Potential habitat for this species is present in open forests, footslope and riparian woodlands of the study area.

The **Eastern False Pipistrelle** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was previously recorded at Moolarben biodiversity offset sites (EcoLogical 2012) and Wilpinjong Coal Mine (Greg Richards and Associates 2005) and is expected to occur in the study area where suitable habitat exists. This species roosts in hollow trunks of eucalypt trees in colonies of three to 80. They hunt in gaps and spaces in the forest and avoid dense regrowth (Churchill 2008). The study area contains potential wintering habitat in open forests, footslope and riparian woodlands.

The **Greater Broad-nosed Bat** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was previously recorded at Moolarben biodiversity offset sites (EcoLogical 2012) and is expected to occur in the study area where suitable habitat exists. This species roosts in tree hollows, crack and fissures in trunk and dead branches and under peeling bark. They hunt on the forest edge. Potential habitat for this species is present in open forests, footslope and riparian woodlands of the study area.

The **Little Pied Bat** is listed as a vulnerable under the TSC Act. It was not recorded in the study area. It was previously recorded in the proposed MCP Stage 2 area (Ecovision Consulting 2008), Moolarben biodiversity offset sites (EcoLogical 2012) and Ulan Coal Mine (Umwelt 2009), therefore is likely to occur in the study area where suitable habitat is present. Potential habitat within the study area is present as open forests and woodlands. Potential roosting habitat is available within tree hollows of large eucalypts that have dead limbs, Cypress Pines and crevices/cracks in rocky outcrops. Pregnancy, birth and lactation in females occur from October to December (Churchill 2008).

The **Southern Long-eared Bat** is listed as a vulnerable species under the TSC Act and EPBC Act. It was not recorded in the study area. It was previously recorded in the MCP Stage 1 and 2 areas (Moolarben Biota 2006; Ecovision Consulting 2008) and Ulan Coal Mine (Umwelt 2009) and is expected to occur in the study area where suitable habitat exists. This species roosts in tree hollows, fissures in branches and under peeling bark. They hunt on the wing in canopy gaps (Churchill 2008). Habitat opportunities are present for this species in open forest on ridges, footslope and riparian woodlands. Roosting habitat within the study area is available in the hollows of live trees, which could also be used as maternity sites.

The **Yellow-bellied Sheathtail Bat** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was recorded in the MCP Stage 1 area (Moolarben Biota 2006) and Wilpinjong Coal Mine (Greg Richards and Associates 2005) and is expected to occur in the study area where suitable habitat exists. This species roosts in large tree hollows, in colonies of approximately 30 bats. They hunt above the canopy, and sometimes on the forest edge (Churchill 2008). Foraging opportunities are present for this species in footslope and riparian woodland. Roosting opportunities for the species are available in large tree hollows in eucalypt woodlands.

Given these species high dispersal capability, the 'local population' is considered to be those potentially present in the study area, in connected habitats to the east, and in connected conservation lands in the north and south (Goulburn River NP and Munghorn Gap Nature Reserve).

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the proposed modification on threatened tree-roosting bats (Table B.14).

Table B.14 Assessment of impact criteria for the threatened tree-roosting bats

Criteria	Discussion
1: life cycle of threatened species	The study area contains potential foraging and breeding habitat, in the form of hollow-bearing trees, for these microbat species. Hollow-bearing trees are considered a limiting resource in the study area (mainly restricted to Ridgetop Blue-leaved Ironbark Grey Gum Forest) and the removal of this resource could impact these species given the likely competition for such resources in the landscape. The Little Pied Bat also roosts and breeds in caves. Three km of cliffline will be removed for the project. As this species also breeds in tree hollows and the study area is connected to conservation areas where this habitat is available, the proposed modification is unlikely to impact their lifecycle. Potential breeding habitat will be removed for all species (with the exception of the Eastern False Pipistrelle, which breeds in upland tall moist forest outside the study area), which may cause migration out of the study area into nearby conservation reserves and other connected patches of forest and woodland. Bats may also be deterred from breeding in areas adjacent to active mining areas due to increased noise, night light and dust. Measures to reduce these potential impacts will be implemented through the LMP.

Table B.14 Assessment of impact criteria for the threatened tree-roosting bats

Criteria	Discussion
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to this assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to this assessment.
4: habitat removal, fragmentation, isolation and importance	The proposed modification will remove 104 ha of potential foraging and breeding habitat for tree-roosting bats from the study area, and 3 km of cliffline that may contain roosting caves for the Little Pied Bat, which also roosts in tree hollows. This habitat is considered important for the local populations of these species, if they are present, with the exception of the Eastern False Pipistrelle. This species is an altitudinal migrant that sometimes migrates to lower altitude woodlands in winter. However, as the 'local population' is defined as those individuals potentially occurring in the study area and nearby conservation reserves where suitable habitat is available, they are unlikely to be significantly impacted by the proposed modification. The proposed modification is considered unlikely to fragment habitat for these species, as it removes the western edge of a large expanse of bushland. Additionally, nest boxes will be installed in rehabilitation areas in accordance with the LMP.
5: critical habitat	Critical habitat has not been declared for any of these threatened microbats.
6: consistency with recovery or threat abatement plans	The main objective for the Little Pied Bat in the Action Plan for Australian Bats (Environment Australia 1999) is to protect known roost sites. The proposed modification is not consistent with this strategy. There are no recovery objectives for the Yellow-bellied Sheathtail Bat in this strategy. Recovery objectives for the Southern Long-eared Bat (Schulz and Lumsden 2010) focus on clarification of the species range. The proposed modification does not interfere with this objective. Priority actions for the Eastern False Pipistrelle, Little Pied Bat, Greater Broad-nosed Bat and East-coast Freetail Bat focus on research, awareness and identification of key foraging and roosting habitats for the species (OEH 2012b). The proposed modification does not interfere with these actions.
7: key threatening processes	The proposed modification is likely to constitute and increase 'clearing of native vegetation' and 'loss of hollow bearing trees'. Measures detailed in the LMP will minimise this impact of these KTPs. The effects of the loss of hollow-bearing trees will be minimised through the installation of nest boxes in appropriate locations.
Conclusion	The proposed modification is not expected to result in significant impacts to the local populations of tree-roosting bats because: • the local population consists of those individuals potentially occurring in the study area, connected private lands and conservation reserves; and • the proposed modification is unlikely to fragment habitat as it removes the western edge of a large expanse of bushland.

xv Threatened non-flying mammals: Koala, Squirrel Glider and Spotted-tailed Quoll

The **Squirrel Glider** is listed as a vulnerable species under the TSC Act. It was not recorded in the study area. It was recorded in the MCP Stage 1 area (Moolarben Biota 2006), at Ulan Coal Mine (Umwelt 2009) and Wilpinjong Coal Mine (Mount King Ecological Surveys 2005). Potential habitat is limited for this species in the study area, and restricted to footslope woodlands that contain tree hollows. This species is known to rarely occur within the locality.

The **Koala** is listed as a vulnerable species under the TSC Act and EPBC Act. It was not recorded in the study area. It was recorded at Ulan Coal Mine (Umwelt 2009) and in Munghorn Gap Nature Reserve in 2009 (OEH 2012c). Limited habitat is available in the study area in White Box dominated forests and woodlands on the western edge of the study area. This species breeds between September and December (DECC 2008c).

The **Spotted-tailed Quoll** is listed as a vulnerable species under the TSC Act and an endangered species under the EPBC Act. It was recorded south of Munghorn Gap Nature Reserve in 2000 (OEH 2012c). Potential habitat is present in open woodlands that contain gullies, rocky escarpments and outcrops (Belcher 2000; Belcher *et al.* 2000). It utilises a range of habitats including open forest and open woodland. Shelter habitat is available in caves, among rocks, hollow logs and low tree hollows (Edgar and Belcher 1995; Belcher and Darrant 2004). Potential latrine and den sites are present in rocky outcrops and overhangs.

These species are known to rarely occur in the locality. The paucity of records in the study area is not considered to represent the absence of these species, and therefore it is assumed they occur in very low numbers. Given the limited nature of habitat, it is likely that the study area does not constitute important habitat and these species may be utilising habitat present as part of a larger movement corridor with surrounding conservation reserves.

'Local populations' of these species are considered to be those potentially present in the study area, in connected habitats to the east, and in connected conservation lands in the north and south (Goulburn River NP and Munghorn Gap Nature Reserve).

An assessment of impact criteria under Part 5a of the EP&A Act has been completed to assess potential impacts of the proposed modification to threatened non-flying mammals (Table B.21).

Table B.15 Assessment of impact criteria for non-flying mammals

Criteria	Discussion
1: life cycle of threatened species	These non-flying mammal species were not recorded in the study area. They are considered likely to occur, but in low numbers. Potential breeding habitat in the form of woodlands will be removed as a result of the proposed modification and could impact the Squirrel Glider and Koala, and to a lesser extent the Spotted-tail Quoll due to its large home range size and high dispersal capability. Approximately 3 km of cliff line, which could be providing potential den sites for the Spotted-tail Quoll, will also be removed. As these species are likely to only be present as vagrants or temporary visitors moving through the area between habitat patches, the study area is not likely to constitute important breeding habitat. Therefore their life cycles are unlikely to be significantly impacted such that local populations are placed at risk of extinction.
2: life cycle of endangered population	This question refers to endangered populations, therefore is not relevant to the assessment.
3: EEC extent and modification	This question refers to TECs, therefore is not relevant to the assessment.
4: habitat removal, fragmentation, isolation and importance	The following habitat will be removed as a result of the proposed modification: • Fourteen ha potential foraging, sheltering and breeding habitat for the Squirrel Glider; • Ninety potential habitat for the Spotted-tailed Quoll; and • Twenty nine ha of potential secondary habitat and 105 ha of potential supplementary habitat for the Koala. The proposed modification is unlikely to fragment habitat in the study area as it only removes the western edge of a large expanse of bushland. Additionally, as the occurrence of such species is likely to be opportunistic and temporary, it is considered that retained vegetation will provide suitable habitat and movement corridors for most of these mammals.
5: critical habitat	Critical habitat has not been declared for any of these threatened species.
6: consistency with recovery or threat abatement plans	A recovery action relevant to the proposed modification from the National Recovery Plan for the Spotted-tailed Quoll (Long and Nelson 2004) is to 'reduce the rate of loss and fragmentation of Spotted-tailed Quoll habitat'. The proposed modification is not consistent with this action. A recovery action relevant to the proposed modification from the Koala Recovery Plan (DECC 2008c) is to revegetate and rehabilitate koala habitats. The proposed modification will remove 134 ha of potential Koala habitat, and as such is not consistent with the strategy. Priority actions for the Squirrel Glider focus on research and conservation on private lands (OEH 2012b). The proposed modification does not interfere with these actions. MCO's commitment to rehabilitate the majority of the proposed extension areas for biodiversity outcomes and implementation of detailed measures in accordance with the LMP will mitigate these potential impacts.
7: key threatening processes	The proposed modification is likely to constitute and increase 'clearing of native vegetation', 'removal of dead wood and dead trees', 'loss of hollow-bearing trees' and 'predation by European Red Fox'. The LMP will detail measures to minimise these impacts.
Conclusion	The proposed modification is not expected to result in significant impacts to threatened non-flying mammal species as: • the species have a low likelihood of occurrence in the study area; and • the study area is not considered to constitute important habitat for these species. They are expected to occur as vagrants or temporary visitors moving between patches of habitat.

B.2 Significant impact criteria in accordance with the EPBC Act

The following sections provide the criteria that must be considered in the assessment of all threatened species listed under the EPBC Act. There are separate criteria for each listing category under the EPBC Act, in accordance with *'EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance'* (DEH 2006).

B.2.1 Significant impact criteria for critically endangered and endangered ecological communities

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- reduce the extent of an ecological community;
- fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- adversely affect habitat critical to the survival of an ecological community;
- modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
    - assisting invasive species, that are harmful to the listed ecological community, to become established; or
    - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- interfere with the recovery of an ecological community.

B.2.2 Significant impact criteria for critically endangered and endangered species

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

- lead to a long-term decrease in the size of a population;
- reduce the area of occupancy of the species;
- fragment an existing population into two or more populations;
- adversely affect habitat critical to the survival of a species;

- disrupt the breeding cycle of a population;
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- introduce disease that may cause the species to decline; or
- interfere with the recovery of the species.

B.2.3 Significant impact criteria for vulnerable species

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

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

B.2.4 Significant impact criteria for listed migratory species

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

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

B.2.5 Assessments of impact criteria

Assessments of impact criteria have been prepared for species listed under the EPBC Act, in accordance with the criteria above.

i Critically endangered and endangered ecological community: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act. See Section B.1.1 (i) for a description of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. An assessment of significance has been completed to assess potential impacts on these threatened ecological communities (Table B.16).

Table B.16 Assessment of impact criteria for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC

Criteria	Discussion
1: reduce extent of EEC	This TEC has been heavily cleared in the Hunter-Central Rivers CMA (90 % cleared since 1750 (DECC 2008a)). Within the study area, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland is restricted to hillsides and the footslopes. Due to its restricted distribution in the study area, there is potential for the local occurrence of this community to be placed at risk of extinction. An area of derived grassland occurs between the two proposed active mining areas, and may be subject to indirect impacts such as an increase in dust and weed spread. The proposed modification will result in the removal of approximately 16.5 ha of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Given the level of clearing in the CMA and its restricted distribution in the study area, the removal of these areas of woodland could have an adverse effect on the extent of the community, potentially placing them at risk of extinction in the locality from stochastic events (ie bushfire). Potential indirect impacts of the proposed modification that could cause modification of this community including increased dust deposition and introduction or spread of weeds. To minimise these potential impacts rehabilitation, weed control and monitoring will be implemented as part of the proposed modification. However, the proponent has committed to rehabilitate this community and conserve nearby areas outside the proposed extension areas in the longterm.
2: fragment an EEC	An area of derived grassland occurs between the two proposed active mining areas, and is likely to be fragmented by the proposed activity.
3: adversely affect critical habitat for an EEC	Habitat critical to the survival of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland has been identified by DECCW (2010a) as wherever it occurs. The proposed modification will result in the removal of 16.5 ha of habitat critical to the survival of the community. However, the proponent has committed to rehabilitate this community and conserve nearby areas outside the proposed extension areas in the longterm.
4: modify or destroy abiotic factors	The proposed modification is not expected to affect abiotic factors that the community relies on.
5: substantial change in composition of an EEC	Potential changes to composition of the remaining CEEC (derived grassland) could occur through weed invasion or dust deposition (where species assemblages change to favour dust tolerant species). In order to reduce the potential for these impacts, management and mitigation measures will be implemented as part of the Environmental Management Plan for the proposed modification.

Table B.16 Assessment of impact criteria for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC

Criteria	Discussion
6: substantial reduction in quality or integrity of EEC	Potential reduction in integrity or quality of the CEEC could occur, primarily through weed invasion. Management of weeds will be implemented as part of the Environmental Management Plan for the proposed modification.
7: interfere with recovery	Recovery objectives for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland focus on the achievement of 'no net loss', increasing connectivity and restoring sites (DECCW 2010a). The LMP to be developed for the proposed modification will incorporate these objectives, with species characteristic of these communities to be planted within rehabilitated areas. However, as the proposed modification removes this vegetation type, it is not considered to be consistent with recovery of the CEEC.
Conclusion	The proposed modification is expected to result in significant impacts to White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland because it: • removes 16.5 ha of the CEEC from the study area; • impacts critical habitat for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Woodland; • temporarily fragments and isolates the remaining derived grassland form of the CEEC; and • is not consistent with the recovery plan for this community. However, it is noted that the proponent is committed to restablishing this community in accordance with the LMP.

ii Endangered woodland birds: Swift Parrot and Regent Honeyeater

See Section B.1.1 (xii) for a description of the Swift Parrot and Section B.1.1 (xi) for a description of the Regent Honeyeater. An assessment of impact criteria has been completed to assess potential impacts of the proposed modification on these endangered woodland birds (Table B.17).

Table B.17 Assessment of impact criteria for endangered woodland birds

Criteria	Discussion
1: long-term decrease in population size	The study area is part of an important area for the Regent Honeyeater (NPWS 2002) and given the presence of White Box, a preferred feed tree species (Menkhorsst, Schedvin and Geering 1999), the species may intermittently forage in the study area. However, the species has not been identified in the study area during past and present surveys (Moolarben Biota 2006; EMM 2013). The Swift Parrot breeds outside the study area, therefore the proposed modification will not impact on breeding habitat or breeding success for the species. The proposed modification will result in the loss of potential winter foraging habitat for the Swift Parrot from the local area, but this is not expected to be significant given the suitable foraging habitat present in nearby conservation reserves.

Table B.17 Assessment of impact criteria for endangered woodland birds

Criteria	Discussion
2: reduce area of occupancy	Swift Parrots and Regent Honeyeaters show very high site fidelity, returning to sites that have previously been used on a cyclic basis. However, as site use depends on the availability of foraging resources, the species are unlikely to be recorded at the same site every year (SEWPaC 2012b). Therefore the proposed modification is unlikely to substantially reduce the area of occupancy of these species.
3: fragment a population	The removal of an area of potential foraging habitat will not fragment populations of these highly mobile species.
4: adversely affect critical habitat	Box-Ironbark Woodland is critical wintering habitat for these species. In NSW, 70% of this habitat has been cleared. Although the study area doesn't contain Box-Ironbark Woodland, it contains a favoured winter-flowering tree species, White Box, present. Therefore, 11 ha of potential wintering habitat will be cleared for the proposed modification. However, the clearing of this small area of potential wintering habitat is not considered to be significant.
5: disrupt the breeding cycle of a population	The breeding cycle of the Swift Parrot will not be disrupted as it occurs outside of the study area. However, the Mudgee-Wollar area has been identified as an important area for the Regent Honeyeater, and contains potential breeding habitat for the species, due to the presence of White Box. Given the critically endangered status of this species, any disruption to breeding habitat could cause the population to decline.
6: decrease availability or quality of habitat	Eleven ha of potential winter foraging habitat for these species will be removed by the proposed modification. The LMP will detail measures to minimise habitat clearing and rehabilitate habitats following the completion of mining.
7: result in invasive species	Following clearing for the proposed modification, these species may be subject to competition from the native (however territorial) Noisy Miner which is present across much of the study area.
8: introduce disease	These species are not known to be subject to disease.
9: interfere with recovery	Recovery actions for these two species (Menkhorst *et al* 1999; Swift Parrot Recovery Team, 2001) centre upon the maintenance and enhancement of habitat at key sites. The LMP will minimise impacts on habitat for these species and rehabilitation efforts will replace potential habitat. However, there will be a lag time in these areas associated with the development of suitable habitat features (ie large flowering eucalypts) from the progressive rehabilitation.
Conclusion	The proposed modification is not expected to result in significant impacts on the Swift Parrot as: • the species breeds outside the study area; and • the study area is connected to large conservation reserves containing alternate foraging habitat. The proposed modification is not expected to result in significant impacts on the Regent Honeyeater as: • a small area (11 ha) of foraging habitat will be removed; • the species was not detected in the study area during detailed ecological surveys; • clearing will be progressive; and • disturbed areas will be progressively rehabilitated to woodland that contains White Box, an important feed species.

iii Endangered mammals: Spotted-tail Quoll

See Section B.1.1 (xviii) for a description of the Spotted-tail Quoll. An assessment of impact criteria has been completed to assess potential impacts of the proposed modification on this endangered mammal (Table B.18).

Table B.18 Assessment of impact criteria for the Spotted-tail Quoll

Criteria	Discussion
1: long-term decrease in population size	Maintenance of territories of female Spotted-tail Quolls (particularly their prey items, breeding dens and connectivity between these dens) are of critical importance to the conservation of the species, as the distribution of males appears to be largely influenced by the presence of breeding adult females (Belcher and Darrant 2004). The local population should one occur, is likely to be temporarily impacted during the life of the mine within the study area. However, this species has a large home-range size and is likely to be using it in association with other areas of woodland. If it is using the study area, the proposed modification is unlikely to impact the long-term survival of the species within the region.
2: reduce area of occupancy	The proposed modification may reduce the potential area of occupancy of this species during the life of the mine.
3: fragment a population	It is unlikely that the study area supports a local population of the species, given the availability of habitat within nearby conservation areas. As such, individuals likely to use the study area as a movement corridor or supplementary habitat are unlikely to be directly impacted by the proposed modification. This species uses landscape features such as vegetated creeklines for dispersal throughout its territory (Strahan 1995). Indirect impacts may fragment the corridors used by this species within the study area, should it occur. However, the design of the proposed modification avoids the fragmentation of riparian corridors.
4: adversely affect critical habitat	Habitat in the study area is not considered critical to the survival of the Spotted-tail Quoll as it is expected that they occur as vagrants or temporary visitors, moving between patches of habitat.
5: disrupt the breeding cycle of a population	The breeding cycle of this species may be disrupted through the removal of sparsely distributed potential breeding habitat within the study area. The breeding cycle may also be subject to disturbances adjacent to habitat including light, dust and noise, particularly for dispersing individuals looking for mates.
6: decrease availability or quality of habitat	Spotted-tail Quolls have large home ranges (620 – 2,560 ha for males and 90 - 650 ha for females (Claridge *et al*, 2005)), making it difficult for individuals to disperse to alternative breeding sites outside the study area and causing intraspecific competition, should the study area represent an area of habitat for this species.
7: result in invasive species	The European Red Fox is known to prey upon the Spotted-tailed Quoll (Murray and Poore 2004). European Red Fox numbers may increase in remnant habitat areas as a result of the proposed modification. Measures to restrict the spread of feral animals through the study area will be implemented to minimise this potential impact.
8: introduce disease	The Spotted-tail Quoll is not known to be susceptible to any diseases.
9: interfere with recovery	Maintenance of territories of female Spotted-tail Quolls (particularly their prey items, breeding dens and connectivity between these dens) are of critical importance to the conservation of the subspecies, as the distribution of males appears to be largely influenced by the presence of breeding adult females (Belcher and Darrant 2004). Revegetation will aim to rehabilitate corridors within the study area during the mine life and after mine closure.

Table B.18 Assessment of impact criteria for the Spotted-tail Quoll

Criteria	Discussion
Conclusion	The proposed modification is not expected to result in significant impacts to the Spotted-tail Quoll as: • they have a low likelihood of occurrence in the study area due to non-detection during targeted surveys; and • the study area is not considered to constitute important habitat for this species. They are expected to occur as vagrants or temporary visitors moving between patches of habitat.

iv Vulnerable bats: Large-eared Pied Bat and Southern Long-eared Bat

See Section B.1.1 (xvi) for a description of the Large-eared Pied Bat and Section B.1.1 (xvii) for the Southern Long-eared Bat. An assessment of impact criteria has been completed to assess potential impacts on these bats (Table B.19).

Table B.19 Assessment of impact criteria for vulnerable bats

Criteria	Discussion
1: long-term decrease of an important population	An important population of the Large-eared Pied Bat has been identified in the sandstone escarpments of the Hunter Valley (SEWPaC 2012b). Numerous records exist from Goulburn River NP (directly north of the site), which appears to be a stronghold for the species that will not be affected by the proposed modification. The study area does not contain large areas of sandstone escarpments that would support breeding habitat for the species. Therefore, the proposed modification is not considered to have the potential to result in a long-term decrease of an important population. Important populations have not been identified for the Southern Long-eared Bat, however this species has a low detection rate (1.4%) in the south west slopes, in which the study area is located.
2: reduce area of occupancy of an important population	No important populations of the Large-eared Pied Bat or Southern Long-eared Bat have been identified in the locality.
3: fragment an important population	The proposed modification is considered unlikely to form a barrier to movement for these two highly mobile species.
4: adversely affect critical habitat	As neither of these species were recorded in the study area, and suitable breeding habitat is not present for the Large-eared Pied Bat, it is not considered to contain critical habitat.
5: disrupt the breeding cycle of an important population	Sandstone escarpments are not a widespread feature in the study area, therefore it is not considered to contain breeding habitat for the Large-eared Pied Bat. Hollow-bearing trees are considered a limited resource in the study area. However, as the study area is connected to a large tract of bushland to the east, and part of a corridor connecting to Goulburn River NP and Munghorn Gap Nature Reserve where breeding habitat is also available, this impact is unlikely to disrupt the Southern Long-eared Bat's breeding cycle.
6: decrease availability or quality of habitat	Approximately 104 ha of woodland representing foraging habitat for these species and will be removed for the proposed modification.

Table B.19 Assessment of impact criteria for vulnerable bats

Criteria	Discussion
7: result in invasive species	Measures will continue to be implemented in accordance with the LMP to limit the introduction and spread of invasive species in the study area.
8: introduce disease	Bat species are prone to Australian Bat Lyssavirus. However, this virus has not been isolated from either of these species.
9: interfere with recovery	Recovery actions for the Southern Long-eared Bat focus on gaining a better understanding of the species ecology. The proposed modification does not directly interfere with this objective. A relevant objective to the proposed modification for the Large-eared Pied Bat is the protection of all known roost sites (Environment Australia 1999). Known or potential roost sites for the Large-eared Pied Bat do not occur, therefore, the proposed modification is consistent with this objective.
Conclusion	The proposed modification is not expected to result in significant impacts to the Large-eared Pied Bat as: • they were not recorded in the study area; and • the study area does not contain large areas of sandstone escarpments that would support breeding habitat for the species. The proposed modification is considered unlikely to result in significant impacts for the Southern Long-eared Bat as: • the study area does not contain an important population of the species; and • the study area is part of a large contiguous tract of bushland extending to the east, and is connected to nearby conservation reserves where breeding habitat is available.

v Vulnerable arboreal mammals: Koala

See Section B.1.1 (xviii) for a description of an assessment of impact criteria has been completed to assess potential impacts on the Koala (Table B.20).

Table B.20 Assessment of impact criteria for the Koala

Criteria	Discussion
1: long-term decrease of an important population	An important population of the Koala does not occur in the study area.
2: reduce area of occupancy of an important population	An important population of the Koala does not occur in the study area.
3: fragment an important population	An important population of the Koala does not occur in the study area.
4: adversely affect critical habitat	As no individuals or evidence of their presence was detected during targeted surveys, habitat in the study area is not considered critical to the survival of the Koala.

Table B.20 Assessment of impact criteria for the Koala

Criteria	Discussion
5: disrupt the breeding cycle of an important population	An important population of the Koala does not occur in the study area.
6: decrease availability or quality of habitat	The proposed modification will remove approximately 134 ha of potential Koala habitat. A rehabilitation program will be undertaken in line with the LMP for the proposed modification, which would provide sheltering and foraging habitat for this species into the future.
7: result in invasive species	The Koala is known to be subject to predation by domestic dogs. The proposed modification is not considered to increase the threat of this species to the Koala.
8: introduce disease	The Koala is known to be susceptible to Chlamydia. There is circumstantial evidence that chlamydiosis might increase in response to environmental stresses such as overcrowding and poor nutrition (Melzer, Carrick, Menkhorst, Lunney and John 2000). As Koalas are considered to be a vagrant species in the study area, the proposed modification is unlikely to cause environmental stress such that a disease outbreak would occur.
9: interfere with recovery	A recovery plan for the Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) will be developed and is to commence following the expiration of the National Koala Conservation and Management Strategy in 2014. A recovery action relevant to the proposed modification from the Koala Recovery Plan (DECCW 2008c) is to revegetate and rehabilitate koala habitats. The proposed modification will remove approximately 134 ha of potential Koala habitat but will also rehabilitate woodland which would provide sheltering and foraging habitat for this species into the future.
Conclusion	The proposed modification is not expected to result in significant impacts to the Koala as: • this species has a low likelihood of occurrence in the study area due to non-detection during targeted surveys; and • the study area is not considered to constitute important habitat for this species. It is expected to occur as vagrants or temporary visitors moving between patches of habitat.

vi Migratory birds: Rainbow Bee-eater and Rufous Fantail

Habitat is present for the **Rainbow Bee-eater** in open forest, footslope and riparian woodlands of the study area. It is a habitat generalist, and breeds outside the study area on Rottnest Island (Western Australia) and islands in the south west Torres Strait (SEWPaC 2012b).

The **Rufous Fantail** is likely to occur in the study area when on passage to coastal lowlands in winter, foraging in open forests containing ironbark species. They breed outside the study area, in south-east Australia.

An assessment of significance has been completed to assess potential impacts on these migratory birds (Table B.21).

Table B.21 Assessment of impact criteria for migratory birds

Assessment part	Discussion
1: substantially modify important habitat	The study area does not constitute an area of important habitat for these species, as an ecologically significant proportion (as defined under the guidelines (DEH, 2006)) of their population does not reside in the study area, no breeding occurs in the area, they are not at the limit of their range and they are not known to be declining.
2 : result in invasive species	These migratory species are known to be subject to predation by the European Red Fox. Measures to manage feral animals, including the European Red Fox, will continue to be implemented in accordance with the LMP.
3: disrupt lifecycle of ecologically significant proportion of population	An ecologically significant proportion of these species do not reside in the study area. In addition, they do not breed in the study area, foraging habitat is sub-optimal and the proposed modification is unlikely to disrupt their migration patterns.
Conclusion	The proposed modification is not expected to result in significant impacts to the migratory bird species as: • an ecologically significant proportion of the species is not known to reside in the study area; and • the study area does not contain important habitat for the species.

vii Migratory birds: Regent Honeyeater

A description of the Regent Honeyeater is provided in Section B.1.5 (xi). An assessment of impact criteria has been completed to assess potential impacts on these migratory birds (Table B.22).

Table B.22 Assessment of impact criteria for migratory birds

Criteria	Discussion
1: substantially modify important habitat	The study area contains a small area (11 ha) of potential foraging habitat for the species. However, the species was not detected by past surveys and those for the current modification (Moolarben Biota 2006; EMM 2013). Considering these factors, the proposed modification is considered unlikely to substantially modify an area of important habitat.
2 : result in invasive species	The Regent Honeyeater is known to be subject to grazing by rabbits, preventing regeneration of canopy eucalypts (SEWPaC, 2012). Measures to limit the occurrence of this introduced predator will continue to be implemented in accordance with the LMP.
3: disrupt lifecycle of ecologically significant proportion of population	This species has not been recorded in the study area, therefore, the study area is not considered to contain an ecologically significant proportion of the population.
Conclusion	The proposed modification is unlikely to result in significant impacts to the Regent Honeyeater as: • an ecologically significant proportion of the species does not reside in the study area; • the species has not been recorded in the study area; and • only a small area of potential foraging habitat will be gradually removed.

Appendix C

Species list

Table C.1 Flora species recorded

Family	Common name	Scientific name
Asteraceae	Purple Burr-daisy	*Calotis cuneifolia*
Asteraceae	Sifton Bush	*Cassinia aculeata*
Asteraceae	Sifton Bush	*Cassinia arcuata*
Asteraceae	Yellow Buttons	*Chrysocephalum semipapposum*
Asteraceae	Fleabane	*Conyza bonariensis**
Asteraceae	Scotch Thistle	*Onopordum acanthium**
Asteraceae	Dandelion	*Taraxicum officinale**
Asteraceae	Golden Everlasting	*Xerochrysum bracteatum*
Cactaceae	Tiger Pear	*Opuntia aurantica**
Cactaceae	-	*Opuntia elata**
Cactaceae	Prickly Pear	*Opuntia stricta**
Campanulaceae	Tufted Bluebell	*Wahlenbergia communis*
Casuarinaceae	Scrub She-oak	*Allocasuarina distyla*
Casuarinaceae	Drooping She-oak	*Allocasuarina verticillata*
Convolvulaceae	Kidney Weed	*Dichondra repens*
Cupressaceae	Black Cypress Pine	*Callitris endlicheri*
Cyperaceae	Rough-saw Sedge	*Gahnia aspera*
Cyperaceae	-	*Lepidosperma gunnii*
Cyperaceae	Heath Bog-rush	*Schoenus ericetorum*
Dilleniaceae	-	*Hibbertia circumdans*
Ericaceae - Stypheloideae	Native Cranberry	*Astroloma humifusum*
Ericaceae - Stypheloideae	-	*Monotoca elliptica*
Ericaceae - Stypheloideae	Pink Five Corners	*Styphelia triflora*
Fabaceae - Faboideae	-	*Dillwynia juniperina*
Fabaceae - Faboideae	Native Indigo	*Indigofera australis*
Fabaceae - Faboideae	Prickly Shaggy Pea	*Podolobium ilicifolium*
Fabaceae - Faboideae	False Sarsparilla	*Hardenbergia violacea*
Fabaceae - Mimosoideae	Currawang	*Acacia doratoxylon*
Fabaceae - Mimosoideae	White Sally	*Acacia floribunda*
Fabaceae - Mimosoideae	Gold Dust Wattle	*Acacia uncinata*
Fabaceae - Mimosoideae	Varnish Wattle	*Acacia verniciflua*
Goodeniaceae	Forest Goodenia	*Goodenia hederacea*
Lobeliaceae	Whiteroot	*Pratia purpurascens*
Lomandraceae	-	*Lomandra confertifolia subsp. similis*
Lomandraceae	-	*Lomandra filiformis subsp. coriacea*
Lomandraceae	-	*Lomandra longifolia*
Lomandraceae	Many flowered Mat Rush	*Lomandra multiflora subsp. multiflora*
Malvaceae	Kurrajong	*Brachychiton populneus*
Myrtaceae	Rough-barked Apple	*Angophora floribunda*
Myrtaceae	White Box	*Eucalyptus albens*
Myrtaceae	Hybrid stringybark	*Eucalyptus cannonii x macrorhyncha*
Myrtaceae	Narrow-leaved Ironbark	*Eucalyptus crebra*
Myrtaceae	Slaty Gum	*Eucalyptus dawsonii*

Table C.1 Flora species recorded

Family	Common name	Scientific name
Myrtaceae	Blue-leaved Ironbark	*Eucalyptus nubila*
Myrtaceae	Grey Gum	*Eucalyptus punctata*
Myrtaceae	Narrow-leaved Stringybark	*Eucalyptus sparsifolia*
Myrtaceae	Violet Kunzea	*Kunzea parvifolia*
Myrtaceae	-	*Sannantha cunninghamii*
Pittosporaceae	Blackthorn	*Bursaria spinosa*
Plantaginaceae	Plantain	*Plantago lanceolata**
Poaceae	Quaking Grass	*Briza minima**
Poaceae	Purple Wiregrass	*Aristida ramosa*
Poaceae	Wallaby Grass	*Austrodanthonia monticola*
Poaceae	Bamboo Grass	*Austrostipa verticillata*
Poaceae	Speargrass	*Austrostripa scabra*
Poaceae	Short-haired Plumegrass	*Dichelachne micrantha*
Poaceae	Wheat Grass	*Elymus scaber*
Poaceae	Brown's Lovegrass	*Eragrostis brownii*
Poaceae	Snowgrass	*Poa sieberiana*
Poaceae	Kangaroo Grass	*Themeda australis*
Proteaceae	Crinkle Bush	*Lomatia silaifolia*
Proteaceae	Narrow-leaved Geebung	*Persoonia linearis*
Rosaceae	Bidgee Widgee	*Acaena novae-zeelandiae*
Rubiaceae	-	*Pomax umbellata*
Rutaceae	Common Correa	*Correa reflexa*
Rutaceae	Scaly Phebalium	*Phebalium squamulosum ssp. gracile*
Santalaceae	Native Cherry	*Exocarpos cuppressiformis*
Sapindaceae	Sticky Hop Bush	*Dodonaea viscosa*
Xanthorrhoeaceae	Johnson's Grass Tree	*Xanthorrhoea johnsonii*
Zamiaceae	-	*Macrozamia spiralis*

*Notes 1. * - introduced species*

Table C.2 Fauna species recorded

Family	Common name	Scientific name
Amphibians		
Hylidae	Eastern Dwarf Sedge Frog	*Litoria fallax*
Myobatrachidae	Common Eastern Froglet	*Crinia signifera*
Reptiles		
Agamidae	Jacky Lizard	*Amphibolurus muricatus*
Chelidae	Eastern Snake-necked Turtle	*Chelodina longicollis*
Elapidae	Common Death Adder	*Acanthophis antarcticus*
Elapidae	Red-bellied Black Snake	*Pseudechis porphyriacus*
Varanidae	Lace Monitor	*Varanus varius*
Birds		
Acanthizidae	White-throated Gerygone	*Gerygone olivacea*
Acanthizidae	Yellow Thornbill	*Acanthiza nana*
Acanthizidae	Brown Thornbill	*Acanthiza pusilla*
Acanthizidae	Buff-rumped Thornbill	*Acanthiza chrysorrhoa*
Acanthizidae	Weebill	*Smicronis brevirostris*
Accipitridae	Wedge-tailed Eagle	*Aquila audax*
Ardeidae	White-necked Heron	*Ardea pacifica*
Artamidae	Grey Butcherbird	*Cracticus torquatus*
Artamidae	Pied Currawong	*Strepera graculina*
Artamidae	Black-faced Woodswallow	*Artamus cinereus*
Artamidae	Pied Currawong	*Strepera graculina*
Cacatuidae	Sulfur-crested Cockatoo	*Cacatua galerita*
Cacatuidae	Glossy black Cockatoo	*Calyptorhynchus lathami*
Cacatuidae	Yellow-tailed Black Cockatoo	*Calyptorhychus funereus*
Cacatuidae	Galah	*Eolophus roseicapilla*
Campephagidae	Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*
Caprimulgidae	White-throated Nightjar	*Eurostopodus mysticalis*
Chradiidae	Masked Lapwing	*Vanellus miles novaehollandiae*
Climacteridae	White-throated Treecreeper	*Cormobates leucophaea*
Climacteridae	Brown Treecreeper	*Climacteris picumnus victoriae*
Columbidae	Spotted Dove*	*Streptopelia chinensis*
Columbidae	Peaceful Dove	*Geopelia placida*
Corcoracidae	White-winged Chough	*Corcorax melanorhamphos*
Corvidae	Australian Raven	*Corvus coronoides*
Corvidae	Little Raven	*Corvus mellori*
Cracticidae	Australian Magpie	*Gymnorhina tibicen*
Cuculidae	Channel-billed Cuckoo	*Scythops novaehollandiae*
Cuculidae	Koel	*Eudynamys scolopacea*
Dicaeidae	Mistletoebird	*Dicaeum hirundinaceum*
Dromaiidae	Emu	*Dromaius novaehollandiae*
Estrildidae	Diamond Firetail	*Stagnopleura guttata*
Estrildidae	Double-barred Finch	*Taenopygia bichenovii*
Falconidae	Brown Falcon	*Falco berigora*

Table C.2 Fauna species recorded

Family	Common name	Scientific name
Halcyonidae	Laughing Kookaburra	*Dacelo novaeguineae*
Halcyonidae	Sacred Kingfisher	*Todiramphus sanctus*
Hirundinidae	Welcome Swallow	*Hirundo neoxema*
Hirundinidae	Tree Martin	*Petrochelidon nigricans*
Locustellidae	Rufous Songlark	*Cincloramphus mathewsi*
Maluridae	Superb Fairy Wren	*Malurus cyaneus*
Meliphagidae	Noisy Friarbird	*Philemon corniculatus*
Meliphagidae	Red Wattlebird	*Anthochaera carunculata*
Meliphagidae	Yellow-tufted Honeyeater	*Lichenostomus melanops*
Meliphagidae	Noisy Friarbird	*Philemon corniculatus*
Monarchidae	Leaden Flycatcher	*Myiagra rubecula*
Motacillidae	Australian Pipit	*Anthus novaeseelandiae*
Pachycephalidae	Rufous Whistler^	*Pachycephala rufiventris*
Pachycephalidae	Grey Shrike Thrush	*Colluricincla harmonica*
Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*
Pardalotidae	Brown Thornbill	*Acanthiza pusilla*
Pardalotidae	Striated Thornbill	*Acanthiza lineata*
Petroicidae	Eastern Yellow Robin	*Eopsaltria australis*
Petroicidae	Jacky Winter	*Microeca fascinans*
Podargidae	Tawny Frogmouth	*Podargus strigoides*
Psittaculidae	King Parrot	*Alisterus scapulatus*
Psittaculidae	Turquoise Parrot	*Neophema pulchella*
Psittaculidae	Red-rumped Parrot	*Psephotus haematonotus*
Psittaculidae	Turquoise Parrot	*Neophema pulchella*
Psittaculidae	King Parrot	*Alisterus scapulatus*
Rhipiduridae	Grey Fantail	*Rhipidura albiscapa*
Rhipiduridae	Willie Wagtail	*Rhipidura leucophrys*
Strigidae	Powerful Owl	*Ninox strenua*
Mammals		
Canidae	Red Fox*	*Vulpes vulpes*
Leporidae	Rabbit	*Orcytolagus cuninculus**
Macropodidae	Red-necked Wallaby	*Macropus rufogriseus*
Macropodidae	Swamp Wallaby	*Wallabia bicolor*
Macropodidae	Eastern Grey Kangaroo	*Macropus giganteus*
Miniopteridae	Eastern Bentwing Bat	*Miniopterus schreibersii oceanensis*
Molossidae	White-striped Freetail Bat	*Tadarida australis*
Molossidae	-	*Mormopterus sp 4*
Molossidae	Inland Broadnosed Bat	*Scotorepens balstoni*
Phalangeridae	Brushtail Possum	*Trichosurus vulpecula*
Pseudocheiridae	Ringtail Possum	*Pseudocheirus peregrinus*
Suidae	Pig	*Sus scrofa*
Tachyglossidae	Short-beaked Echidna	*Tachyglossus aculeatus*
Tytonidae	Masked Owl	*Tyto novaehollandiae*

Table C.2 Fauna species recorded

Family	Common name	Scientific name
Varanidae	Lace Monitor	*Varanus varius*
Vespertillionidae	Chocolate Wattled Bat	*Chalinolobus morio*
Vespertillionidae	Southern Forest Bat	*Vespadelus regulus*
Vespertillionidae	Little Forest Bat	*Vespadelus vulturnus*
Vespertillionidae	Gould's Long-eared Bat	*Nyctophilus gouldi*
Vespertillionidae	Gould's Wattled Bat	*Chalinolobus gouldii*
Vespertillionidae	Eastern Cave Bat	*Vespadelus troughtoni*
Vespertillionidae	Long-eared Bat	*Nyctophilus sp.*
Vombatidae	Wombat	*Vombatus ursinus*

*Notes 1. * - introduced species*

Appendix D

Biodiversity offset strategy

Moolarben Coal Project Stage 1 - Optimisation Modification Project

Biodiversity Offset Strategy and Proposed Offset Package

Prepared for
Moolarben Coal Operations Pty Limited
9 May 2013




DOCUMENT TRACKING

ITEM	DETAIL
Project Name	Moolarben Coal Project Stage 1 – Optimisation Modification Project Biodiversity Offset Strategy and Proposed Offset Package
Project Number	13MUDENV-0002
Project Manager	Daniel Magdi Phone 02 4302 1228 Mudgee NSW 2850
Prepared by	Jo Daley, Rebecca Dwyer, David Allworth, Brain Towle, Daniel Magdi, Steven Ward, Robert Humphries
Approved by	Robert Humphries
Status	Final
Last saved on	15 May 2013
Cover photo	Clockwise from top left: Narrow-leaved Ironbark – Grey Gum Shrubby Woodland (Moolarmoo property) DA 2013; Grey-crowned Babbler nest (Elward) DM 2013; Dwyer's Red Gum low woodland (Property #5) DA 2013; Hollow-bearing Rough-barked Apple (Clifford property) DM 2013

This report should be cited as 'Eco Logical Australia (2013). *Moolarben Coal Project Stage 1 – Optimisation Modification Project: Biodiversity Offset Strategy and Proposed Offset Package*. Prepared for Moolarben Coal Operations Pty Limited.

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd

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Abbreviations

ABBREVIATION	DESCRIPTION
BBAM	Biobanking Assessment Methodology
BGW	Box Gum Woodland (abbreviation for the TSC and EPBC Act listed ecological community 'White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grassland')
BOS	Biodiversity Offset Strategy
BOP	Biodiversity Offset Package
CEEC	Critically Endangered Ecological Community
CMA	Catchment Management Authority
DECCW	former NSW Department of Environment, Climate Change and Water (now OEH)
DGRs	Director-General's Requirements
DNG	Derived Native Grassland
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Populations and Communities
DP&I	NSW Department of Planning and Infrastructure
EA Report	Ecological Assessment Report
EEC	Endangered Ecological Community
EP&A Act	NSW *Environmental Planning and Assessment Act* 1979
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999
IBRA	Interim Biogeographic Regionalisation of Australia
LGA	Local Government Area
MCO	Moolarben Coal Operations Pty Limited
MCP	Moolarben Coal Project
MNES	Matters of National Environmental Significance (EPBC Act)
NPW Act	NSW *National Parks and Wildlife Act* 1975
OEH	NSW Office of Environment and Heritage
ROMP	Rehabilitation and Offset Management Plan
SSD	State Significant Development
TSC Act	NSW *Threatened Species Conservation Act* 1995

Executive Summary

Moolarben Coal Operations Pty Limited (MCO) commissioned Eco Logical Australia (ELA) to prepare a Biodiversity Offset Strategy (BOS) and Biodiversity Offset Package (BOP) for the proposed Moolarben Coal Project Stage 1 – Optimisation Modification Project (the proposed modification) as described in the Ecological Assessment report (EA report) (EMM 2013). It is noted that no Director-General's Requirements (DGRs) have been issued for the proposed modification.

This BOS and proposed BOP have been prepared to accompany the EA for the proposed modification prepared by EMM (2013).

The BOS is based on a direct impact area of 178 hectares (ha) of which 171.41 hectares comprises native vegetation and threatened species habitat in various states of condition (EMM 2013). The BOS has been prepared in recognition of the NSW Offsetting Principles (OEH 2008), the Office of Environment Heritage (OEH) Interim Policy on assessing and offsetting impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure projects (OEH 2011) and the EPBC Act offset guide (DSEWPaC 2012).

The measures to avoid and mitigate the impacts of the proposed modification are outlined in the EA (EMM 2013). This report provides a detailed description of the proposed offset strategy to compensate for residual adverse ecological impacts. It uses 'maintain or improve' principles to inform the 'quantum' of offsets required consistent with OEH's Interim Offset Policy for Major Projects (OEH 2011).

The Interim Offset Policy for Major Projects uses a three-tiered approach to achieving offset outcomes. Tier 1 full 'Improve or Maintain' outcome, Tier 2 'Negotiated No Net Loss' outcome and Tier 3 'Mitigated Loss' outcome. The calculations indicate that to achieve a full Tier 1 improve or maintain offset outcome for impacts to vegetation and general biodiversity, an offset consisting of appropriate vegetation types as well as threatened species habitats in the order of 1,094 ha would be required. This would be reduced to 949 ha following successful rehabilitation of the mine site to pre-existing vegetation communities. However, as a 'red flag' community would be impacted (17.2 ha of White box- Yellow Box Grassy woodland on basalt slopes in the upper Hunter valley NSW), a Tier 1 offset cannot be achieved. Following investigation of potential offset sites that provide appropriate biodiversity values, a **direct offset** package of 629 hectares of remnant and regenerating 'like for like' vegetation types and threatened fauna habitat is proposed.

The proposed **direct** offset package involves permanent protection on title by the registration of a Conservation Covenant under s.69B of the *National Parks and Wildlife Act* 1974 (or other similar conservation covenant or land transfer to national park estate with the agreement of the NSW Minister for the Environment) over 7 properties already owned (or in the process of being purchased) by MCO.

Collectively, these properties significantly exceed a Tier 3 'mitigated loss' outcome (almost double) and meet 66% of a Tier 2 'no net loss' outcome. In summary, the BOS and proposed BOP provide:

- A 'maintain or improve' quantification of the impacts of the proposed modification informed by the Biobanking Assessment Methodology (BBAM) as required by the Major Projects Offset Policy (OEH 2011);
- Offset properties to be permanently protected on title via registration of a conservation

covenant (or similar) where existing biodiversity values would be protected and enhanced; and

- Long term biodiversity management of these properties.

1 Biodiversity Offset Strategy

1.1 INTRODUCTION

Moolarben Coal Operations Pty Limited (MCO) operates the Moolarben Coal Project (MCP) approximately 40km north east of Mudgee. The MCP was approved by the Minister for Planning in September 2007, under Part 3A of the *Environmental Planning and Assessment Act 1979*. The MCP is located in the headwaters of the Goulburn River catchment within the broader Hunter-Central Coast Catchment Management Area (CMA) and is situated adjacent to the Goulburn River National Park and Munghorn Gap Nature Reserve.

MCO commissioned Eco Logical Australia (ELA) to prepare a Biodiversity Offset Strategy (BOS) to compensate for the non-avoidable impacts to native vegetation and threatened species habitats from the proposed modification to the MCP. The proposed modification is described in the Ecological Assessment report (EA report) which has been prepared in support of the modification application (EMM 2013).

This BOS is based on a direct impact area of 178 hectares (ha) of which 171.41 ha comprises native vegetation and threatened species habitat in various states of condition (EMM 2013). The BOS has been prepared to provide '*a comprehensive offset strategy to ensure that the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term'* in general recognition of the NSW Offsetting Principles (OEH 2008) and the Office of Environment Heritage (OEH) Interim Policy on assessing and offsetting impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure Projects (OEH 2011) (**Appendix A**).

The proposed modification is subject to a separate referral to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSWEPaC) under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) for impacts to Matters of National Environmental Significance (MNES), specifically, but not limited to, 16.5 ha of White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grasslands (Box – Gum Woodlands) and is likely to be determined as a 'Controlled Action'.

The EBPC Act Offset Policy requires '*offset measures to be considered for residual impacts that cannot be mitigated to ensure the protection of MNES in perpetuity*'. This BOS has been prepared to generally be consistent with the EPBC Act Offset guide (DSEWPaC 2012).

The measures to avoid and mitigate the impacts of the proposed modification are outlined in Chapter 7 of the EA report prepared by EMM (2013). These measures include but were not limited to:

- The exclusion of Moolarben Creek from the proposed modification boundary to protect riparian zones and the special habitats that these areas provide;
- Maintaining connectivity between forested areas to the north and south of the project boundary;
- Gradual clearance of the proposed extension areas combined with pre-clearance fauna surveys to reduce impacts to native fauna including threatened species;

- Implementation of pest control measures in the proposed extension areas in accordance with a Landscape Management Plan;
- Salvage of habitat features important to threatened species for re-instatement within rehabilitation areas;
- Measure to reduce impacts to loss of rocky outcrop roosting habitat; and
- Rehabilitation of the proposed extension areas for biodiversity outcomes specifically re-creation of 'Box-Gum Woodlands' and sedimentary Ironbark forests.

This report provides a detailed description of the BOS which addresses the improve or maintain principles as required by the DP&I and OEH's offset policies for Major Projects (OEH 2011) and the EPBC Act Environmental Offset Policy (DSEWPaC 2012) respectively. The proposed BOS and BOP provides:

- A 'maintain or improve' quantification of the impacts of the proposed modification informed by the Biobanking Assessment Methodology (BBAM) to guide the development of the offset strategy;
- Offset properties to be permanently protected via an appropriate conservation mechanism such as registration of a Conservation Agreement under s.69B of the *National Parks and Wildlife Act* (NPW Act) or other equivalent measure, including possible transfer to the national parks estate subject to the agreement of the NSW Minister for the Environment , to ensure the protection, enhancement and conservation management of biodiversity values; and
- long term biodiversity management of these properties.

1.2 OFFSET PRINCIPLES

The following principles for providing offsets against the impacts of the proposed modification have been used to guide the development of the BOS:

NSW Offsetting Principles (DECC 2008)

1. Impacts must be avoided first by using prevention and mitigation measures.
2. All regulatory requirements must be met.
3. Offsets must never reward ongoing poor performance.
4. Offsets will complement other government programs.
5. Offsets must be underpinned by sound ecological principles.
6. Offsets should aim to result in a net improvement in biodiversity over time.
7. Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs.
8. Offsets should be agreed prior to the impact occurring.
9. Offsets must be quantifiable and the impacts and benefits must be reliably estimated.

10. Offsets must be targeted.
11. Offsets must be located appropriately.
12. Offsets must be supplementary.
13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

Commonwealth (DSEWPaC 2012)

Suitable offsets must:

1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action.
2. Be built around direct offsets but may include other compensatory measures.
3. Be in proportion to the level of statutory protection that applies to the protected matter.
4. Be of a size and scale proportionate to the residual impacts on the protected matter.
5. Effectively account for and manage the risks of the offset not succeeding.
6. Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action, see section 7.6).
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable.
8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

In assessing the suitability of an offset, government decision-making will be:

9. Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty.
10. Conducted in a consistent and transparent manner.

The Commonwealth policy identifies two kinds of biodiversity offset, '**direct offsets'** including such measures as long-term protection of existing habitat and '**compensatory measures'** (indirect offsets) for such measures as implementing recovery plan actions or contributions to relevant research.

The proposed offset strategy has been designed to meet the principles of both the NSW and Commonwealth policies.

1.3 OFFSET APPROACH

ELA has investigated the availability and suitability of potential offset sites on behalf of MCO. This has included identifying lands with appropriate conservation values in proximity to the MCP including land owned by MCO, land for sale or landowners who had expressed interest in managing their properties for conservation, identifying where these lands have potential to provide 'like for like' vegetation and threatened species habitat (consistent with the provisions of the Major Projects Offset Policy), and where cost effective management can be implemented to improve the overall conservation value of the

land. Where possible, focus was directed to land adjacent to existing conservation areas including Goulburn River National Park, Munghorn Gap Nature Reserve, MCO's Stage 1 and proposed Stage 2 offsets (**Figure 1**), thereby adding to the overall extent and connectivity of conserved land in the area. The approach also focused on increasing the strategic value of MCO's offsets for the MCP in its entirety.

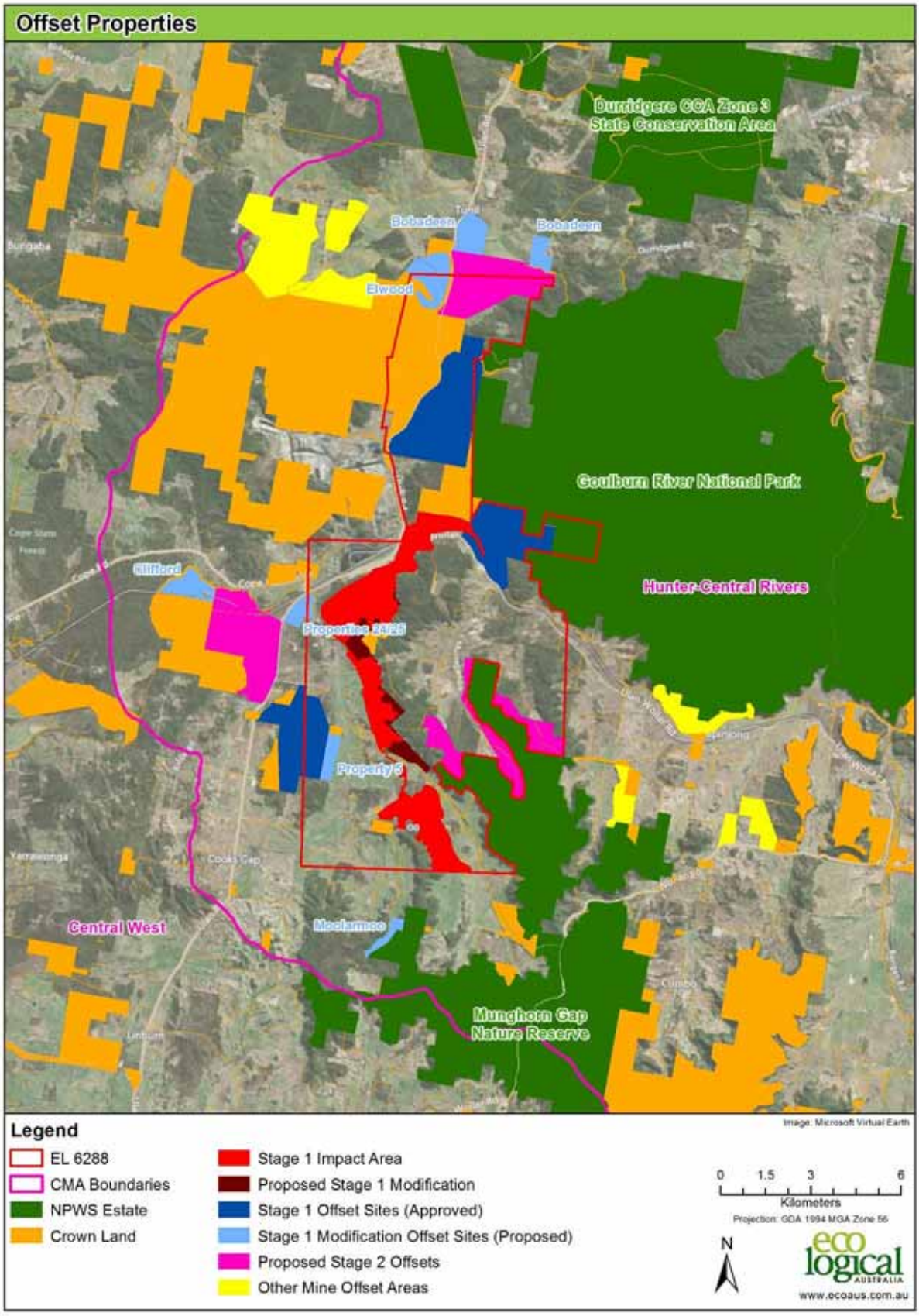

Figure 1: MCP Stage 1 Modification location, existing and proposed offset areas

1.4 OFFSET REQUIREMENTS TO MEET AN IMPROVE OR MAINTAIN CONSERVATION OUTCOME (NSW)

The proposed modification involves an expansion of approved open cut mining areas that will result in the direct and indirect loss of up to 171.4 ha of remnant native vegetation, including 17.2 ha of the NSW *Threatened Species Conservation Act* (TSC Act) listed endangered ecological community (White Box – Yellow Box- Blakely's Red Gum woodland), of which 16.5 ha is consistent with the Commonwealth EPBC Act listed critically endangered community 'White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grasslands' (Box Gum Woodland), habitat for eight threatened fauna species (Glossy Black Cockatoo, Turquoise Parrot, Brown Treecreeper, Diamond Firetail, Powerful Owl, Masked Owl, Eastern Bentwing-bat and Eastern Cave Bat) and potential habitat for several others threatened fauna species not recorded to date in the proposed modification area (EMM 2013 and **Table 1**). No threatened flora species were recorded in the proposed modification area (EMM 2013) despite three species being recorded in the Stage 1 (Moolarben Biota 2006) and Stage 2 (Ecovision Consulting 2008) assessments (*Diuris tricolor, Eucalyptus cannonii* and *Pomaderris queenslandica*).

The OEH Interim Major Projects Offset Policy (OEH 2011) specifically acknowledges that proposals assessed as Major Projects under the EP&A Act do not have to meet the 'maintain or improve' standard which is required under the Biobanking Scheme however, the impacts should be quantified using the Biobanking Assessment Methodology (BBAM) for benchmarking purposes. The approach taken by MCO is consistent with this policy. The BBAM has been used to 'inform' the quantum of offset required, and whilst it is OEH's preference that a Tier 1 'maintain or improve' outcome is achieved, the policy provides a structured approach for assessing proposals that meet one or two alternative standards (Tier 2 "no net loss" and Tier 3 "mitigated loss"), which take into consideration the environmental, social and economic benefits provided by the proposed modification.

Accordingly, the BBAM was used to inform the 'quantum' of biodiversity offsets required to meet a 'maintain or improve' outcome. An informal Biobanking Assessment of the impact site has been undertaken by an accredited Biobank Assessor using a stratified biometric vegetation map of the impact area and eight (8) biometric plots collected by EMM (2013). The eight plots do not strictly meet the requirements of the BBAM, however provide a robust base on which to conduct the improve or maintain calculations. The results of this assessment are summarised in **Table 1** and indicate that 10,171 biodiversity credits are required to meet a full 'improve or maintain' outcome. Using the OEH credit converter which assumes the average biobank site will generate 9.3 credits per ha, this is equivalent to an offset area of 1,094 ha.

A second informal Biobanking Assessment was undertaken in accordance with Section 3.6.2 of the Biobanking Operational Manual (assess site value following rehabilitation/restoration of a development site) consistent with the commitment in the EA report (EMM 2013) to rehabilitate the mine site to the pre-existing native vegetation post mining. This rehabilitation would generate 1,345 credits and thus reduce the offset requirements from 10,171 credits to 8,826 (**Table 1**). This is equivalent to an offset area of 949 ha.

Whilst there have been eight threatened fauna species listed on the Schedules of the TSC Act recorded utilising habitats within the impact area, none require species credit and therefore do not require specific offset requirements under the BBAM or OEH (2011), however, proposed offset areas have been assessed for the presence of these and other threatened species to provide 'like for like' habitats to those being impacted consistent with Offset Principle 10.

No threatened plants have been recorded in the impact area despite targeted surveys (EMM 2013). Nineteen hybrid specimens of the threatened eucalypt *Eucalyptus cannonii* were recorded (confirmed

by the Royal Botanic Gardens). This species regularly hybridizes with the non-threatened and widespread Red Stringybark *Eucalyptus macrorhyncha* (NPWS 2000).

One of the vegetation types impacted (Box Gum Woodland) is a red flagged vegetation type under the BBAM (i.e. a vegetation type listed as an endangered ecological community and/or a vegetation type that is greater than 70 percent cleared in the CMA). Accordingly, a Tier 1 offset under OEH (2011) cannot be achieved. In these circumstances the Major Projects Offset Policy allows for a Tier 2 or 3 outcome.

The Biobanking assessments indicate that the offsets can be secured in a range of 'similar' vegetation types, across a number of CMA subregions and in accordance with the BBAM, meet the 'like for like' offset principle (Principle 10). Additionally, the variation criteria in the OEH major projects offset policy allows vegetation types in the same vegetation 'formation' in the same IBRA region to be used as offsets where a Tier 1 or 2 offset cannot be met (OEH (2011) Attachment B variation criteria "a").

1.4.1 Assessment of potential offset properties

Preliminary biodiversity assessments of MCO owned properties were undertaken by ELA between February and April 2013 to confirm that they provided the biodiversity values required for the proposed modification (i.e. like for like vegetation types and threatened fauna records and/or habitat equivalent to that being impacted) and that they were capable of being managed for improved biodiversity conservation outcomes in the long term (**Appendix B** and **Tables 2** and **3**).

Table 2 provides a summary of the vegetation types confirmed on each of the potential offset properties and whether each vegetation type is considered to be a 'matching' or 'like for like' vegetation type in accordance with OEH (2011) as informed by the BBAM credit profiles.

Table 2 shows that each of the vegetation types mapped on the proposed offset properties (other than the 3.73 ha of HU647 Tea-tree shrubland and 0.44 ha of HU548 Giant Stinging Tree – Fig dry subtropical rainforest) matches the vegetation type and/or vegetation formation criteria consistent with OEH (2011). The vegetation type with the largest offset requirement (HU552 Grey Gum – Narrow-leaved Ironbark woodland) only has 162 ha of matching offset vegetation types (providing an offset ratio of 1.45:1), however the endangered vegetation type (HU654 White Box – Yellow Box grassy woodland) has 330 ha of matching offset vegetation types (providing an offset ratio of 19:1). Overall the proposed offset properties provide an offset ratio of 3.67:1.

Of the 629 ha of mapped vegetation on the proposed offset properties, 250 ha (mostly on the Bobadeen property) has been mapped as derived native grasslands (DNG), that is, the original native vegetation community now exists in a modified state due to past land management practices including tree/shrub removal and grazing. The quality of this DNG has been assessed by ELA ecologists and was found to be mostly in moderate to good condition with a high species richness including gazing sensitive species and although it had been grazed, it had not been subject to cultivation or pasture improvement practices. Some areas of DNG in poorer condition have been included in the area calculations in **Table 2** but where significant enhancement in biodiversity values has been assessed as not likely, excluded from the proposed offset areas (e.g. parts of the Clifford property).

Table 3 shows that collectively each of the potential offset properties either has confirmed records of the threatened fauna species being impacted or these species are likely to occur (to be confirmed by more detailed assessment). In addition, several threatened species, including two threatened flora species (*Acacia ausfeldii* and *Diuris tricolor*) and six threatened fauna species (Large-eared Pied Bat, Eastern False Pipistrelle, Southern Myotis, Yellow-bellied Sheathtail-bat, Grey-crowned Babbler and Speckled Warbler) that are not being impacted by the proposed modification have been recorded on the

potential offset properties. It is likely that during the preparation of management plans and monitoring of these sites (see Section 3 Commitments) that other threatened species will be recorded.

In summary, the properties assessed:

- Collectively include all of the vegetation types impacted on a 'like for like' basis consistent with OEH (2011) (Offset Principle 10);
- Are in close proximity to the impact area;
- Are strategically located adjacent to existing conservation reserves or biodiversity offset areas from previous mining projects providing strategic links and connectivity to these reserves;
- Are of a size, shape and condition conducive to long term conservation management (Offset Principle 5 and 11);
- Are not currently required under any existing legislative requirement to be actively managed for biodiversity conservation and thus also meet the "additionality" NSW offset principle (Principle 2 and 12).

Table 1: Summary of improve or maintain impact calculations used to inform the BOS

Vegetation Type	Area Impacted (ha)	Credits Required Stage 1 Mod	Credits Required/ha	Credits Gained for Rehabilitation*	Credits Required after Rehabilitation	Offset Area (ha) Required	
						Minimum Outcome Tier 3 (2:1)	IoM Outcome Tier 1**
Grey Gum - Narrow-leaved Stringybark - ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin	111.13	7,130	64.2	842	6,288	222.3	767
White Box - Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin	13.33	696	52.2	101	595	26.7	75
Rough-barked Apple grassy open forest on valley flats of the North Coast and Sydney Basin	0.58	40	69.0	51	0	1.2	4
Rough-barked Apple - Silvertop Stringybark - Ribbon Gum shrub/grass open forest on hills of the southern Nandewar Bioregion	29.07	1,289	44.3	221	1,068	58.1	139
White Box Yellow Box Grassy Woodland on basalt slopes in the upper Hunter Valley NSW	17.2	1,016	58.7	130	886	34.6	109
Total	**171.41**	**10,171**	**59.3**	**1,345**	**8,826**	**342.8**	**1,094**

*Use average number of credits generated per ha as 9.3 (See OEH offset converter)

Table 2: Area of matching vegetation types on proposed offset properties

Impact Site (Moolarben)					Potential Offset Properties Area (ha)									
Vegetation Type	**Vegetation Formation**	**% Cleared in CMA**	**Area Impacted (ha)**	**Target Offset Area (Tier 1)**	**Like for like' vegetation types allowed (Incl Formation Matching**)**	**BBAM and/or Formation match**	**% Cleared in CMA**	**Clifford**	**Elward**	**Property #5**	**Property #24 & 25**	**Old Bobadeen**	**Moolarmoo**	**Total**
HU552 Grey Gum - Narrow-leaved Stringybark - ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin	Dry Sclerophyll Forests (Shrubby subformation)	70	111.13	767	HU552 Grey Gum - Narrow-leaved Stringybark - ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin	BBAM	70%						1.76	**1.76**
					HU537 Dwyer's Red Gum low woodland on exposed sandstone ridges of the upper Hunter Valley, Sydney Basin	BBAM	5%	3.61	5.07	16.36				**25.04**
					HU574 Narrow-leaved Ironbark - Grey Gum shrubby woodland on footslopes on the upper Hunter Valley, Sydney Basin	BBAM	5%	10.67	76.39	12.47			21.95	**121.48**
					HU608 Scribbly Gum - Brown Bloodwood woodland of the southern Brigalow Belt South	BBAM	5%	4.28	10.33					**14.61**
Sub-total "like for like" offset vegetation for Impacts to HU552								**18.56**	**91.79**	**28.83**	**0**	**0**	**23.71**	**162.89**
HU653 White Box - Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter valley, Sydney Basin	Dry Sclerophyll Forests (shrub/grass subformation)	10	13.33	75	HU575 Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin	BBAM	35%					7.86		**7.86**
Sub-total "like for like" offset vegetation for Impacts to HU653								**0**	**0**	**0**	**0**	**7.86**	**0**	**7.86**
HU605 Rough-barked Apple grassy open forest on valley flats of the North Coast and Sydney Basin	Dry Sclerophyll Forests (Shrubby subformation)	65	0.58	4	HU605 Rough-barked Apple grassy open forest on valley flats of the North Coast and Sydney Basin	BBAM	65%							**0**
Sub-total "like for like" offset vegetation for Impacts to HU605								**0**	**0**	**0**	**0**	**0**	**0**	**0**
HU604 Rough-barked Apple - Silvertop Stringybark - Ribbon Gum shrub/grass open forest on hills of the southern Nandewar bioregion	Dry Sclerophyll Forests (shrub/grass subformation)	65	29.07	139	HU603 Rough-barked Apple - Silvertop Stringybark - Red Stringybark grassy open forest on hills of the upper Hunter Valley, southern North Coast	BBAM	65%			10.93	60.09			**71.02**
					HU527 Caley's Ironbark - Currawang shrubby woodland on sandstone ridges of the upper Hunter Valley, Sydney Basin	Formation	5%		50.88				1.87	**52.75**
Sub-total "like for like" offset vegetation for Impacts to HU604								**0**	**50.88**	**10.93**	**60.09**	**0**	**1.87**	**123.77**

Impact Site (Moolarben)					Potential Offset Properties Area (ha)									
Vegetation Type	**Vegetation Formation**	**% Cleared in CMA**	**Area Impacted (ha)**	**Target Offset Area (Tier 1)**	**Like for like' vegetation types allowed (Incl Formation Matching**)**	**BBAM and/or Formation match**	**% Cleared in CMA**	**Clifford**	**Elward**	**Property #5**	**Property #24 & 25**	**Old Bobadeen**	**Moolarmoo**	**Total**
HU654 White Box Yellow Box Grassy Woodland on basalt slopes in the upper Hunter Valley NSW	Grassy Woodlands	90	17.2	109	HU654 White Box Yellow Box Grassy Woodland on basalt slopes in the upper Hunter Valley NSW	BBAM	90%					154.5		**154.5**
					HU515 Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands	Formation	80%	63.43	13.41	24.21	3.41	21.79	18.47	**144.72**
					HU551 Grey Box - Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin	Formation	70%	20.24	10.96					**31.2**
Sub-total "like for like" offset vegetation for Impacts to HU654								**83.67**	**24.37**	**24.21**	**3.41**	**176.29**	**18.47**	**330.42**
HU647 Tea-tree shrubland of drainage areas of the slopes and tablelands	Forested Wetland	20							**3.73**					**3.73**
HU548 Giant Stinging Tree- Fig dry subtropical rainforest of the North Coast and Brigalow Belt South	Rainforest	70											**0.44**	**0.44**
Grand Total			**171.41**	**1,094**				**102.23**	**170.77**	**63.97**	**63.5**	**184.15**	**44.49**	**629.11**

** Major Projects Offset Policy Tier 3 allows converting one vegetation type for another vegetation type within the same vegetation formation and IBRA bioregion and still meet 'like for like' requirements

Table 3: Threatened fauna species recorded or predicted to occur at impact and offset sites

Scientific name	Impact Site (Moolarben)				Proposed Offset Properties					
	Common name	BBAM Predicted	Recorded on Site	Credit Type	Clifford	Elward	Property #5	Property #24/25	Bobadeen (Williams)	Moolarmoo
Threatened Fauna (Assumed Present by BBAM, Confirmation of records in offset area not required)										
Burhinus grallarius	Bush Stone-curlew	Yes	No	Ecosystem	No	No	No	No	No	No
Calyptorhynchus lathami	Glossy Black Cockatoo	Yes	Yes	Ecosystem	Likely	Likely	Yes	Likely	Likely	Likely
Callocephalon fimbriatum	Gang-gang Cockatoo	Yes	Likely	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Cercartetus nanus	Eastern Pygmy Possum	Yes	No	Ecosystem	No	No	No	No	No	No
Chalinolobus dwyeri	Large-eared Pied Bat	Yes	Likely	Ecosystem	Yes	Possible	Likely	Likely	Likely	Possible
Circus assimilis	Spotted Harrier	Yes	No	Ecosystem	No	No	Likely	Likely	Likely	Possible
Climacteris picumnus victoriae	Brown Treecreeper	Yes	Yes	Ecosystem	Likely	Yes	Likely	Likely	Likely	Likely
Dasyurus maculatus	Spotted-tailed Quoll	Yes	Possible	Ecosystem	No	No	No	No	Possible	Possible
Daphoenositta chrysoptera	Varied Sittella	Yes	Likely	Ecosystem	Likely	Likely	Likely	Likely	Likely	Possible
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Yes	No	Ecosystem	Yes	Likely	Likely	Likely	Likely	Likely
Glossopsitta pusilla	Little Lorikeet	Yes	Likely	Ecosystem	No	No	Likely	Likely	Likely	Likely
Grantiella picta	Painted Honeyeater	Yes	Likely	Ecosystem	No	No	Likely	Likely	Likely	Likely
Hieraaetus morphnoides	Little Eagle	Yes	No	Ecosystem	Likely	Possible	Likely	Likely	Likely	Possible
Lathamus discolor	Swift Parrot	No	Possible	Ecosystem	Possible	Possible	Possible	Possible	Possible	Possible
Lophoictinia isura	Square-tailed Kite	Yes	Likely	Ecosystem	No	No	Possible	Possible	Possible	Possible
Melanodryas cucullata	Hooded Robin	No	Likely	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Melithreptus gularis gularis	Black-chinned Honeyeater	Yes	Likely	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (foraging)	Yes	Yes	Ecosystem	Yes	Yes	Likely	Yes	Likely	Likely
Myotis adversus	Southern Myotis	No	No	Ecosystem	No	Yes	Likely	Likely	Possible	Possible
Neophema pulchella	Turquoise Parrot	Yes	Yes	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Ninox connivens	Barking Owl	Yes	Possible	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Ninox strenua	Powerful Owl	Yes	Yes	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Nyctophilus timoriensis	Greater Long-eared Bat (south eastern form)	Yes	Likely	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Petaurus australis	Yellow-bellied Glider	Yes	No	Ecosystem	No	No	No	No	No	No
Petaurus norfolcensis	Squirrel Glider	Yes	Possible	Ecosystem	No	No	No	No	Possible	Possible
Petroica boodang	Scarlet Robin	Yes	Likely	Ecosystem	No	No	Likely	Likely	Likely	Likely
Phascolarctos cinereus	Koala	Yes	Possible	Ecosystem	No	No	No	No	Possible	Possible
Pomatostomus temporalis	Grey-crowned Babbler	Yes	Likely	Ecosystem	Likely	Yes	Likely	Likely	Likely	Likely
Pteropus poliocephalus	Grey-headed Flying-fox	Yes	No	Ecosystem	No	No	Possible	Possible	Possible	Possible
Pyrrholaemus sagittatus	Speckled Warbler	Yes	Likely	Ecosystem	Likely	Yes	Likely	Yes	Likely	Likely
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Yes	Likely	Ecosystem	Likely	Yes	Likely	Likely	Likely	Likely
Scoteanax rueppellii	Greater Broad-nosed Bat	Yes	Possible	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Stagonopleura guttata	Diamond Firetail	Yes	Yes	Ecosystem	Yes	Likely	Likely	Likely	Likely	Likely
Tyto novaehollandiae	Masked Owl	Yes	Yes	Ecosystem	Likely	Likely	Likely	Likely	Likely	Possible
Vespadelus troughtoni	Eastern Cave Bat (foraging)	Yes	Yes	Ecosystem	Likely	Likely	Likely	Likely	Likely	Likely
Xanthomyza phrygia	Regent Honeyeater	Yes	Likely	Ecosystem	Likely	Likely	Likely	Likely	Likely	Possible

1.5 EPBC ACT OFFSET REQUIREMENTS

The DSEWPaC has recently released an EPBC Act 'offset assessment guide' (DSEWPaC 2012) that replaces the previous draft Commonwealth Offset policy (DEWHA 2007). The policy was finalised on 20 September 2012 and applies to any new referrals and variations to approval conditions from 2 October 2012 and any projects currently under assessment. Offsets are only relevant to EPBC Act approvals declared as a 'controlled action' and where there is likely to be a residual 'significant' impact (DSEWPaC 2012).

A referral for the proposed modification is currently being prepared for DSEWPaC.

It is likely that the DSEWPaC will conclude that the proposed action is a controlled action based on impacts to listed threatened species and communities, in particular, but not limited to, impacts to 16.5 ha of critically endangered 'Box Gum Woodlands' and loss of potential foraging habitat for the vulnerable Large-eared Pied Bat and endangered Spotted-tailed Quoll, Swift Parrot and Regent Honeyeater.

The DSEWPaC offset policy states that impacts should first be avoided and mitigated as offsets do not reduce the impacts of a proposed action. Offsets will not be considered until all reasonable avoidance and mitigation measures are considered. EMM (2013) outlines the measures taken to avoid and mitigate impacts to MNES including Box Gum Woodland and these are summarised in Section 1.1 of this report.

Direct offsets are to meet a minimum 90 per cent of the measureable environmental gain for the impacted protected matter. A conservation gain may be achieved by:

- Improving existing habitat for the protected matter;
- Creating new habitat for the protected matter;
- Reducing threats to the protected matter;
- Increasing the values of a heritage place, and/or;
- Averting the loss of a protected matter or its habitat that is under threat.

The delivery of offsets that establish positive social or economic co-benefits are encouraged such as increasing landscape connectivity, offsets that employ local indigenous rangers to undertake management actions or pay rural landholders to protect and manage land for conservation purposes.

The DSEWPaC policy states that offset packages should be developed in consultation with the Department and that if the Department is satisfied that the offset activities are suitable, the Department will consider the magnitude and composition of the proposed offset package. The Department will take a range of considerations at both the impact and proposed offset site(s) into account, including:

Matters to be considered at the impact site:

1. Presence and conservation status of protected matters likely to be impacted by the proposed action;
2. Specific attributes of the protected matter being impacted at a site, for example: the type of threatened species or ecological community habitat, the quality of habitat, population attributes such as recruitment or mortality, landscape attributes such as habitat connectivity, or heritage values;

3. Scale and nature of the impacts of the proposed action – including direct and indirect impacts; and
4. Duration of the impact (not of the action).

Matters to be considered at the offset site:

5. Extent to which the proposed offset actions correlate to, and adequately compensate for, the impacts on the attributes for the protected matter;
6. Conservation gain to be achieved by the offset. This may be through positive management activities that improve the viability of the protected matter or averting the future loss, degradation or damage of the protected matter;
7. Current land tenure of the offset and the proposed method of securing and managing the offset for the life of the impact;
8. Time it will take to achieve the proposed conservation gain;
9. Level of certainty that the proposed offset will be successful. In the case of uncertainty, such as using a previously untested conservation technique, a greater variety and/or quantity of offsets may be required to minimise risk;
10. Suitability of the location of the offset site. In most cases this will be as close to the impact site as possible. However, if it can be shown that a greater conservation benefit for the impacted protected matter can be achieved by providing an offset further away, then this will be considered.

From a review of the EPBC Act offset policy and the associated 'offsets assessment guide' ELA has generated suggested values for the attributes utilised in the offset calculator and provided justification for these below. These values are based on ELA's knowledge of the calculator tool and have been undertaken by Dr Steven Ward who has attended training sessions with the DSEWPaC on the application of the policy. We note that the policy states that the operation of the EPBC offset assessment guide is to be performed by expert users within the Department, but provide the suggested values based on our experience and knowledge of the proposed offset sites.

We note that under the EPBC Act Environmental Offsets Policy consideration of offsets is only required for MNES where there remains a residual significant impact after avoidance and mitigation measures. For the proposed modification, significant impacts are only anticipated to occur on *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (Box Gum Woodland), which is listed as a Critically Endangered Ecological Community under the EPBC Act. Nevertheless, from discussion with DSEWPaC staff it is understood that the assessment of offset requirements will likely be requested for other species. On this basis, and not pre-empting the EPBC Act referral above, the offset calculations have also been undertaken for impacts to potential foraging habitat of Large-eared Pied Bat, Spotted-tailed Quoll, Swift Parrot and Regent Honeyeater.

Accordingly, impacts for each Commonwealth listed species has been entered into the EPBC Act offsets calculator, together with informed values/estimates for 'Habitat Context', 'Start Condition', 'Stocking Rate', 'Future Condition with Development' (assuming mine site rehabilitation), to obtain a 'Total Quantum of Impact' (**Table 4)**.

In order to meet the EPBC Act offset requirements, the calculated 'Net Present Value' of the proposed offset sites must exceed the 'Total Quantum of Impact' value.

Habitat scores were generated by combining scores for context, condition, and species stocking rate. For Box Gum Woodland the habitat scores were based on 50% context and 50% condition, whilst for threatened species habitat scores were based on 30% context, 30% condition and 40% species stocking rate. Following the offset assessment guide requirements a rounding function was used to convert the numbers generated to a whole integer out of 10.

The habitat scores for impact sites all used a context component score of 6/10, as the sites have all previously been used for rural activities, with varying levels of cattle and sheep grazing. The impact sites are also adjacent to an existing approved open cut mine site. Accordingly, the condition of vegetation at the impact site was rated from between 4/10 (Spotted-tailed Quoll) to 7/10 for Large-eared Pied Bat, Swift Parrot and Regent Honeyeater on the basis of habitat quality and likelihood of use from nearby records.

At the offset sites, the habitat context component ranged from 7/10 to 9/10, as the sites had limited grazing history over most parts and were adjacent to existing national parks and/or previously approved offset areas. Habitat condition ranged from 3/10 for DNG areas to 7/10 for intact woodland areas, similarly habitat stocking rates for the subject threatened species ranged from 0/10 for DNG areas to between 5 and 7/10 for woodland areas.

The risk-related time horizon was set at 20 years (the maximum cap), as it is assumed that the impact associated with the proposed mine will be permanent (a conservative assumption given the commitment to rehabilitate the mine to pre-existing conditions and the ecological offsets will also be permanent). The time until ecological benefit was set at 10 years for woodland areas and 20 years for DNG area, to allow time for the woodland vegetation community response (and associated improvement in species habitat). Risk of loss of woodland areas was set at 20% as all of the offset sites are currently used for grazing and the risk of loss of the DNG vegetation was set at 40% as there is a substantially higher risk that these areas will continue to be degraded by agriculture to the point where the native vegetation component is lost. The risk of loss with the offset was set at 1% as the proposed conservation covenants provides the highest level of conservation security in NSW outside national parks and can only be terminated by the Minister for the Environment.

Table 4 indicates that for each of the MNES impacted, the proposed offset package exceeds the offset requirement, ranging from 105 to 224%.

Table 4: Offset measures for impacts and potential impacts on Matters of NES (EPBC Act)

IMPACT AREA ATTRIBUTES			OFFSET SITE ATTRIBUTES		
IMPACT SITE	**AREA OF IMPACT (ha)**	**TOTAL QUANTUM OF IMPACT**	**AREA**	**FINAL NPV SCORE**	**% OF IMPACT OFFSET**
White-Box Yellow Box	16.5	11.55	298.43	25.88	224.06
Large-eared Pied Bat (Potential Habitat)	170.7	102.42	625.68	107.66	105.11
Spotted-tailed Quoll (Potential Habitat)	170.7	85.32	625.86	126.88	148.66
Regent Honeyeater and Swift Parrot (Potential Habitat)	170.7	102.42	625.86	140.05	136.74

2 Proposed Offset Package

It is proposed that the 7 properties already owned (or in the process of being purchased) by MCO (shown in **Figure 1** and summarised in **Table 5**) will comprise the offset package.

A Rehabilitation and Offset Management Plan (ROMP) will be prepared to guide the management, monitoring and reporting of the effectiveness of the offset areas. Combined, these 7 properties provide a direct offset of 629 ha and an offset ratio of 3.67:1 (Offset : Impact).

Table 5: Name and area of mapped native vegetation of each offset property

Property	Lot/Dp	Area of mapped native vegetation (Ha)
Clifford	Lot 288 DP 704081	102.23
Elward	Lot 84 DP 704077	170.77
Property # 5	Lot237 DP 755442	63.97
Properties # 24 & # 25	Lot 31 DP 633148, Lot 8 DP 626648	63.5
Bobadeen	Lot 5 DP750736, Part Lot 1 DP 593639, Lot 1 DP110465, Part Lot 6 DP 750736, Lot 5 DP 750750, Lot 2, 3, 4 & 5 DP111560	184.15
Moolarmoo	Lots 184 & 221 DP 755442	44.49
Total		**629.11**

A comparison of the mapped vegetation types (**Figures 2-7**) with those being impacted and the threatened species habitat has been undertaken in accordance with the Offset Principles and Major Projects Offset Policy (OEH 2008, 2011). Each property investigated has the appropriate vegetation types, area, threatened species habitats and also contribute to regional conservation priorities and landscape connectivity (**Figure 1**, **Table 2 and Appendix B)**. Areas of highly disturbed or poor quality vegetation, including areas of DNG have been excluded from the offset area calculations due to the risks and time delays associated with enhancing these areas.

Of the 629 ha of mapped vegetation, it is all in moderate-good biometric condition, including approximately 250 ha of DNG and all but 4.17 ha provides 'matching/like for like' or 'better' conservation values.

In particular, the properties include 330 ha of equivalent vegetation types to the 17.2 ha of White Box – Yellow Box grassy woodland being impacted including 154 ha of White Box –Yellow box grassy woodland and 144 ha of Blakely's Red Gum – Yellow Box –grassy woodland (equivalent to the NSW and Commonwealth listed Box Gum Woodland) providing an offset ratio of 19:1 for impacts to this EEC.

In addition, the preliminary fauna assessment undertaken by ELA at each of the proposed offset properties (**Table 4** and **Appendix B)** has confirmed records (or potential habitat) for each of the impacted threatened fauna species and confirmed and potential habitat for various other threatened fauna species.

Figure 2: Mapped vegetation of the Clifford property

Figure 3: Mapped vegetation of the Bobadeen property

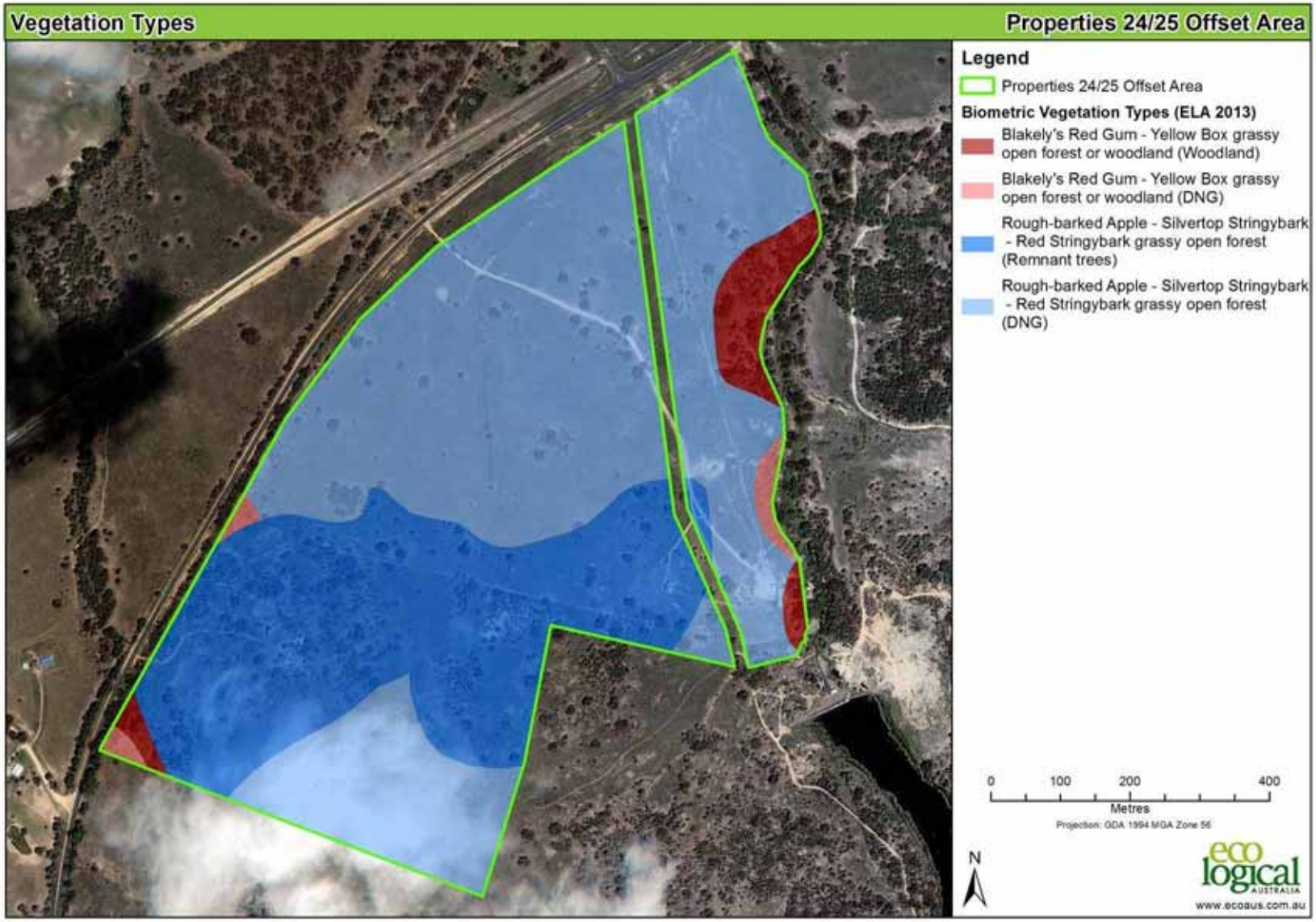

Figure 4: Mapped vegetation of properties #24 and 25

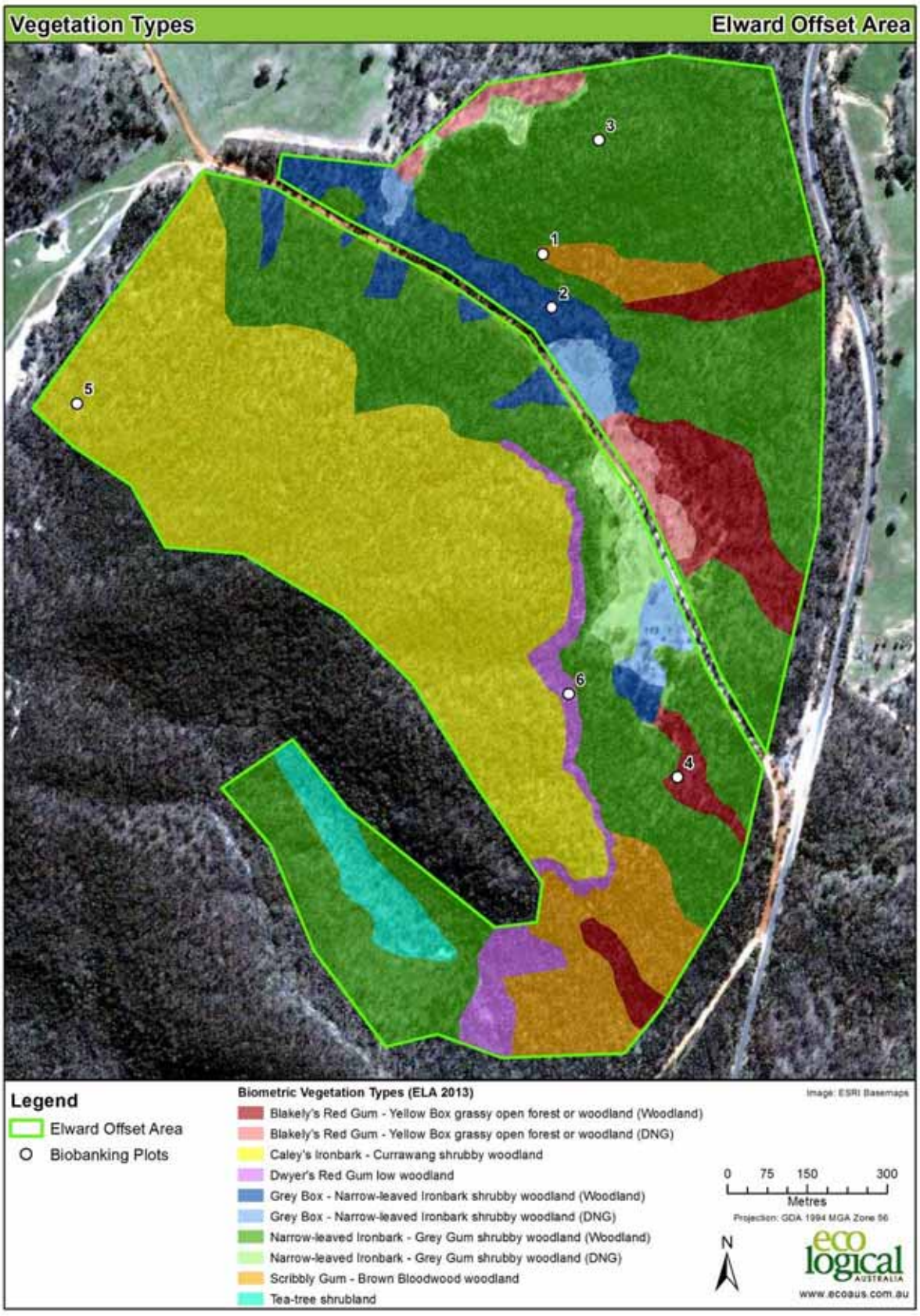

Figure 5: Mapped vegetation of the Elward property

Figure 6: Mapped vegetation of the Moorlamoo property

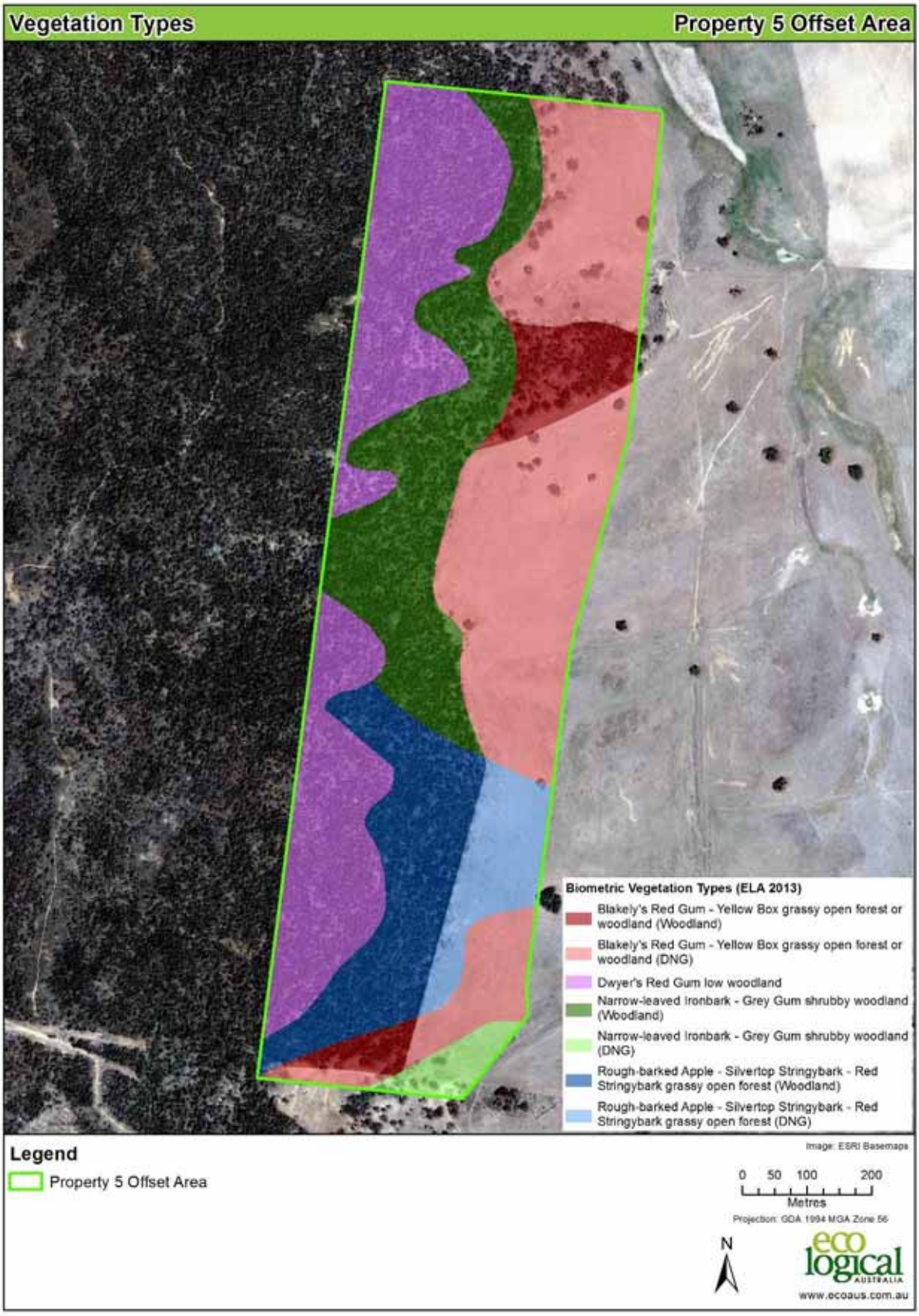

Figure 7: Mapped vegetation of property #5

2.1 CONSISTENCY WITH NSW OFFSET PRINCIPLES

The following section assesses the proposed offset package compared with the NSW offsetting principles (OEH 2008).

1. *Impacts must be avoided first by using prevention and mitigation measures.*

Offsets are then used to address remaining impacts. This may include modifying the proposal to avoid an area of biodiversity value or putting in place measures to prevent offsite impacts.

> A number of avoidance and mitigation measures have been considered in the design of the proposed modification (see Section 1.1 of this report and EMM (2013)). These measures have reduced impacts to native flora and fauna as much as possible. Any unavoidable residual impacts will be offset (as outlined in this report).

2. All regulatory requirements must be met.

Offsets cannot be used to satisfy approvals or assessments under other legislation, e.g. assessment requirements for Aboriginal heritage sites, pollution or other environmental impacts (unless specifically provided for by legislation or additional approvals).

> The development proposal has been prepared as a Part 3A Project Modification under s.75W of the EP&A Act 1979.

3. Offsets must never reward ongoing poor performance.

Offset schemes should not encourage landholders to deliberately degrade or mismanage offset areas in order to increase the value from the offset.

> The proposed offset areas have not been mismanaged in order to increase their value. On the contrary, past sensitive gazing management of the proposed offset properties has resulted in these properties maintaining high biodiversity conservation values that will be protected and enhanced as a result of the proposed offset package.

4. Offsets will complement other government programs.

A range of tools is required to achieve the NSW Government's conservation objectives, including the establishment and management of new national parks, nature reserves, state conservation areas and regional parks and incentives for private landholders.

> The proposed offset package will compliment other government programs by adding to and enhancing the conservation values of adjacent national parks and protecting links and wildlife corridors between these areas and existing biodiversity offset areas resulting from other mining projects (see **Figure 1**).

5. Offsets must be underpinned by sound ecological principles.

They must:

- Include the consideration of structure, function and compositional elements of biodiversity, including threatened species
- Enhance biodiversity at a range of scales

- Consider the conservation status of ecological communities
- Ensure the long-term viability and functionality of biodiversity.

Biodiversity management actions, such as enhancement of existing habitat and securing and managing land of conservation value for biodiversity, can be suitable offsets. Reconstruction of ecological communities involves high risks and uncertainties for biodiversity outcomes and is generally less preferable than other management strategies, such as enhancing existing habitat.

> The proposed offset package has been informed using OEHs quantitative assessment methodologies consistent with OEH (2011). It has been specifically targeted to address the communities and species being impacted on a 'like for like or better' basis and the properties identified in the proposed offset package have been selected based on their size, location and condition to achieve a viable conservation area. The proposed package includes the funding of and implementation of a range of biodiversity management actions that will legally protect, enhance and maintain the condition of existing habitat in the long term.

6. Offsets should aim to result in a net improvement in biodiversity over time.

Enhancement of biodiversity in offset areas should be equal to or greater than the loss in biodiversity from the impact site.

Setting aside areas for biodiversity conservation without additional management or increased security is generally not sufficient to offset against the loss of biodiversity. Factors to consider include protection of existing biodiversity (removal of threats), time-lag effects, and the uncertainties and risks associated with actions such as revegetation.

Offsets may include enhancing habitat, reconstructing habitat in strategic areas to link areas of conservation value, or increasing buffer zones around areas of conservation value and removal of threats by conservation agreements or reservation.

> The proposed offset areas are substantially larger than the area to be impacted and have been determined using quantitative methods to exceed a mitigated loss outcome as described in OEH (2011). Offset areas will be secured prior to impact occurring with management commencing and ongoing after the areas are secured. Funding for long term management will be provided by MCO.

7. Offsets must be enduring & they must offset the impact of the development for the period that the impact occurs.

As impacts on biodiversity are likely to be permanent, the offset should also be permanent and secured by a conservation agreement or reservation and management for biodiversity. Where land is donated to a public authority or a private conservation organisation and managed as a biodiversity offset, it should be accompanied by resources for its management. Offsetting should only proceed if an appropriate legal mechanism or instrument is used to secure the required actions.

> Offset areas will be protected on title and managed with secure funding in the long term.

8. Offsets should be agreed prior to the impact occurring.

Offsets should minimise ecological risks from time-lags. The feasibility and in-principle agreements to the necessary offset actions should be demonstrated prior to the approval of the impact. Legal

commitments to the offset actions should be entered into prior to the commencement of works under approval.

> The proposed offset package forms part of the environmental assessment for the proposed modification and it is understood and accepted that they will become conditions of approval, i.e. the offsets will be agreed and approved prior to the impact occurring.

9. Offsets must be quantifiable & the impacts and benefits must be reliably estimated.

Offsets should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset. The methodology must be based on the best available science, be reliable and used for calculating both the loss from the development and the gain from the offset. The methodology should include:

- The area of impact
- The types of ecological communities and habitat/species affected
- Connectivity with other areas of habitat/corridors
- The condition of habitat
- The conservation status and/or scarcity/rarity of ecological communities
- Management actions
- Level of security afforded to the offset site.
- The best available information/data should be used when assessing impacts of biodiversity loss and gains from offsets. Offsets will be of greater value where:
- They protect land with high conservation significance
- Management actions have greater benefits for biodiversity
- The offset areas are not isolated or fragmented
- The management for biodiversity is in perpetuity (e.g. secured through a conservation agreement).
- Management actions must be deliverable and enforceable.

The offset package has been informed by the improve or maintain calculations referred to in OEH's Major Projects Offset policy and has taken into consideration the area of impact, the vegetation types and condition, species, and connectivity. The calculations for the proposed offset areas have also taken into consideration area, the vegetation types and condition, species, connectivity, level of protection and required management actions. The offset areas are not isolated or fragmented and will be managed for biodiversity in the long term and secured via a conservation agreement registered on title (or similar mechanism) or by gazettal as an addition to existing national park (subject to the agreement of the NSW Minister for the Environment).

10. Offsets must be targeted.

They must offset impacts on the basis of like-for-like or better conservation outcome. Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements.

> The proposed offset package has been targeted based on a '*like for like or better'* conservation outcome and is consistent with the BBAM and OEH (2011) interim policy on assessing and offsetting biodiversity impacts of major projects.

11. Offsets must be located appropriately.

Wherever possible, offsets should be located in areas that have the same or similar ecological characteristics as the area affected by the development.

> The offset areas are either located adjacent to existing national parks or nature reserves or already approved or proposed offset areas.

12. Offsets must be supplementary.

They must be beyond existing requirements and not already funded under another scheme. Areas that have received incentive funds cannot be used for offsets. Existing protected areas on private land cannot be used for offsets unless additional security or management actions are implemented. Areas already managed by the government, such as national parks, flora reserves and public open space cannot be used as offsets.

> The proposed offset package is supplementary. The offset properties are currently zoned rural and have been used historically for agricultural productivity including grazing and timber collection and permit ongoing rural activities. The properties have no existing obligation to be managed for biodiversity conservation, therefore all management actions applied will be supplementary or additional to existing requirements.

13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

Offsets must be audited to ensure that the actions have been carried out, and monitored to determine that the actions are leading to positive biodiversity outcomes.

> The delivery of the proposed offset package will be enforceable through a conditions of approval.

2.2 CONSISTENCY WITH EPBC OFFSET POLICY

The proposed offset package addresses the principles for offsets and the matters to be considered outlined in DSEWPaC (2102). In particular, the proposed package:

- Utilises a quantitative assessment approach using the recently released EPBC Act offset calculator. The 'Net Present Value' of the proposed offset properties exceeds the 'Total Quantum of Impact' value for each of the MNES impacted by the proposal;

- Is built around direct offsets;
- Is proportionate to the level of statutory protection that applies to the protected matter;
- Is targeted to the EPBC Act matters being impacted (White Box – Yellow Box Blakely's Red Gum grassy woodland and derived native grasslands);
- Is of a size and scale proportionate to the residual impacts on the protected matter;
- Addresses the risk of the offset not succeeding by ensuring that the offsets are in place prior to the impact occurring, have existing biodiversity values that can be enhanced with a low risk of failure and provides for long term protection and management of these values; and
- Provides offsets that are additional to what is already required as the land proposed to provide the offset is currently rural land with no requirement for active conservation management.

In addition, the offset package:

- Will be agreed to prior to impact;
- Is in close proximity to the impact site; and
- Will be enforceable, monitored and audited in accordance with project approval conditions.

The cost to secure and manage the proposed offset package is estimated to be in the range of $4M-$5M (land value, registration of conservation covenants, flora and fauna inventories, preparation of management plans, annual monitoring and long term management costs).

3 Statement of Commitments

This biodiversity offset strategy and proposed offset package is MCO's offset commitment for the proposed modification.

In line with the contents of this document, MCO will:

1. Prepare and register a Conservation Covenant under Section 69B of the *National Parks and Wildlife Act* 1974 (or equivalent conservation protection measure including the option to transfer land to the Minister for the Environment with agreement) to cover all seven properties referred to in Section 2 and **Table 5** to provide long term protection of the offset areas following approval of the proposed modification;

    - Should any of the nominated properties not be available for long term conservation protection, alternative offset sites of equivalent area and biodiversity values required by this BOS will be identified, and secured for long term conservation protection;

2. Undertake a detailed flora and fauna inventory and mapping of the vegetation types and threatened species present on each offset property and identify the management issues to prepare a Rehabilitation and Offset Management Plan (ROMP) for the total offset package as a whole (with incorporation into the Stage 1 ROMP);

3. Prepare a ROMP that includes each property and clearly outlines the responsible parties for the implementation of the plan, the works required to improve and maintain the biodiversity values (including but not restricted to fire management, weed and feral animal control, erosion and sediment control, restrictions on access, revegetation), performance criteria and a reporting and monitoring program. The management plan will be prepared by MCO and reviewed by an appropriately qualified and experienced ecologist and will be incorporated into a single management plan covering the already approved Stage 1 offsets;

4. Implement the management actions specific to each property and provide an annual report on the implementation of the plan and the results (changes in biodiversity values) to the DP&I/OEH and DSEWPaC;

5. Provide adequate funds to implement the management plan on an annual basis; and

6. Arrange for the independent review of the adequacy and implementation of the conservation management plans every 3 years.

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Appendix A: OEH Interim Policy on assessing and offsetting biodiversity impacts of Part 3A, state significant development and state significant infrastructure projects

NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects

Approved by the Chief Executive Officer 25 June 2011

1 Introduction

Offsetting is one practical tool for decision makers who have to balance the relative environmental, social and economic merits of development proposals under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The NSW Office of Environment and Heritage (OEH) has developed the Biobanking Scheme to provide a structured, market driven approach to offsetting. The Biobanking Scheme requires proposals to meet the 'improve or maintain' standard, and is based on sound science and robust, transparent rules.

The Biobanking Scheme is voluntary and many proposals in NSW are assessed outside the Scheme. The majority of these proposals have been assessed by the Department of Planning and Infrastructure (DP&I) as major projects under Part 3A of the EP&A Act. DP&I have now repealed Part 3A. Most developments that would previously have been assessed and determined under Part 3A will now fall into either:

- Part 4 – State Significant Development (SSD): these will be projects put forward by the private sector and determined by the Planning Assessment Commission.
- Part 5.1 – State Significant Infrastructure (SSI): infrastructure projects undertaken by or on behalf of public authorities and determined by the Minister for Planning and Infrastructure.

There are also transitional arrangements for existing projects that will continue to be assessed and processed as Part 3A projects. For the purposes of this policy these existing proposals will continue to be referred to as Part 3A; SSD and SSI are referred to collectively as 'State significant projects'.

A proportion of Part 3A and State significant projects also affect nationally listed threatened species and threatened ecological communities (TECs). These proposals are considered by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The question of suitable offsetting often arises in the context of these decisions. This policy seeks to provide a consistent and transparent approach to impact assessment and offsetting for projects assessed under Part 3A or as SSD or SSI. This policy also provides the basis for aligning NSW and Commonwealth assessment and offsetting processes by providing an assessment pathway that is likely to satisfy both NSW and DSEWPC requirements provided that certain standards are met.

This policy will operate on a trial basis in partnership with DSEWPC and DP&I until 30 June 2012, and will be reviewed at the end of this period.

2 Scope and application

This interim policy relates to proposals that are assessed by DP&I under the Part 3A, SSD or SSI provisions of the EP&A Act, and are not being considered as part of the Biobanking Scheme.

This interim policy:

- acknowledges that proposals assessed as State significant projects or Part 3A do not have to meet the "improve or maintain" standard, which is required under the Biobanking scheme;
- nevertheless, adopts the use of the Biobanking Assessment Methodology (BBAM) for the purpose of:
  - quantifying and categorising the biodiversity values and impacts of State significant projects or Part 3A proposals;

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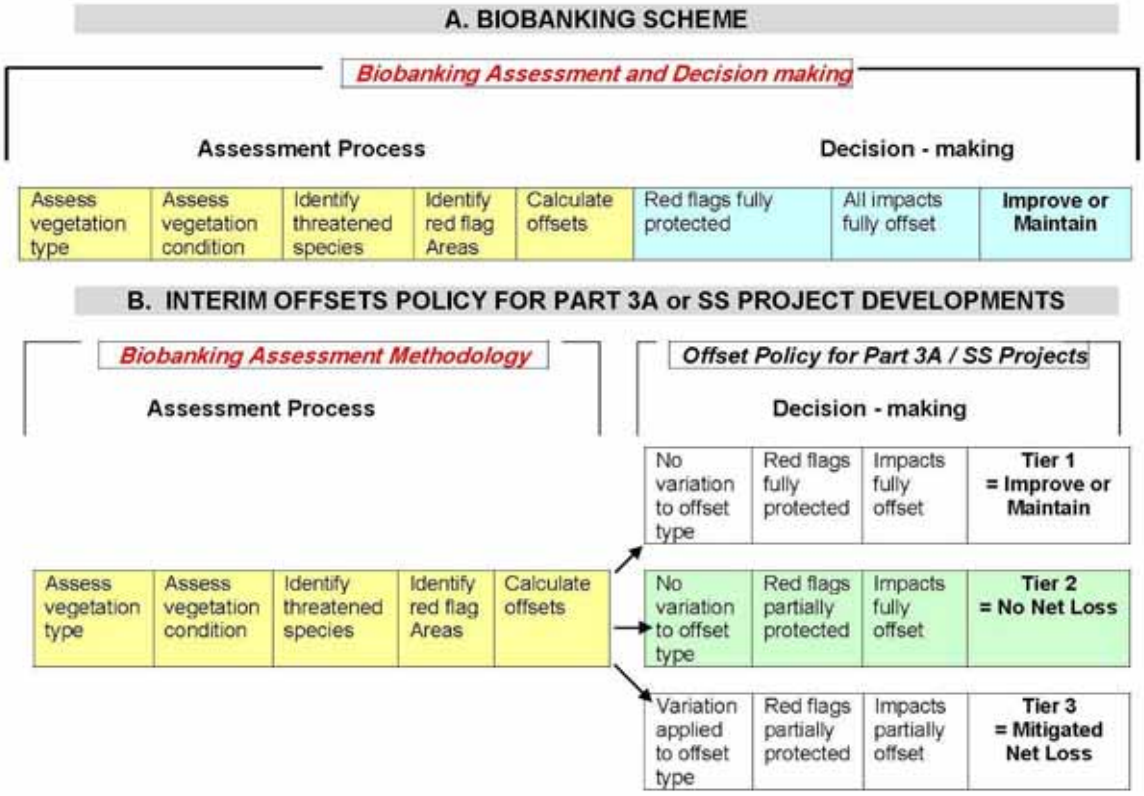
- establishing, for benchmarking purposes, the offsets that would be required if the State significant project or Part 3A proposal had been expected to meet the improve or maintain standard;
- provides a structured approach to determining how proposals may, in lieu of meeting the improve or maintain standard, meet one of two alternative standards established under this policy.

Diagram 1 illustrates how the BBAM is applied under this policy, in contrast to its application under the BioBanking Scheme.

Diagram 1: Application of the Biobanking methodology to Part 3A and State significant (SS) project offsetting decisions



This interim policy does not apply to:

- decisions on developments under Part 4 or 5 of the EP&A Act (except SSD under Part 4 or SSI under 5.1 of the EP&A Act); or
- decisions on the making of environmental planning instruments (EPIs) under Part 3 of the EP&A Act.

3 Definitions

BBAM:	Biobanking Assessment Methodology
Biobanking Credit Calculator:	As defined under the BBAM
Biodiversity Credits:	Ecosystem or species credits required to offset the loss of biodiversity values on development sites or created on biobank sites from management actions that improve biodiversity values
DGRs:	Director-General's Requirements for either an EIS (issued by DP&I) or a SIS (issued by OEH)

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EARs	Environmental Assessment Requirements
Ecosystem credit:	As defined by the *Threatened Species Conservation Act 1995* (TSC Act)
EPI:	Environmental Planning Instrument as defined by the EP&A Act
ESD:	Ecologically Sustainable Development
State significant project:	Collectively State significant development and State significant infrastructure projects
Planning authority:	A person or body exercising and consent or approval role under the EP& A Act – usually a Council or DP&I;
Proponent:	A person or body seeking consent or approval under the EP&A Act.
Red flag:	As defined by the BBAM – areas of particular conservation significance of sufficient scale to be viable over the medium to long term.
Relevant planning decisions	Decisions made by DP&I under Part 3A, 4 or 5.1 of the EP&A Act
Variation criteria:	Options outlined in this policy vary the offsetting requirement in certain circumstances
Species credit:	As defined by the TSC Act
SSD:	State significant development as defined by the EP&A Act
SSI:	State significant infrastructure as defined by the EP&A Act
Threatened Species concurrence and consultation decisions:	Decisions made under section 79(B), in the case of Part 4 EP&A Act matters, and sections 112B and 112C, in the case of Part 5 matters
Voluntary planning Agreement	A planning agreement as defined by the EP&A Act

4 OEH's policy on impact assessment and offsetting

Attachment A sets out the process for Part 3A proposals considered under this policy. It is expected to be similar for State significant projects (this will be confirmed after release of the new regulations outlining the State significant project process).

4.1 Determining offset requirements

Under this policy, the Biobanking Assessment Methodology (BBAM) is used for the following purposes:

- to describe, quantify and categorise the biodiversity values and impacts of a proposal;
- to identify, for benchmarking purposes, the offsetting that would be required to meet the improve or maintain standard; and
- to provide the information for calculating offsets under this policy.

The BBAM is an assessment tool that allows the impacts of a proposal and its offsetting requirements to be calculated in a consistent and transparent way. The BBAM can be applied on:

- a voluntary basis by the proponent, either on a formal basis as part of the Biobanking Scheme, or as part of the assessment of a State significant project or Part 3A proposal;
- by OEH to inform its submissions to the DP&I on State significant project or Part 3A proposals. In such cases OEH would be using the assessment information provided by the proponent to assess likely impacts and calculate offset requirements.

OEH will support both of these options being implemented by:

- Amending and then recommending standard Environmental Assessment Requirements for State significant projects or Part 3A to include the option for the proponent to use the BBAM in his or her environmental assessment; and
- Internally applying the BBAM to State significant projects or Part 3A proposals using the information provided by the proponents in their Environmental Assessment; and using that

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assessment and this policy as the basis for OEH submissions on State significant projects or Part 3A proposals. (See Attachment A.)

Due to resourcing constraints it will not be possible for OEH to undertake this work for all State significant projects or Part 3A proposals but all efforts should be made to use the BBAM where the State significant project or Part 3A proposal is or is likely to be an EPBC Act controlled action.

Where it is not possible due to resourcing constraints to apply the BBAM, offsets are to be negotiated on a case by case basis and in accordance with OEH's offsetting principles (See http://www.environment.nsw.gov.au/biocertification/offsets.htm). The *NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects* is not relevant to offsets that have been calculated without applying the BBAM.

The Policy provides for a range of mechanisms to be used to implement offsets (ie. not only biobanking credits) in view of the currently limited supply of biodiversity credits on the market.
The Policy describes 3 possible outcomes that proposals should strive to meet depending on the circumstances. These outcomes are described in Table 1.

Table 1: Offsetting calculations using the BBAM*

Outcome achieved	Level of impact	Offsetting requirement
- Improve or maintain (Tier 1)	- red flag assets protected and clearing only occurs within the variation rules set by the BBAM	- calculated by the credit calculator**
- No net loss (Tier 2)	- some/all red flags not protected and clearing allowed outside the variations rules permitted by the BBAM	- calculated by the credit calculator**
- Mitigated net loss (Tier 3)	- as for 'no net loss'	- calculated by the credit calculator but then amended by the offset variation criteria contained in Attachment A of this policy to a minimum land offset to clearing ratio of 2:1

* These standards do not apply where the BBAM has not been used as it is not possible to identify red flags or credit requirements in the absence of the BBAM assessment.
** The difference between Tier 1 and 2 relates only to the clearing of red flags. The amount of offsetting required is the same for both Tiers

OEH's submissions will advocate that proposals deliver at least one of these outcomes, with "improve or maintain" (Tier 1) being preferred.

4.2 Determining an appropriate outcome

Tier 1: "Improve or Maintain"

While not required of State significant projects or former Part 3A proposals, the "Improve or Maintain" nevertheless represents a high standard of biodiversity protection. OEH should set out in its submissions to DP&I the requirements for meeting this standard. DSEWPC has advised that proposals that meet the "Improve or Maintain" standard are likely to satisfy its requirements for impact assessment and offsetting.

A proposal can fall short of the "Improve or Maintain" standard in two main ways: either red flag assets are to be cleared outside the rules allowed by the BBAM; and/or the amount and type of offsetting secured is inconsistent with the requirements of the BBAM credit calculator.

Tier 2: Negotiating a "No Net Loss" outcome

'No Net Loss' is attained when it is proposed to clear red flags outside the variation rules permitted by the BBAM, but all impacts are to be fully offset in accordance with the BBAM requirements.

In deciding whether this is appropriate, consideration should be given to:

a) whether any feasible alternatives exist that would avoid clearing;

b) the value of the resource (in the case of extractive industries) or other economic benefits and the likely contribution of the proposal to local and regional economies.

Most Part 3A proposals and State significant projects are of social and economic significance to State and regional economies. It is for DP&I to compare and balance the significance of economic or social benefits, and potential environmental (including biodiversity) impacts and gains.

DP&I has prepared draft social and economic impact assessment guidelines to assist decisions makers balance social, economic and environmental outcomes. OEH will work with DP&I on the preparation of these guidelines and their subsequent integration with future versions of this policy.

Proposals that meet the 'No Net Loss' outcome may satisfy DSEWPC requirements for impact assessment and offsetting provided that a sound economic and social justification for anticipated impacts is provided.

Tier 3: Negotiating a "Mitigated Net Loss" outcome

"Mitigated Net Loss" occurs when red flag assets are to be cleared and this clearing is considered acceptable under the requirements set out for no net loss; and the amount and type of offsetting proposed is inconsistent with the requirements of the BBAM credit calculator. In considering whether the mitigated net loss standard is appropriate, consideration should be given to:

a) whether the credits required by the calculator are available on the market;
b) whether alternative offset sites (other than credits) are available on the market;
c) the overall cost of the offsets and whether these costs are reasonable given the circumstances.

Should any of these circumstances apply, then it is reasonable to apply the variation criteria to the point that:

a) suitable offset sites can be found within a reasonable[2] timeframe;
b) the costs of offsetting is brought within a reasonable range; and
c) an offset to clearing ratio of at least 2:1 vegetated to cleared hectares is achieved.

The variation criteria are set out at Attachment B. In summary the variation criteria:

- Make provision for the conversion of ecosystem credits to another type of ecosystem credit;
- Make provision for conversion of one type of ecosystem credit to another type of ecosystem credit and for the waiving of species credits in some circumstances;
- Remove the need for offsets where clearing is minimal and confined to non-threatened vegetation; and
- Make provision for the conversion of ecosystem and species credits to hectares which, in turn, allows the land value of the offset to be estimated. In this way, approvals can be issued that specify either the hectares or the financial contribution that would need to be made to secure the land required for offsetting.

OEH should set out in its submissions to DP&I the requirements for meeting this standard.

Proposals that meet a mitigated net loss outcome will be considered on merit by DSEWPC.

5 Securing an offset site

5.1 Criteria for determining suitability of an offset site

OEH offset principles require offsets to be managed under effective and secure long term management arrangements. Dedication of land under the *National Parks and Wildlife Act 1974* (NPW Act), and the establishment of biobanking sites with Biobanking Agreements under the TSC Act, meet this requirement because:

a) The unambiguous principal objective of ongoing site management is biodiversity conservation;

[2] What is "reasonable" is contingent upon a range of factors and needs to be considered on a case by case basis.

b) Management is undertaken in accordance with a Plan of Management;

c) There is reasonable likelihood that sufficient resourcing will be available to implement the Plan of Management over-time;

d) The arrangements are in-perpetuity, and conservation obligations are transparently transferred and disclosed to any new owners of the land through appropriate administrative procedures; and

e) There are appropriate accountability mechanisms to secure the outcomes and these mechanisms cannot be altered without alternative and comparable offsetting arrangements being put in place.

f) An alternative to establishing biobanking sites is to retire biobanking credits, where appropriate credits are available. The Minister for Planning may approve a project under Part 3A subject to a condition that requires a proponent to acquire and retire biodiversity credits of a specified number and class (section 75JA, EP&A Act). S.89I and 115ZC allow approvals for all State significant projects to include conditions that require biodiversity credits to be obtained and retired by the proponent.

Other conservation mechanisms may also meet the criteria in certain circumstances. These include:

a) Conservation Agreements under the NPW Act;

b) Trust Agreements under the *Nature Conservation Trust Act 2001* (NCT Act);

c) A Property Vegetation Plan registered on title under the *Native Vegetation Act 2003* (NV Act); and

d) A Planning agreement under s93F of the EPA Act.

The suitability of these mechanisms (or any other mechanism) depends on whether the proposed arrangements are likely to result in the management of the land in accordance with the five criteria above.

5.2 Offsetting and reservation under the NPW Act

If an offset site is proposed that may involve the transfer of land to OEH for reservation under the NPW Act, then consultation must occur with the relevant PWG Branch Director at the earliest possible stage. No commitment should be made to accept an offset involving new reserves without the agreement of the Deputy Chief Executive, PWG. Similarly, no commitment should be made to accept offsets involving other forms of in-perpetuity protection without the agreement of the relevant sponsoring body.

6 Implementation and accountabilities

Staff may use the BBAM only if they have been trained. Some Catchment Management Authorities (CMAs) have indicated an interest in participating in offsetting discussions and may be available to assist OEH to undertake this work. OEH, however, will remain the lead Agency responsible for offsetting negotiations on behalf of the Environment portfolio. Positions with significant responsibilities under this interim policy are listed below.

Position	Responsibility
Director, LEC Manager, Conservation Policy and Strategy, LEC	Policy development and review
Manager, Biodiversity and Vegetation Programs	Issue biobanking statements and agreements State-wide co-ordination of biobanking program Overall program support including Biobanking helpline, Workshops and Training and accreditation programs.
Regional Director, EPRG	To approve the communication of BBAM outcomes to proponents and planning authorities To approve amendments to credit requirements in accordance with the requirements of this policy To liaise with PWG Branch Directors on offset proposals involve new reserves
Manager, Planning and Aboriginal Heritage,	To approve use of BBAM by OEH staff when dealing with

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EPRG Manager, Metro Projects and Support (Metro only), EPRG Manager Environment and Conservation Programs (NW only), EPRG Manager, Regional Operations, EPRG	SSD, SSI or Part 3A matters
Regional Operations Officers, EPRG Catchment Management Officer, CMA	Must be trained in BBAM in order to apply to methodology

7 Policy review

This interim policy will be reviewed by 30 June 2012.

8 Contacts for further advice

For further advice on this policy please contact:
Ms Julie Ravallion, Manager, Conservation Policy and Strategy on 02 9995 6729

For advice offsetting and new reserve proposals please contact Mr Ray Fowke, Environment Planning Advisor on 02 9585 6607

For advice on the Biobanking Scheme please contact the Biobanking helpline.

9 Related policies and other documents

BioBanking Assessment Methodology and Credit Calculator Operational Manual, March 2009, http://www.environment.nsw.gov.au/resources/biobanking/09181bioopsman.pdf

OEH's offsetting principles can be found at:
http://www.environment.nsw.gov.au/biocertification/offsets.htm

The Department of Sustainability, Environment, Water, Population and Communities' draft offsetting policy can be found at:
(http://www.environment.gov.au/epbc/publications/draft-environmental-offsets.html)

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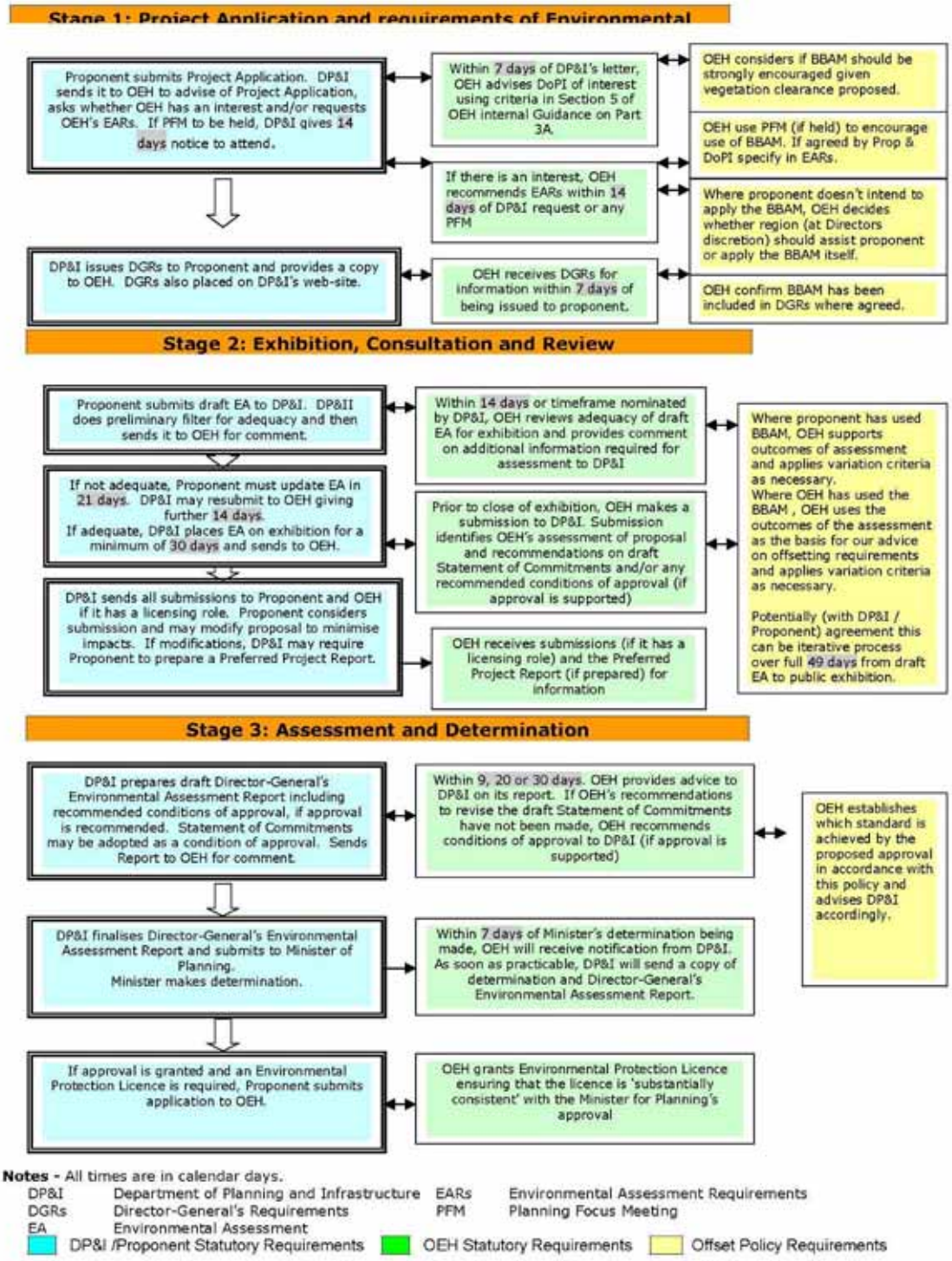
Attachment A: **Typical Project Application's Process under Former Part 3A**

Note: The project application process for State significant projects is under development (as of July 2011)



Notes - All times are in calendar days.

DP&I	Department of Planning and Infrastructure	EARs	Environmental Assessment Requirements
DGRs	Director-General's Requirements	PFM	Planning Focus Meeting
EA	Environmental Assessment		

DP&I /Proponent Statutory Requirements | OEH Statutory Requirements | Offset Policy Requirements

Attachment B: Variation criteria for mitigated net loss (Tier 3)

To achieve Tier 3 - mitigated net loss standard, the following variation criteria may be applied to the offsetting requirements of the BBAM. The minimum area standard is an offset to clearing ratio of 2:1.

Variation criteria	When is this option appropriate	How
a) Convert ecosystem credits for one vegetation type to any vegetation type within the same vegetation formation in the same IBRA bioregion	When no matching ecosystem credits are available	Review to biometric vegetation database to identify vegetation types in the same formation in the same IBRA bioregion. Number of credits should be the same.
b) Convert one type of species credit to another type of species credit with the same or more endangered conservation status	When species credit is not available and the matching species credit is considered a greater conservation priority.	Review conservation status of species Number of credits should be the same
c) Remove/reduce the need for offsetting	Where clearing is minimal (less 4 ha) and where the vegetation is not a highly cleared vegetation type or a Commonwealth or State listed TEC.	Identify and remove credits required for offsetting vegetation under 4ha and for vegetation types that aren't greater than 70% cleared or a Commonwealth or State listed TEC
d) Convert ecosystem credits required to hectares and, if necessary, convert hectare figure to an estimate of land value	Where suitable offset sites are known to exist but: • there is insufficient time to secure the offset sites at the time the decision is made; or • the proposal is to use the services of a third party provider such as the Nature Conservation Trust to secure offset sites and an estimate of cost is required.	Convert credits required to hectares using the credit to ha converter[1] and ensure that the approval: • specifies the type, location and condition of offsets; and • secured offset sites in accordance with the requirements of section 5 of this Policy. An estimate of the cost of the offset can be made by using a Valuer Generals estimate of land value.
e) Waive the requirement for species credits NB: This criteria should not be used for EPBC Act listed species where the proposal is a controlled action	Where no matching credits are available and all ecosystem credits have been obtained in accordance with this policy	Remove the requirement
f) Convert ecosystem credits to a regional conservation priority as identified in a regional conservation plan or similar	When no matching credits are available and variation 1 is not feasible	Identify areas of high conservation priority in existing regional conservation plans or similar. Convert credits required to hectares[1]. Identify eligible offset sites and ensure areas are of sufficient size, condition and landscape context.

OEH is currently finalising an excel spreadsheet which converts credits to hectares. This spreadsheet will be lodged on the OEH intranet site.

Appendix B: Preliminary Flora and Fauna Assessments of Proposed Offset Properties

A preliminary investigation of the biodiversity values of the proposed offset properties was undertaken for a total of six days between February and April 2013. The property inspections were carried out by ELA ecologists Brian Towle, David Allworth and Daniel Magdi. Biometric vegetation type and condition mapping was undertaken across all properties, biometric plot data was collected at the Clifford and Elward properties only and brief fauna surveys (habitat assessment, diurnal bird surveys and Anabat devices) were undertaken at the Clifford, Elward and Property #24.

Elward and Clifford Properties

The Elward and Clifford properties were surveyed over a 5 day period from 26 February to 28 February 2013 and 7 and 8 March. The properties were extensively walked to obtain the patterns of vegetation and waypoints were taken to determine boundaries.

Targeted fauna surveys were undertaken across the two properties over a two day period, to determine the potential presence of target threatened fauna species being impacted by the proposed modification (**Figure 10**). The surveys included:

- Habitat assessment – investigation into the broad habitat types located across the two properties;
- Diurnal bird survey – four 30 minute diurnal bird surveys were conducted across each property over the two day period;
- Anabat devices – two anabat devices were placed in different habitat types over a one night period per site. Anabat analysis was undertaken by Alicia Scanlon of ELA.

The Elward property is located on Triassic Narrabeen Sandstone. The area consists of cliff lined ridge areas dominated by *Eucalyptus fibrosa* (Broad-Leaved Ironbark) with a shrubby understorey. In areas below the cliff line or 'jump up' *Eucalyptus crebra* (Narrow-leaved Ironbark) was dominant, with areas of *Eucalyptus blakelyi* (Blakely's Red Gum) with grassy understorey in drainage lines. The majority of the property is still in woodland form. Seven Biometric Vegetation types were identified across the Elward property. Although the vegetation on the properties have more affinity with vegetation communities of the Central West CMA, they are located in the east flowing Hunter catchment. Therefore the Biometric Vegetation types were matched to the Hunter Central Rivers vegetation types. At times more appropriate equivalents were available from the Central West vegetation types. One biometric plot was undertaken in each vegetation zone (vegetation type and condition state) to inform a site condition score for improve or maintain calculations:

- Dwyer's Red Gum low woodland on exposed sandstone ridges of the upper Hunter Valley, Sydney Basin;
- Narrow-leaved Ironbark - Grey Gum shrubby woodland on footslopes on the upper Hunter Valley, Sydney Basin;

- Scribbly Gum - Brown Bloodwood woodland of the southern Brigalow Belt South;
- Caley's Ironbark - Currawang shrubby woodland on sandstone ridges of the upper Hunter Valley, Sydney Basin;
- Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands (**Figure 8**);
- Grey Box - Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin;
- Tea-tree shrubland of drainagee areas of the slopes and tablelands.

The Clifford property is located on a low slope area with a Carboniferous Granite outcrop in the western sector. Broad drainage lines with deeper soils have grassy woodland of Blakely's Red Gum. Along creek lines there are deeper sands with Angophora floribunda (Rough-Barked Apple) and *Eucalyptus rossii* (Inland Scribbly Gum) or frontage areas with duplex soils supporting *Eucalyptus moluccana* (Grey Box). Rough Barked Apple is common throughout, and Narrow-leafed Ironbark and *Eucalypts dealbata* (Tumbledown Red Gum) area found on rises. Approximately half the property is cleared, with some areas with a strong presence of native grasses. Five Biometric Vegetation types were identified across the Clifford property:

- Dwyer's Red Gum low woodland on exposed sandstone ridges of the upper Hunter Valley, Sydney Basin;
- Narrow-leaved Ironbark - Grey Gum shrubby woodland on footslopes on the upper Hunter Valley, Sydney Basin;
- Scribbly Gum - Brown Bloodwood woodland of the southern Brigalow Belt South;
- Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands (**Figure 9**);
- Grey Box - Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin.

The fauna surveys undertaken within the Elward and Clifford property identified a range of broad habitat features providing habitat for a range of threatened fauna species. These habitat elements include:

- Intact canopy layer;
- Derived native grasslands;
- Hollow-bearing trees;
- Stags;
- Ephemeral drainage lines and associated vegetation;
- Dams with open water and emergent vegetation;
- Woody debris (fallen logs and braches);
- Rocky outcrops
- Cliff lines.

Most of the habitat elements are present within the wooded areas of the two properties, however, cliff line habitat only occurs within the Elward property.

The habitat elements available within the properties potentially provide sheltering, foraging, and roosting habitat for a range of fauna groups, particularly where canopy trees and stags support hollows for arboreal mammals, birds and bats to shelter/roost/breed. Intact canopy, shrub layers and derived grassland provide foraging habitat for birds and bats. Woody debris and rocky outcrops provide potential foraging and sheltering habitat for ground dwelling mammals, frogs and reptiles.

The brief fauna survey recorded nine threatened fauna species:

- Brown Treecreeper (Elward property);
- Diamond Firetail (Clifford property);
- Grey-crowned Babbler (Elward property);
- Speckled Warbler (Elward property);
- Eastern Bent-wing Bat (Elward and Clifford properties);
- Eastern False Pipistrelle (Clifford property)
- Large-eared Pied Bat (Clifford property)
- Southern Myotis (Elward property);
- Yellow-bellied Sheathtail Bat (Elward property).

Figure 8: Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands within the Elward property.

Figure 9: Scribbly Gum - Brown Bloodwood woodland of the southern Brigalow Belt South within the Clifford property.

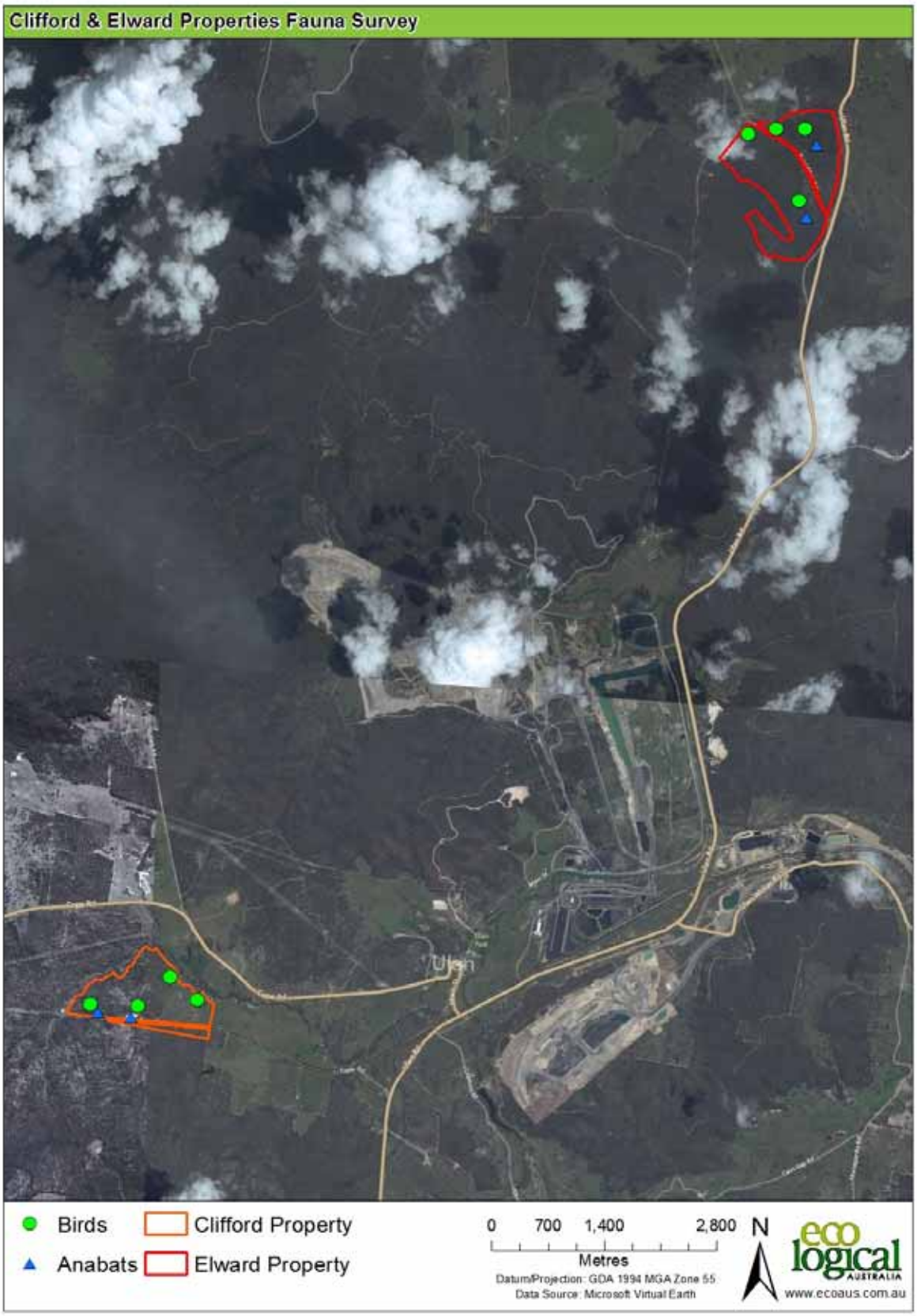


Figure 10: Fauna survey locations within the Clifford and Elward properties

Moolarmoo and Bobadeen (Williams) Properties

The Moolarmoo and Williams properties were surveyed on the 26 March 2013 for a total of 9 hours to validate vegetation types and condition. Dominant species were recorded in each visually determined different vegetation community to allow the allocation of a Biometric Vegetation Types.

The Moolarmoo property is located in a cliff lined valley, which includes steep colluvial slopes and rockfall areas at the base of the Narrabeen Sandstone cliffs. The valley floor is of Permian sediments. The valley floor and low slopes are cleared and supported a mix of Rough Barked Apple, *Eucalyptus melliodora* (Yellow Box) and Blakely's Red Gum, remnant trees remain. The steeper areas have Rough Barked Apple and *Eucalyptus punctata* (Grey Gum). On the cliff line there is Grey Gum and Stringybarks. The rocky nature of the cliff bases provide the fire protection to allow large figs (*Ficus rubiginosa*) to grow. As the valley narrows wet forest/ rainforest species such as *Pittosporum undulatum* (Sweet Pittosporum) appear. Five Biometric Vegetation Types were identified across the Moolarmoo property:

- Grey Gum - Narrow-leaved Stringybark - ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin;
- Narrow-leaved Ironbark - Grey Gum shrubby woodland on footslopes on the upper Hunter Valley, Sydney Basin;
- Caley's Ironbark - Currawang shrubby woodland on sandstone ridges of the upper Hunter Valley, Sydney Basin;
- Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands;
- Giant Stinging Tree- Fig dry subtropical rainforest of the North Coast and Brigalow Belt South (**Figure 11**).

The Williams property (Old Bobadeen) is an elevated property located on Triassic Narrabeen Beds, Jurassic Purlawaugh Formation, Jurassic Pilliga Sandstones and Tertiary Basalts. Along flowlines there are Blakely's Red Gum and Yellow Box, with some Rough Barked Apple. On slopes there is the native grasslands derived from cleared Box-Gum Grassy Woodland. Rocky outcrops support Narrow-Leafed Ironbark with a shrubby understorey. Rocky outcrops occur at a range of elevations. The majority of this property is cleared. The property has extensive areas of Derived Native Grasslands of Box-Gum Woodland in moderate to good condition. Three Biometric Vegetation Types were identified across the Bobadeen property:

- Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin;
- White Box Yellow Box Grassy Woodland on basalt slopes in the upper Hunter Valley NSW (**Figure 12**);
- Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands.

Figure 11: Giant Stinging Tree- Fig dry subtropical rainforest of the North Coast and Brigalow Belt South (Moolarmoo)

Figure 12: White Box Yellow Box Grassy Woodland on basalt slopes in the upper Hunter Valley NSW (Bobadeen).

Properties #5, #24 and #25

Property #24 and #25 were surveyed on the 16 April 2013. The vegetation mapping of these properties was undertaken by an overall drive and walk across the properties to allow interpretation of the aerial photography. For the delineation of lines the property was criss-crossed to visually intersect all boundaries.

Property #5 was surveyed on the 16 April. The vegetation mapping of this property was undertaken by walking across the site (both on top of the escarpment and on low slope cleared areas) to allow interpretation of the aerial photography. For the delineation of lines the property was criss-crossed to visually intersect all boundaries.

Property #24 and # 25 contain a granite outcrop in the in southern half, with low slope area running north and north-east to a flowline. The property has been extensively cleared in the past, but there is now widespread regeneration with numerous small trees having established. Where granite rock outcrops occur, Tumbledown Red Gum, Narrow-leafed Ironbark, *Eucalyptus macrorhyncha* (Red Stringybark) and Rough-Barked Apple predominate. With development of soils downslope and along creek lines Blakely's Red and Rough-Barked Apple are dominant. Two Biometric Vegetation Types were identified across the property #24/25:

- Rough-barked Apple - Silvertop Stringybark - Red Stringybark grassy open forest on hills of the upper Hunter Valley, southern North Coast;
- Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands.

Property #5 is bisected by a north-south running sandstone escarpment overlying granite which outcrops in the lower slope areas. The steep slopes of the escarpment and the ridge above the escarpment are fully vegetated with woodland. The lower sloping area on the eastern half of the site have been cleared and is now dominated by native grassland. The lower slope areas have Blakely's Red Gum Grass Woodland and remnant clumps of Rough-Barked Apple sparsely scattered across the native grassland. On the escarpment and ridges Tumbledown Red Gum, *Eucalyptus parramattensis* (Parramatta Red Gum), Red Stringybark, Narrow-leaved Ironbark, *Callitris endlicheri* (Black Cypress Pine) and Rough-Barked Apple are dominant. Four Biometric Vegetation Types were identified across the property #5:

- Dwyer's Red Gum low woodland on exposed sandstone ridges of the upper Hunter Valley, Sydney Basin;
- Narrow-leaved Ironbark - Grey Gum shrubby woodland on footslopes on the upper Hunter Valley, Sydney Basin;
- Rough-barked Apple - Silvertop Stringybark - Red Stringybark grassy open forest on hills of the upper Hunter Valley, southern North Coast;
- Blakely's Red Gum - Yellow Box grassy open forest or woodland of the New England Tablelands.

Previous fauna monitoring in spring 2010 (ELA 2011) was undertaken within Property #24 (**Figure 13**). The monitoring included a suite of methods:

- Active searches for amphibians during the day and night for a period of 0.5 hrs;
- Diurnal bird survey for a period 1 hr;
- Nocturnal bird call playback over a night period for a period of 0.75 hrs;

- Mammal trapping including 10 A Elliott's, three B Elliott's, three bandicoot cage traps, one large cage trap, five small hair tubes and five large hair tubes;
- Spotlighting was undertaken for mammals, reptiles and amphibians for 0.5 hrs over one night;
- One Anabat device for a period of one night;
- Active searches for reptiles during the day and night for a period of 0.5 hrs.

The fauna monitoring undertaken within Property #24 during spring 2010 (ELA 2011) identified two threatened fauna species, including:

- Speckled Warbler;
- Eastern Bent-wing Bat.

One threatened fauna species was opportunistically identified within Property #5, the Glossy Black Cockatoo was observed flying across the proposed offset area. Fauna monitoring has also been undertaken in the Stage 1 Offset Area located adjacent to Property #5. This fauna monitoring has been undertaken since 2011 and a number of threatened fauna species have been identified. Similar habitat characteristics are found within Property #5 and therefore it is likely that similar threatened species will reside for foraging or roosting purposes within the remnant vegetation of Property #5. The threatened species identified include:

- Brown Treecreeper;
- Glossy Black Cockatoo;
- Powerful Owl;
- Speckled Warbler;
- Varied Sittella;
- Eastern Bent-wing Bat;
- Eastern Cave Bat;
- Eastern False Pipistrelle;
- Large-eared Pied Bat;
- Little Pied Bat;
- Southern Myotis;
- Yellow-bellied Sheathtail Bat.

Figure 13: 2010 spring survey methods within Property #24.

Figure 14: Rough-barked Apple - Silvertop Stringybark - Red Stringybark grassy open forest on hills of the upper Hunter Valley, southern North Coast (Property #24).

Figure 15: Dwyer's Red Gum low woodland on exposed sandstone ridges of the upper Hunter Valley, Sydney Basin (Property #5).

SYDNEY
Ground Floor Suite, 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 1, 6 Bolton Street
Newcastle NSW 2300
T 02 4927 0506 F 02 4926 1312

BRISBANE
Suite 1, Level 4, 87 Wickham Terrace
Spring Hill Queensland 4000
T 07 3839 1800 F 07 3839 1866

www.emgamm.com

EMM
EMGA Mitchell McLennan