LIDDELL COAL OPERATIONS

APPENDIX H

Ecological Assessment (Umwelt, 2013a)

APPENDICES

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Liddell Coal Operations Pty Limited

ECOLOGICAL ASSESSMENT

Liddell Coal Operations Extension Project

September 2013

Liddell Coal Operations Pty Limited

ECOLOGICAL ASSESSMENT

Liddell Coal Operations Extension Project

September 2013

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Liddell Coal Operations Pty Limited

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Executive Summary

The Liddell Coal Operations (LCO) is an existing open cut coal mining operation located approximately 25 kilometres north-west of Singleton in the Hunter Valley of New South Wales. LCO is located within both the Singleton and Muswellbrook Local Government Areas (LGAs). LCO currently has approval to mine within their current footprint until 2023; however current coal reserves within this approved footprint will be exhausted by 2014. LCO is seeking modification to their existing approval to extend currently approved mining activities to include additional coal resources and to allow the continuation of mining until approximately 2028.

The modification is sought under section 75W of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), and will be subject to assessment by the Director-General of the NSW Department of Planning and Infrastructure (DP&I) and determination by the Minister for Planning and Infrastructure in accordance with Part 3A of the EP&A Act.

Proposed Modification Area

The Proposed Modification Area has a history of mining operation, with the LCO operations subject to continuous operation since the 1950's. Prior to the commencement of mining, the land was subject to agriculture (predominantly grazing) and its associated clearing has resulted in a heavily modified and fragmented landscape.

Methods

EcoLogical (Australia) (ELA) previously undertook flora, fauna and aquatic field surveys of the Proposed Modification Area and other parts of the LCO holdings. Umwelt was engaged to prepare the Ecological Assessment for the Project, as well as to ground-truth and update the existing flora surveys and vegetation mapping.

Methods included a detailed review of relevant literature, reports and vegetation mapping, as well as searches of relevant ecological databases. Information gathered from the literature reviews and database searches was then used to design ecological surveys that were commensurate with the biology/ecology of species and the extent of suitable habitat within and adjoining the Proposed Modification Area; to map and survey vegetation communities; and to target threatened species, endangered populations, threatened ecological communities and their habitats.

A large amount of ecological data had already been collected from LCO during annual flora and fauna monitoring surveys between 2006 and 2011. Annual monitoring sampled up to nine sites and has included flora surveys, bird surveys, herpetological surveys, spotlighting, micro-bat echolocation recording, habitat assessment and targeted blue-billed duck (*Oxyura australis*) surveys.

Flora field surveys were carried out by ELA in May and October 2011 and by Umwelt in October 2012. In total, ELA undertook 20 vegetation surveys quadrats, 18 rapid assessments, one day of targeted threatened species searching and 103 kilometres of meander transects. Umwelt undertook 2 vegetation survey quadrats, 4 rapid assessments and 28 kilometres of meander transects. The combination of this survey effort contributed to the ground-truthing of vegetation community boundaries, refinement of community descriptions, and the provision of a comprehensive understanding of the floristic features of the Proposed Modification Area.

General fauna surveys were undertaken by ELA during July, October and December of 2011 and consisted of hair tube surveys, cage trapping, remote camera surveys, spotlighting, micro-bat echolocation recording, harp trapping, bird surveys, call playback and herpetofauna surveys.

Targeted fauna surveys for the spotted-tailed quoll (*Dasyurus maculatus maculatus*) were undertaken by ELA during November and December of 2012 and by Umwelt during December of 2012.

Aquatic surveys were undertaken by ELA during July of 2012 and comprised habitat assessments, macroinvertebrate sampling, and fish sampling and stygofauna sampling.

Flora Results

A total of 221 (155 native and 66 exotic) were recorded in the Proposed Modification Area. Surveys identified six native vegetation communities, three of which were deemed to be consistent with threatened ecological communities (TECs) listed under the *Threatened Species Conservation Act 1995* (TSC Act). Vegetation communities identified were:

- Central Hunter Box – Ironbark Woodland Endangered Ecological Community (EEC);
- Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated) EEC;
- Central Hunter Box – Ironbark Woodland (Regrowth) EEC;
- Central Hunter Box – Ironbark Derived Native Grassland;
- Central Hunter Swamp Oak Forest; and
- Central Hunter Bulloak Forest.

One endangered population listed under the TSC Act was identified in the Proposed Modification Area, being the tiger orchid (*Cymbidium canaliculatum*) in the Hunter Catchment. No threatened flora species listed under the TSC Act or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were identified.

Fauna Results

A total of 109 fauna species were identified in the Proposed Modification Area, comprising seven frog species, six reptiles, 67 birds and 29 mammals.

A total of 10 fauna species listed as threatened under the TSC Act were recorded in the Proposed Modification Area. A further six fauna species listed under the TSC Act were recorded in the broader LCO, including two species, the spotted-tailed quoll (*Dasyurus maculatus maculatus*) an Australian painted snipe (*Rostratula benghalensis australis*) which are also listed under the EPBC Act. In addition, one migratory species as listed under the EPBC Act were recorded within the Proposed Modification Area with a further six known to occur within the broader LCO.

Aquatic Results

Aquatic surveys by ELA identified 32 macro-invertebrates, three fish species, one mammal species, and 10 stygofauna taxa. Bayswater Creek was described as being in generally poor condition.

Impacts

In determining whether or not the project will significantly impact threatened or migratory species or TECs, the precautionary principle was rigorously applied to ensure that where there was lack of knowledge regarding a species or community, or in relation to the nature or extent of a potential impact, the worst case was assumed. In this way a robust impact assessment was prepared that ensured uncertainties in data were factored in to the later process of impact mitigation and biodiversity offsetting.

The Project will result in the removal of 188 hectares of native vegetation, including 56 hectares of TEC listed under the TSC Act, 65 hectares of derived native grassland and 67 hectares of non-threatened forest vegetation.

The Project will remove one known record of the endangered population of tiger orchid (*Cymbidium canaliculatum*) in the Hunter Catchment and will remove known habitat for ten threatened fauna species. Of the threatened species, migratory species, endangered populations, and TECs known or considered likely to occur, the following were considered to have the potential to be significantly impacted by the Project:

- spotted-tailed quoll (*Dasyurus maculatus maculatus*);
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- speckled warbler (*Chthonicola sagittata*);
- hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*); and
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*).

Impact Mitigation Strategy

LCO has sought to avoid and minimise potential impacts on the ecological values of the Proposed Modification Area throughout the project planning process. This has included reducing the original limit of the open cut mining to be further away from Bowmans Creek as well as changing mine planning to avoid disturbance of an established rehabilitation area.

A range of management strategies will be used by LCO to limit impacts on native flora and fauna species in the Proposed Modification Area and in adjacent habitats and these key impact mitigation strategies are detailed in the Liddell Landscape Management Plan (LMP) (Umwelt 2013).

Key impact mitigation strategies will include weed and feral animal control, fencing and access control, bushfire management, rehabilitation of post-mining area, rehabilitation of the Bowmans Creek riparian corridor with emphasis on habitat restoration and enhancement for the spotted-tailed quoll (*Dasyurus maculatus maculatus*), habitat enhancement measures, and a comprehensive tree felling procedure to limit impacts on hollow-dependent threatened species.

Biodiversity Offset Strategy

A biodiversity offset strategy has been developed for the Project in a manner consistent with Commonwealth and State offsetting policies. The key objectives for the Biodiversity Offset Strategy are to:

- maintain or improve the biodiversity values of the surrounding region in the medium to long term;

- maintain or improve the viability of threatened species that could be affected by the Project through the securing and/or restoration of habitat in the Hunter Valley or elsewhere within their range; and

- ensure that there are no residual net impacts on key threatened species and ecological communities in the long term as a result of the construction and operation of the Project.

The Biodiversity Offset Strategy consists of a number of components designed to address the identified impacts on TECs and threatened species. These measures include:

- establishment of an effective targeted rehabilitation strategy (**Section 6.2**) to be undertaken on a progressive basis and commenced immediately after cessation of works to reduce impacts of the project at any one time and reduce offsetting requirements;

- immediate establishment and long-term protection of the 166 hectares of land (**Section 7.10**) in the form of Mountain Block Offset Area to allow for the conservation of comparable areas of existing vegetation and the protection of threatened woodland birds, known spotted-tailed quoll habitat (including a known den site), TECs and habitat for micro-bats;

- ongoing management and monitoring of the Mountain Block Offset Area (**Section 7.8.5**) to increase existing biodiversity values, including actions such as weed and feral animal management, fencing, and natural regeneration; and

- the development of an appropriate ecological monitoring program (**Section 7.8.5**) to assess the success of the Biodiversity Offset Strategy in counterbalancing the impacts of the Project on ecological values.

The biodiversity offset strategy proposes the conservation of a 166 hectare property known as Mountain Block. This Offset Area provides areas of Central Hunter Grey Box – Ironbark Woodland in the Sydney Basin Bioregion (EEC under the TSC Act) and Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions (EEC under TSC Act), one endangered flora population, three known threatened fauna species and numerous potentially occurring threatened and migratory species.

The Mountain Block Offset Area is strategically positioned within the landscape, occurring to the immediate north of the LCO, joined by the existing riparian corridor along Bowmans Creek. To the west of the Mountain Block Offset Area lies the Hillcrest Offset Area (for the Ravensworth Operations) and near to a number of other offset areas associated with the Mount Owen Complex. Glencore Coal proposes to build upon this strategic location by seeking to provide offset areas for future projects adjacent to or in the vicinity of these existing offset areas to consolidate and secure existing habitat and to improve connectivity throughout these areas with future management works.

In addition to the provision of the Mountain Block Offset Area, the Biodiversity Offset Strategy also provides for a detailed rehabilitation strategy (**Section 6.2**) which includes the regeneration and habitat enhancement of the riparian corridor along Bowmans Creek (covering both previously-mined and non-mined lands) within the LCO, with the specific purpose of enhancing existing habitat and providing additional habitat for the spotted-tailed quoll (*Dasyurus maculatus maculatus*). The vegetation of this corridor will focus on restoring the Central Hunter Grey Box – Ironbark Woodland EEC to this area, as well as a riparian strip consistent with the Hunter Valley River Oak Forest vegetation community.

The biodiversity offset strategy includes long-term protection of the offset sites. The mechanism to achieve long-term protection will be determined in consultation with Department of Planning and Infrastructure and the Office of Environment and Heritage.

The biodiversity offset strategy provides an adequate and appropriate offset to counterbalance the impacts of the Project on regional, state and Commonwealth significant vegetation communities, fauna habitats and threatened and migratory species.

Summary and Conclusion

Pre-mitigation, and prior to the implementation of the biodiversity offset strategy, the Project will result in residual impacts on one TEC, one endangered population and threatened fauna species, including a potential significant impact to five threatened fauna species. In order to reduce the residual impacts, where possible the Project was modified to reduce impacts on ecological communities and threatened species. An impact mitigation strategy and biodiversity offset strategy are proposed to compensate for the residual impacts of the Project. The conservation and management of the proposed offset sites will ensure that the biodiversity values in the surrounding region and the continued viability of threatened species and communities that could be significantly affected by the Project, over the medium to long term, are maintained. Together, the rehabilitation of the Proposed Modification Area, the Mountain Block Offset Area, the rehabilitation of the Bowmans Creek riparian corridor and the proposed mitigation measures ensure that the residual ecological impacts of the Project are adequately mitigated, offset and counterbalanced.

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8 Mountain Block Flora Species List

9 Mountain Block Fauna Species List

1.0 Introduction

Liddell Coal Operations (LCO) is an established mining operation located approximately 25 kilometres north-west of Singleton in the Hunter Valley of New South Wales (refer to **Figure 1.1**). The LCO holdings site is divided by the boundary between the Singleton and Muswellbrook local government areas (LGAs).

LCO is operated and managed by Liddell Coal Operations Pty Limited, a wholly owned subsidiary of Glencore Coal Pty Limited (Glencore Coal), on behalf of a joint venture between Glencore Coal (67.5 per cent) and Mitsui Matsushima Australia (32.5 per cent).

LCO has been in continuous operation since the 1950s. Operations prior to the 1950s were intermittent, with underground operations commencing in 1923 and open cut operations in 1946. During this history, LCO has been subject to a number of development consents within its currently approved DA Boundary and has been owned and operated as both an underground and open cut mining operation. Previous underground mining using partial extraction techniques has resulted in considerable coal reserves being available to the current open cut pits.

In 2001, LCO lodged a development application with Planning NSW (now the Department of Planning and Infrastructure) to continue operations within the LCO holdings. The Minister for Planning granted development consent DA 305-11-01 on 20 November 2002.

1.1 Proposed Project

LCO currently operates under DA 305-11-01, which allows for mining operations to occur within the currently approved mining footprint (see **Figure 1.2**) until the end of 2023. Current open cut mining activities will reach this approved boundary in 2014. Coal reserves have been identified outside of this approved boundary, within the development consent and mining lease boundary, and LCO is therefore seeking to modify DA 305-11-01 to extend currently approved mining activities to include these additional resources to allow continuation of mining until approximately 2028.

The modification is sought under section 75W of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), and will be subject to assessment by the Director-General of the NSW Department of Planning and Infrastructure (DP&I) and determination by the Minister for Planning and Infrastructure in accordance with Part 3A of the EP&A Act.

1.1.1 Currently Approved Operations

LCO is a truck and excavator mining operation, supported by ancillary equipment. The approved mining area at LCO comprises a number of open cut pits including Mountain Block, Antiene East Block, Railway Block, Reservoir Block, Barrier Pit, Central Pit, Entrance Pit, and South Pit. The currently approved mining footprint is approximately 1374 hectares in size.

LCO has approval to mine up to 8 Mtpa of ROM coal, which is processed through the LCO Coal Handling and Preparation Plant (CHPP) and transported to the Port of Newcastle via the Hunter Valley Rail Loop and the Main Northern Railway Line. Of this 8 Mtpa, up to 1.5 Mtpa of ROM coal may be transported to the Cumnock CHPP for processing. Mining operations are undertaken 24 hours per day, seven days per week.

Tailings are disposed of at a number of approved tailings emplacement areas at LCO. Up to 0.5 Mtpa of coal tailings may be transported by truck along the New England Highway to Liddell and Bayswater Power Stations.

FIGURE 1.1

Locality Map

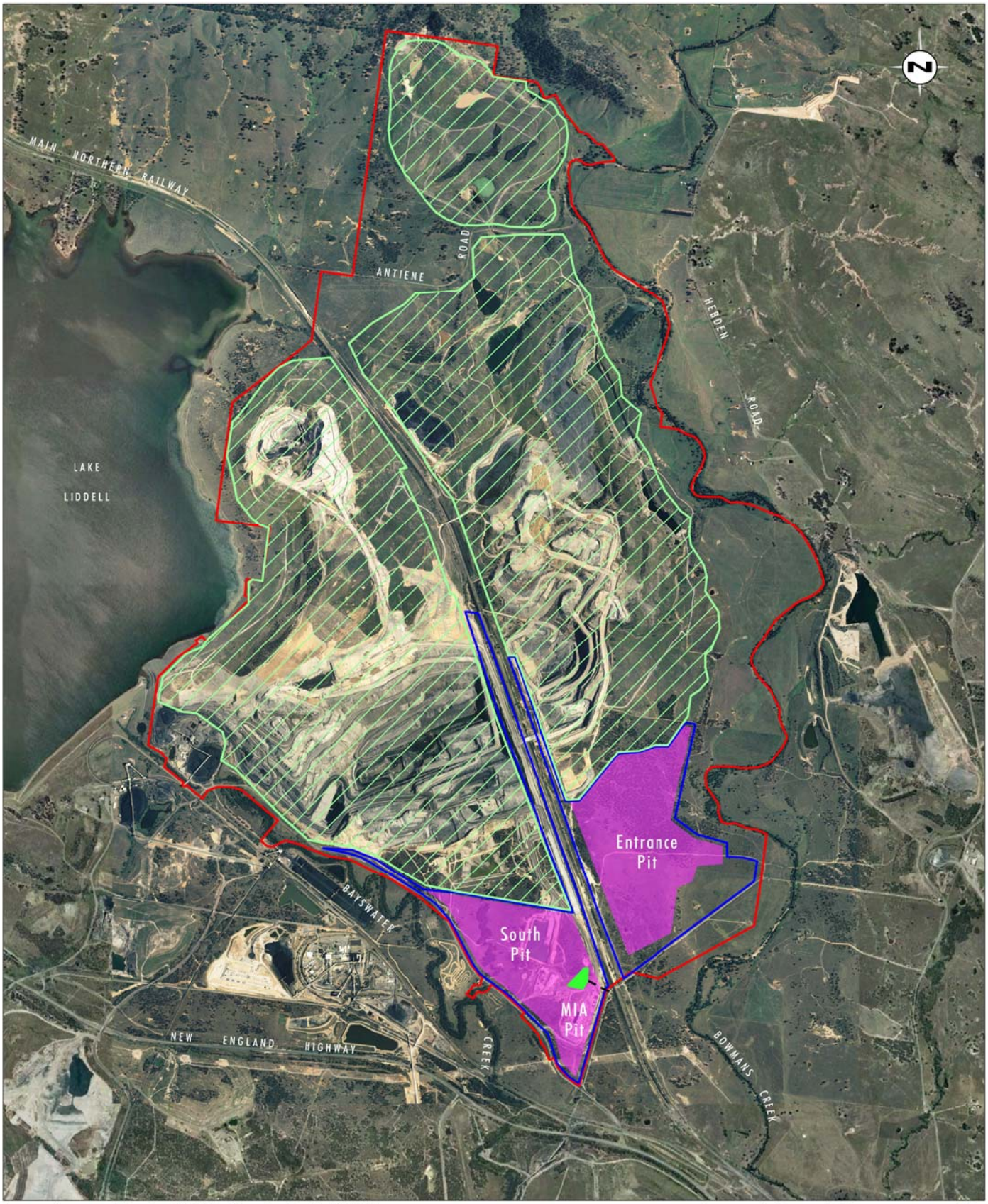

Image Source: Xstrata (2013), Google Earth (2008)
Data Source: Xstrata (2012)

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Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Mining Footprint
- Proposed Modification Area
- Proposed limit of open cut mining
- Proposed Conveyor
- Proposed Stockpile location including hopper/crusher

FIGURE 1.2

Existing and Proposed Operations at Liddell Coal Operations

The existing infrastructure at LCO includes:

- CHPP;
- conveyors;
- site offices, associated car parks, and site services;
- worker amenities;
- workshops;
- fuel and water storage;
- truck loading bin;
- weighbridge;
- water management system, including dams and pipelines and boreholes;
- rail loading facilities;
- 11 kV and 33 kV powerlines; and
- one level railway crossing, one railway bridge and two railway underpasses.

1.1.2 Proposed Operations

The Liddell Coal Operations Extension Project (the Project) will provide for continued open cut mining within the existing development consent and mining lease boundaries primarily through the extension of the existing South Pit and Entrance Pit, and maximising use of existing infrastructure. The key components of this Project (refer to **Figure 1.2**) are as follows:

- **Extension of the open cut mining footprint** – extension of the existing South and Entrance Pits to the south-east, and, upon completion of mining in these pits, the mining of coal resources under the Mine Infrastructure Area (MIA) during which the MIA will be relocated to a temporary facility. The extension will enable the recovery of approximately an additional 38 Mt of coal, and result in an additional surface disturbance of approximately 255 hectares (herein referred to as the Proposed Modification Area).

- **Extension to the Life of Mine** – the extension of open cut mining activities will lead to an associated extension of the life of mine at LCO from 2023 to 2028.

- **Additional Tailings Emplacement Areas** – A tailings emplacement area will be constructed within the final void of the South Pit to dispose of the additional tailings associated with the extension of open cut mining activities.

- **Minor additional infrastructure:**

  - construction and commissioning of a transfer point and conveyor connected to the existing Mount Owen/Glendell/Macquarie Generation conveyor is proposed (refer **Figure 1.2**), enabling LCO to send coal to Ravensworth, and receive coal and crushed gravel from Mt Owen, via the existing conveyor system. The new conveyor will deliver/take material to/from a new 50,000 tonne stockpile; and
  - infrastructure and auxiliary surface disturbance to support the new mining areas will be required, including but not limited to, powerlines, water management infrastructure and haul roads.

No changes to mining method, production rates or operating hours are proposed as part of the Project. The activities that are subject to Project are those that will result in additional surface disturbance as a result of the extension of open cut mining activities.

Table 1.1 summarises and compares the major components of the approved operations at LCO, and the proposed development consent modification.

Table 1.1 – Major Components of Approved Operations and Proposed Modification

Aspect	Existing Approved Operation	Proposed Modification (Mod 5)
Disturbance Area	The Disturbance Area (defined as the DA boundary), covers an area of 2108 hectares.	No change proposed.
Open Cut Mining Area	Current approved mining footprint of 1374 hectares.	Expansion of the mining footprint by 171 hectares, equating to a 12% increase in the open cut mining area.
Production and Resource recovery	Extraction of up to 8 Mt of ROM coal per year. The original EIS (Umwelt 2001) estimated cumulative ROM production over a 21 year mine life of 90.8 Mt. Extraction of up to 0.5 Mtpa of coal tailings with residual energy content for transport to Liddell and Bayswater power stations.	No change in annual production rates. Estimated increase in the total resource recovered by 38 Mt. No change is proposed to the recovery of tailings.
Mine Life	Mining operations approved to take place until 31 December 2023. However, current open cut mining will reach the approved mining footprint will be exhausted in 2014.	Extension of life of mining operations from 31 December 2023 to 31 December 2028.
Vegetation Removal	Progressive campaign approach, with the extent of clearing undertaken in each campaign just sufficient for the subsequent period of mine development.	No change proposed.
Soil Stripping and Stockpiling	Progressive campaign approach, with the extent of stripping undertaken in each campaign just sufficient for the subsequent year of mine development.	Methodology will generally remain the same with different varying depths of topsoil and subsoil suitable for stripping and different designated stockpile areas.
Overburden and Interburden Management	Overburden is blasted and loaded into trucks for transfer and placement in one of the out-of-pit emplacement areas or in-pit within completed sections.	No changes proposed to the method of overburden and interburden management. Minor variation to the mining footprint to achieve the additional coal reserves.

Table 1.1 – Major Components of Approved Operations and Proposed Modification (cont.)

Aspect	Existing Approved Operation	Proposed Modification (Mod 5)
Mining Method	Open cut mining methods (truck and excavator); with limited highwall mining (auger or continuous miner) where open cut mining is not feasible.	No change proposed.
Coal Seams	Current mining targets Lemington, Pikes Gully, Arties, Liddell, Barrett and Hebden seams.	Mining will continue to target these seams. Additionally, mining of the Bayswater seam (above Lemington) has also been identified as being economically viable in exploration programs and will be extracted.
Open Cut Area	Approved mining area at Liddell includes a number of open cut pits – Mountain Block, Antiene East Block, Railway Block, Reservoir Block, Entrance Pit, Barrier Pit, Ten North, Central Pit and South Pit.	Extension of the Entrance Pit and South Pit, and development of the MIA Pit, all within the DA boundary.
Coal Processing	Processing of up to 8 Mtpa at the LCO CHPP, including up to 1.5 Mtpa of ROM coal from Cumnock No. 1 Colliery Up to 1.5 Mtpa of ROM coal may also be sent to Cumnock No.1 Colliery for processing as required.	Coal to continue to be processed at LCO, with no change proposed to the approved annual amount of coal processed at the CHPP. Coal will no longer be processed from Cumnock No. 1 Colliery as this mine is no longer in operation. Up to 2 Mtpa of ROM coal may be processed at LCO CHPP from Mt Owen. The Cumnock CHPP is also no longer in operation, and therefore up to 1.5 Mtpa to be processed at RCCP facility instead of Cumnock CHPP when required, and despatched via the RCT.

Table 1.1 – Major Components of Approved Operations and Proposed Modification (cont.)

Aspect	Existing Approved Operation	Proposed Modification (Mod 5)
Coal Transportation	All product coal from the LCO CHPP (in the order of 6 Mtpa) is to be transported by rail. 127 loading days permitted onto the Hunter Valley Rail Loop, up to a maximum of 220 loading days following completion of a study on the adequacy of the capacity, access to and safety of rail infrastructure to the satisfaction of the Director General. Transport of ROM coal to and from Cumnock No.1 Colliery is permitted by truck via internal haul roads, Pikes Gully Road and Liddell Station Road. No more than 1.5 Mtpa of ROM coal to be transported to Cumnock for processing. Transport of up to 0.5 Mtpa of coal tailings by truck along the New England Highway to Liddell and Bayswater Power Stations is restricted to 114 truck movements per day, five days per week.	All product coal from LCO CHPP to continue to be transported by rail, with the ability to load trains on any day of the year as scheduled by the Hunter Valley Coal Chain. Coal will no longer be transported to/from Cumnock for processing. Up to 1.5 Mtpa of ROM coal will instead be transported by truck to the RCCP facility, as per the approved route to the Cumnock CHPP via internal haul roads, Pikes Gully Road and further along Liddell Station Road. In addition, LCO proposes a new connection to the existing overland conveyor to provide the option of transporting the above ROM coal to RCCP facility. Construction and commissioning of a conveyor and transfer point from the existing Mt Owen /Glendell/Macquarie Generation conveyor, enabling LCO to send or receive coal to and from the existing conveyor system. This conveyor may also be used for the transport of crushed gravel from Mt Owen.
Tailings and rejects	Approval to dispose of tailings in the Antiene tailings dam, Reservoir Pit 1 (Reservoir West), Reservoir Pit 2 (Reservoir South), Reservoir Pit 3 (Reservoir North) and the Railway fines tailings facility. Up to 0.5 Mtpa of tailings material can be transported via road to Bayswater and Liddell power stations.	A tailings emplacement area will be constructed within the final void of the South Pit to dispose of the additional tailings associated with the extension of open cut mining activities.
Coal Storage	Coal is stockpiled in a ROM coal stockpile with an approximate capacity of 100,000 tonnes. Coal is also stockpiled in a supplementary stockpile with a capacity of up to 450,000 tonnes.	Increase in the storage capacity of the ROM coal stockpile to 200,000 tonnes, equating to a total ROM coal storage capacity of 650,000 tonnes. A new 50,000 tonne ROM coal stockpile is proposed near the MIA, from which the new conveyor will take/deliver ROM coal.

Table 1.1 – Major Components of Approved Operations and Proposed Modification (cont.)

Aspect	Existing Approved Operation	Proposed Modification (Mod 5)
General Infrastructure	Primary infrastructure includes, but is not limited to the following: • site offices and site services; • workers amenities; • workshop; • fuel farm; • CHPP; • truck loading bin; • weighbridge; • car parks; • surface water management system; and • RO plant.	No additional buildings are proposed other than the relocation of the MIA to a temporary facility to allow mining underneath the existing MIA. The surface water management system will be updated to effectively cater for the expanded operations, and will continue to use voids for water storage. Mobile Crushing Unit to be utilised for crushing road base material. New dewatering bores will be required. These are expected to be in the Hazeldene workings, Entrance Pit and South Pit. Construction of an explosive reload facility. Other associated infrastructure will be required to support the new mining areas, including powerlines, pipelines, water truck fill points conveyor, coal storage stockpiles and access roads.
Closure and Rehabilitation	Approved Conceptual Mine Closure Plan based on the rehabilitation criteria established in the approved Mining Operations Plan. The plan is reviewed and updated on a three-yearly basis, with a detailed closure plan required five years prior to closure.	Change to the final landform to incorporate additional open cut mining areas and waste quantities.
Operating hours	Mining operations are undertaken 24 hours per day, 7 days per week.	No change proposed.
Employment	The 2006 modification (Umwelt 2006) stated that the total number of permanent employees would be up to 240, plus a temporary construction workforce of 150.	Regularise the current 360 full time personnel and 100 contractors at LCO.
Environmental Management	A comprehensive set of environmental management plans are in place. These plans are backed by an environmental monitoring network including meteorological, air quality, water quality, noise and subsidence monitoring.	The current environmental management plans and monitoring programs will be reviewed and updated as required to incorporate the modification.

Note: All values have been rounded up to the nearest whole number. All values subject to minor mapping/GIS-based variation.

The Project will not involve any changes to ROM coal production rates or the CHPP. Coal will continue to be processed at the LCO CHPP at the approved rate of up to 8 Mtpa. As noted in **Table 1.1** however, coal will however no longer be received from, or sent to, the Cumnock CHPP for processing as currently approved under DA 305-11-01, as this CHPP has been demolished following the cessation of mining operations at Cumnock No. 1 Colliery.

LCO seeks to maintain a contingency for coal processing by delivery of up to 1.5 Mtpa of ROM coal to the Ravensworth Central Coal Processing (RCCP) facility for washing via a new connection to the existing overland conveyor or by road transport route to the RCCP facility. In addition, up to 2 Mtpa may be received from Mt Owen for processing via the same existing overland conveyor. These proposed changes will not result in any additional surface disturbance, and are therefore not included within the Ecological Assessment for this Project.

There are no further changes proposed to the existing approved LCO operations under DA 305-11-01. No changes to the mining method, production rates or operating hours are proposed under the Project.

1.2 Context of Other Contemporary Ecological Studies at LCO

Eco Logical Australia (ELA) was commissioned by LCO to survey and describe the fauna species and habitat values for the Proposed Modification Area for the Project, and this was documented in the *Liddell Coal Operations Extension Project Fauna Survey Report, dated 15 February 2013* (ELA 2013a). This report has been included within **Appendix 1**, and is extensively referred to within this Ecological Assessment in relation to fauna surveys completed for the Project, fauna species (including threatened species) identified and descriptions of fauna habitat types within the Proposed Modification Area.

In addition to this fauna-related data and reporting, ELA completed a considerable amount of flora survey within the Proposed Modification Area as part of the early phases of the current Project. While Umwelt was later engaged by LCO to finalise the flora survey, vegetation mapping, overall impact assessment and biodiversity offsetting components of the Project, this flora survey and resulting data from ELA is highly relevant, and has been used within this Ecological Assessment, where relevant.

ELA was also commissioned by LCO to provide an assessment of the types of groundwater-dependent ecosystems and aquatic communities and habitats that relate to the aquatic environments of the Proposed Modification Area and immediate local area, primarily Bowmans Creek and Bayswater Creek. The resulting report *Liddell Coal Mine Extension – Aquatic Ecology and Groundwater Dependent Ecosystem Assessment* (ELA 2013b) is included as an Appendix to the Environmental Assessment for this Project, and is referred to within this Ecological Assessment.

1.3 Purpose of this Document

This Ecological Assessment has been prepared by Umwelt to build upon the survey work completed in the early phases of the Project by ELA, and to report on the potential impacts of the Project on threatened and migratory species, endangered populations, threatened ecological communities (TECs) and their habitats. Terrestrial vegetation communities, flora and fauna species, aquatic flora and fauna species and habitat types present in the Proposed Modification Area have been identified and considered as part of the impact assessment.

The objectives of this Ecological Assessment are to:

- make use of, and build upon (where necessary) the existing field survey and results gained from ELA (2012 and 2013a and b) in order to document the flora and fauna species (terrestrial and aquatic) occurring within the Proposed Modification Area;
- in addition to the above, include results from literature reviews, previous surveys from LCO and searches from ecological databases to document the ecological features of the Proposed Modification Area and broader LCO holdings;
- document threatened and migratory flora and fauna species, endangered populations, TECs, or their habitats, recorded within the Proposed Modification Area, particularly those listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994* (FM Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- assess the potential impact of the Project on threatened and migratory flora and fauna species, endangered populations, TECs, or their habitats, recorded (or with potential to occur) in the Proposed Modification Area or nearby areas;
- develop appropriate impact mitigation and management options to minimise ecological impacts associated with the Project; and
- prepare a comprehensive Biodiversity Offset Strategy (BOS) to compensate for the residual impacts of the Project that cannot otherwise be satisfactorily avoided, minimised or mitigated.

This Ecological Assessment has been prepared to accompany the broader Environmental Impact Assessment prepared for the Project by GSS Environmental.

1.4 Relevant Legislation and Guidelines

This Ecological Assessment has been prepared to satisfy the Director-General's requirements for the Project, as defined in **Table 1.2** below.

Table 1.2 – Director-General's Requirements – Biodiversity

Issue	Requirement	Section Where Requirement is Addressed
Biodiversity	• Accurate estimates of any vegetation clearing or other impacts.	**Table 4.3** **Section 5.0**
	• An assessment of the potential impacts of the project on any terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities, riparian vegetation or groundwater dependent ecosystems.	**Section 5.0**
	• A description of the measures that would be implemented to maintain or improve biodiversity values of the surrounding region in the medium to long term.	**Section 6.0** **Section 7.0**

In addition, the ecological survey and assessment completed as part of this Project considered the following guidelines, licences and legislation:

- Animal Research Authority as provided by the NSW Department of Primary Industries;
- NSW *Environmental Planning and Assessment Act 1979* (EP&A Act);
- NSW *Fisheries Management Act 1994* (FM Act);
- NSW *Threatened Species Conservation Act 1995* (TSC Act);
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Department of Primary Industries – NSW Fisheries (1999) Policy & Guidelines - Aquatic Habitat Management and Fish Conservation;
- State Environmental Planning Policy (SEPP) 44 (Koala Habitat Protection) (2000);
- Department of Land and Water Conservation (DLWC) (2002) NSW State Groundwater Dependent Ecosystem Policy;
- Department of Environment Conservation (DEC) (2004) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Working Draft, November 2004;
- Department of Planning (DoP) (2005) Guidelines for Threatened Species Assessment;
- Department of Environment and Climate Change (DECC) and Department of Primary Industries (DPI) (2005) Draft Guidelines for Threatened Species Assessment (Part 3A), July 2005;
- Department of Environment and Climate Change (DECC) (2007a) Threatened Species Assessment Guidelines: the Assessment of Significance;
- Department of Primary Industries (DPI) (2008) Threatened Species Assessment Guidelines – The Assessment of Significance. February 2008;
- OEH guidelines Principles for the Use of Biodiversity Offsets in NSW (DECC 2008a);
- DECC (2008). Hygiene Protocol for the Control of Disease in Frogs;
- Department of Environment, Climate Change and Water (DECCW) (2009) Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians;
- Department of Environment, Water, Heritage and the Arts (DEWHA) (2009) Commonwealth EPBC Act Policy Statement.1.1 – Significant Impact Guidelines – Matters of National Environmental Significance;
- NSW OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) (OEH 2011a);
- EPBC Act Environmental Offsets Policy (DSWEPC 2012); and
- Upper Hunter Strategic Assessment – Interim Policy (DP&I 2012).

1.5 Assessment Approach

This Ecological Assessment has been prepared to assess the potential impact of the Project on native flora and fauna species, threatened and migratory species, endangered populations, TECs and their habitats occurring in the Proposed Modification Area and on adjoining lands.

The process of undertaking an ecological assessment requires particular steps to identify the ecological features that require specific assessment, and to determine the level at which they are likely to be impacted. This is initially undertaken without consideration of mitigation or offsetting measures, however preliminary impact assessments inform project design and, in this case, has led to the development of project avoidance measures undertaken specifically to reduce impact on ecological matters (see **Section 5.1**).

Through the use of impact assessments under the EP&A Act and the EPBC Act, a decision is made as to whether or not species, populations or communities will be significantly impacted by the Project. For those species and communities that were determined to be significantly impacted, or potentially significantly impacted, detailed mitigation and offsetting measures were developed. The remainder of this report addresses each of these steps in detail.

During all steps taken as part of this Ecological Assessment, the precautionary principle was applied to ensure that wherever there was uncertainty resulting from lack of data or knowledge, or uncertainty in the level or extent of impact, the worst reasonable case was assumed. The application of the precautionary principle in the project assessment is detailed in **Section 5.7**.

2.0 Regional Setting

2.1 Bioregional Setting

The Proposed Modification Area is located almost on the northern border of the Sydney Basin Bioregion (OEH 2011b), where it joins the boundary of the NSW North Coast Bioregion (**Figure 2.1**). Bioregions are 'relatively large areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems' (NPWS 2003).

The Sydney Basin Bioregion lies on the central east coast of NSW, covers an area of 3,624,008 hectares (OEH 2011b) and is characterised by a temperate climate. The Proposed Modification Area is within the Hunter subregion which is characterised by rolling hills, wide valleys, with the meandering Hunter River system on a wide floodplain. A diverse range of flora and fauna assemblages are likely to occur in the local area, with a mixture of coastal and inland influences. Due to the proximity to the NSW North Coast Bioregion, the Proposed Modification Area also displays environmental characteristics of this bioregion.

2.2 Physiography, Geology and Soils

The Proposed Modification Area is situated centrally on the main floor of the Hunter Valley, within the 22,000 km^2 Hunter catchment which is drained by the Hunter and Goulburn Rivers and their tributaries. The Proposed Modification Area is situated approximately 100 kilometres from the coast and 140 kilometres from the western extremity of the Hunter catchment at the Great Dividing Range.

The Proposed Modification Area is situated in the central portion of the Hunter Valley, characterised by relatively gentle undulating hills, broad river valleys and floodplains. To the south are the dissected sandstone plateaux of Wollemi and Yengo National Parks, while to the north the foothills of the Barrington Tops and Mount Royal Range adjoin the Hunter Valley floor, which is bounded by the Hunter Thrust System (Peake 2006). To the east and west of the Proposed Modification Area extend the highly eroded Permian lowlands of the floor of the Hunter Valley.

2.2.1 Geology

The central Hunter Valley lies at the intersection (defined by the presence of the Hunter Overthrust (McClung 1980)) of the north-eastern margin of the Sydney Basin and the south-eastern margin of the New England Fold Belt. The Hunter Overthrust is a succession of faults where the layers of Carboniferous rock have been thrust south-west and in some areas moved over areas of Permian rock (Branagan & Packham 2000). The Sydney Basin extends from the South Coast of NSW well into the central Queensland Coast (Hawley & Brunton 1995), and it mostly consists of a thick Permian-Triassic rock succession formed during early Permian rifting, and contains large reserves of coal.

The central Hunter Valley is primarily underlain by four major geological strata: Carboniferous; Permian; Triassic and Quaternary. To a lesser extent it is also underlain by Jurassic and Tertiary strata. Carboniferous rocks mostly underlie the areas in the north-east of the region and are a combination of erosion resistant marine, volcanic, conglomerate, and limestone sediments; these typically form steep-sided hills and valleys. Permian rocks make up the majority of the region and mostly consist of the moderately erosion resistant Singleton Coal Measures, conglomerate, sandstone, shale, tuff, and some lava beds which typically form low, undulating hills. The Triassic rock is mostly located in areas in the north-west, west,

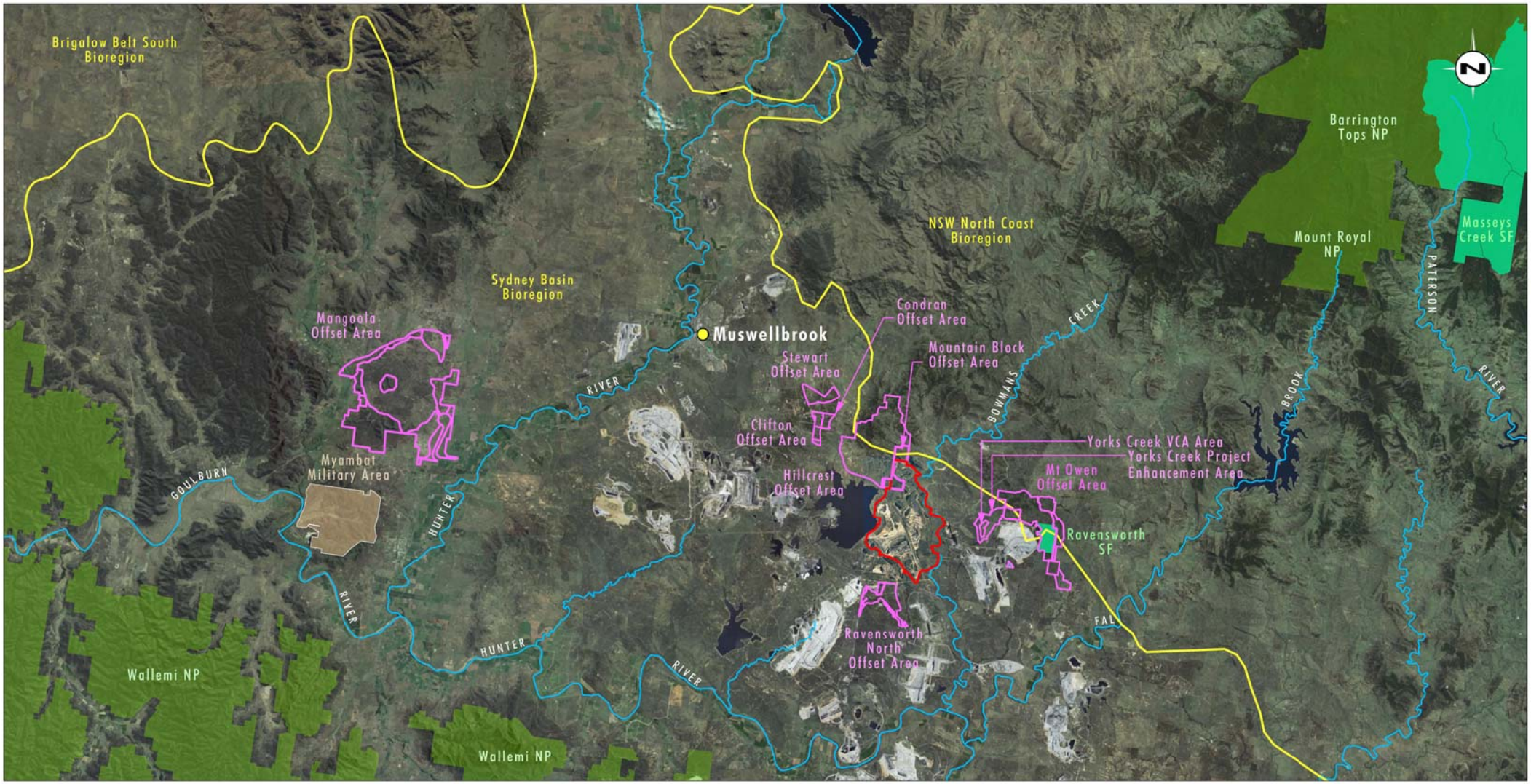

Image Source: Xstrata (2013), Google Earth (2009)
Data Source: Department of Lands (2003) and LPI (2012)

0 5.0 10.0 15.0km
1:350 000

Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Glencore Offset Areas
- Bioregions
- National Park/Nature Reserve (NP/NR)
- State Forest (SF)
- Crown Reserve

FIGURE 2.1

Regional Setting

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and south of the central Hunter Valley and consists of highly erosion resistant sandstone which tends to form infertile, rugged country. Quaternary sediments are mostly identified along and in proximity to the major rivers and creeks of the central Hunter Valley. The Jurassic rocks are typically in the form of Saxonvale volcanics and are mostly found around Bayswater, Fordwich and Lemington; and the Tertiary stratum are typically only found in the form of small basalt caps in several very small areas.

Within the Sydney Basin, LCO is located in the Hunter Coalfield. The coal-bearing sedimentary rocks within LCO include the Foybrook Formation, with the Vane Subgroup of the Whittingham Coal Measures, which form the lower part of the Singleton Supergroup.

The Foybrook formation is formed of compact and lithified sediments that accumulated within a delta plain fluvial environment. The formation contains sandstone, mudstone and shale, conglomerate, coal and tuff respectively.

The sedimentary sequence at LCO is gently folded, with the Camberwell Anticline and Bayswater Syncline extending through the LCO holding in a generally northwest to southeast direction. On the western flank of the anticline, the strata dip gently to the southwest into the Bayswater Syncline. On the eastern flank of the anticline, the strata dip more steeply to the northeast towards the Rixs Creek Syncline.

The north-eastern boundary of the holding is sub-parallel to the Hebden Thrust, a major regional low angle reverse fault. A reverse fault is one in which older rocks are pushed over younger rocks. The Hebden Thrust was responsible for placing the older Greta Coal Measures above the Whittingham Coal Measures at the northern end of the LCO holding.

2.2.2 Soil Landscapes

The central Hunter Valley is covered by the Singleton 1:250,000 sheet (Kovac & Lawrie 1991). This map sheet defines a total of 44 different soil landscapes for the central Hunter Valley. Each soil landscape consists of an area of land that can be uniquely identified by its specific topography and soil, and can be described concisely. The areas of land covered by each soil landscape vary in size from less than 5 km² to over 450 km².

Soil landscapes present in the Proposed Modification Area include the Liddell (ld) and Hunter (hu) soil landscapes. The Liddell soil landscape dominates the Proposed Modification Area, with a smaller area of the Hunter soil landscape occurring in the east. A small extent of the Rosevale soil landscape occurs across the north of the LCO landholdings, however not within the Proposed Modification Area.

2.3 Catchment Characteristics

LCO is located within three catchments: Lake Liddell to the west, Bayswater Creek to the south and Bowmans Creek (formerly Foy Brook) to the east (**Figure 2.1**). Lake Liddell is an artificial lake located on Bayswater Creek, which takes runoff from approximately the upper three quarters of the catchment. The Bayswater Creek catchment (below Lake Liddell) is approximately 3750 hectares and is insufficient in area to maintain continuous flow in the creek. The creek is a highly modified system, designed in its upper reaches to take flow from Lake Liddell, with its lower reaches realigned to permit mining at Ravensworth South and Narama mines.

Bowmans Creek, a relatively unmodified stream, forms the eastern boundary of LCO and has a catchment area of approximately 24,600 hectares which is sufficient to maintain flow in the creek under most climatic conditions. The river baseflow system of Bowmans Creek is considered to conform with the definition of a groundwater-dependent ecosystem (Eco Logical Australia 2012), with groundwater contributing to the flow of the creek. This creek is considered to be in moderate condition (Eco Logical Australia 2012).

These three catchments ultimately drain into the Hunter River, which itself originates in the Mount Royal Range and Barrington Tops Plateau, flowing for some 250 kilometres to the sea at Newcastle. River regulation has lead to the disruption of natural flow regimes and stream geomorphological impacts. In addition, land clearing over the past 200 years has lead to the degradation of riparian corridors, broad scale hydrological changes, biodiversity losses, stream bank erosion and sedimentation.

Groundwater occurs at LCO in two different aquifer types, being the alluvial sediments associated with Bowmans Creek, and the deeper coal seam aquifers. The alluvium associated with Bowmans Creek is approximately 500 to 700 metres wide and 12 metres thick. Sediments are comprised of highly porous sand, loam and course gravels with estimated permeability of 0.5 to 50 metres/day (Mackie Environmental Research 2001). Aquifer recharge is considered to occur primarily as a result of rainfall (Mackie Environmental Research 2001).

2.4 History of Land Use in the Proposed Modification Area

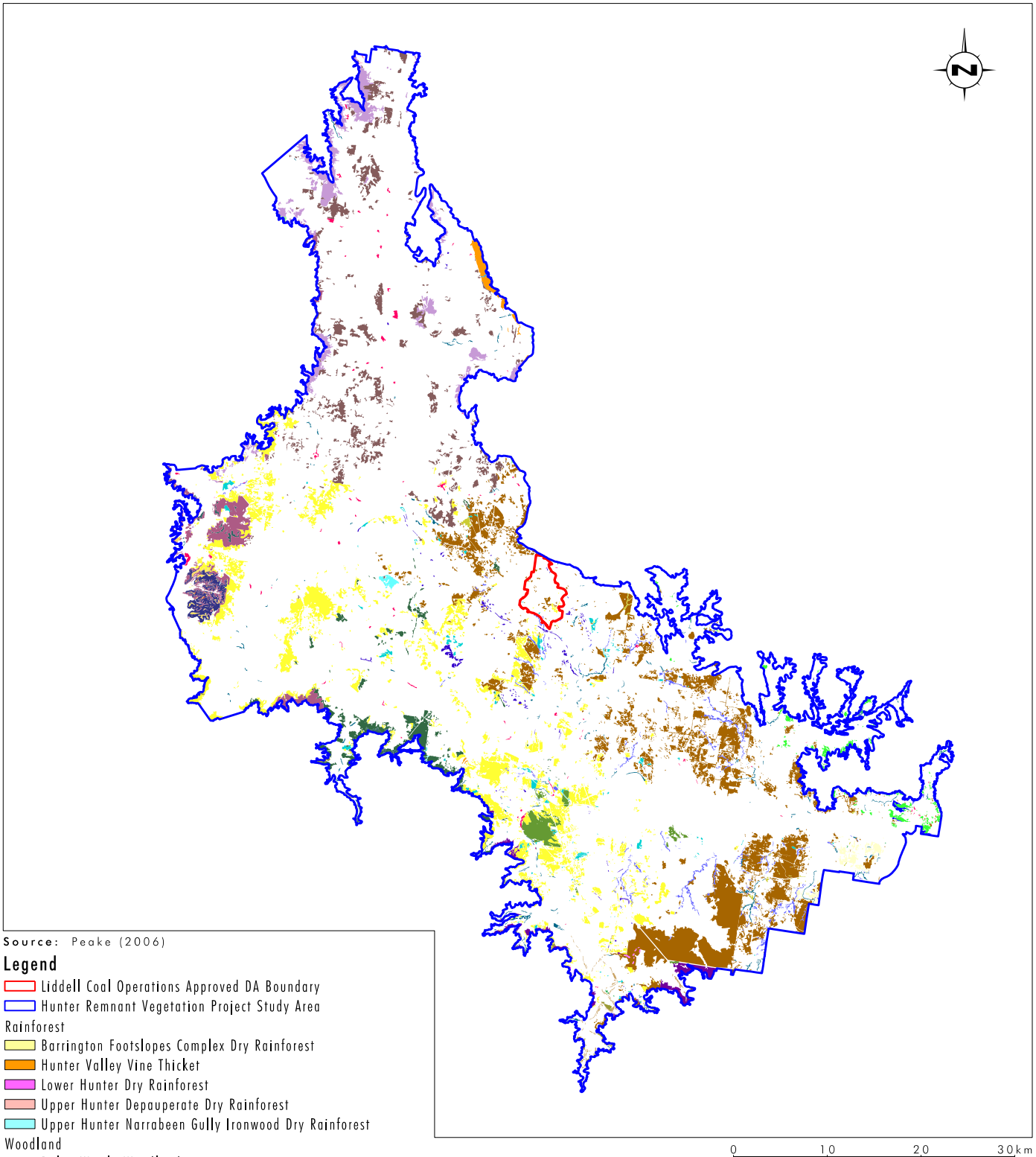
As previously outlined, LCO has had a long history of mining operations, with the LCO holdings being under continuous mining operation since the 1950's. Prior to this, the land was primarily subject to agriculture (predominantly grazing) and its associated clearing has resulted in a heavily modified and fragmented landscape.

Mining has been conducted in the area since the early part of the century. Records indicate underground mining commenced in 1923 at Oaks Colliery with early workings exploiting shallow coal on the eastern limb of the Bayswater syncline near Lake Liddell.

None of the vegetation communities recorded in the Proposed Modification Area can be currently considered 'old growth' vegetation. Old growth refers to any vegetation that was present at the time of European arrival in Australia that still remains in essentially similar condition. The extant vegetation in the Proposed Modification Area is predominately 'regrowth' vegetation, that is, it has been previously cleared of forest and woodland vegetation and its present extent is based entirely on natural regeneration. Regrowth is, ecologically, any native vegetation that has been cleared and has regrown since that time.

2.5 Vegetation Types and Plant Species of the Region

The vegetation communities mapped in the Proposed Modification Area are consistent with the vegetation community descriptions described by Peake (2006) who mapped Hunter Valley floor vegetation on behalf of the Hunter-Central Rivers Catchment Management Authority (HCRCMA) (**Figure 2.2**). The vegetation community classification and mapping is referred to as the Hunter Remnant Vegetation Project (HRVP). That study area covered approximately 315,000 hectares stretching from Scone in the north to Denman in the south-west and Branxton in the south-east. LCO is included in the HRVP study area. This work included the botanical survey of 327 sites and mapping of approximately 60,000 hectares of forest or woodland remnants. Peake (2006) found that the native forests and woodlands of the central Hunter Valley have probably been reduced by approximately 76 per cent (238,000 hectares) since European settlement.



Source: Peake (2006)

Legend

- Liddell Coal Operations Approved DA Boundary
- Hunter Remnant Vegetation Project Study Area

Rainforest
- Barrington Footslopes Complex Dry Rainforest
- Hunter Valley Vine Thicket
- Lower Hunter Dry Rainforest
- Upper Hunter Depauperate Dry Rainforest
- Upper Hunter Narrabeen Gully Ironwood Dry Rainforest

Woodland
- Bulga Wattle Woodland
- Central Hunter Box - Ironbark Woodland
- Central Hunter Paperbark Soaks Woodland
- Hunter Floodplain Red Gum Woodland Complex
- Hunter Valley Weeping Myall Woodland
- Hunter Valley White Box - Spinifex Exposed Woodland
- Narrabeen Footslopes Slaty Box Woodland
- Southern Hunter Escarpment Spotted Gum Woodland
- Upper Hunter Hills Box - Ironbark - Red Gum Woodland
- Upper Hunter Hills Exposed Ironbark Woodland
- Upper Hunter Narrabeen Escarpment Acacia Woodland
- Upper Hunter White Box - Ironbark Grassy Woodland
- Warkworth Sands Woodland
- Western Hunter Narrabeen Exposed Grey Gum - Stringybark Woodland
- Western Hunter Narrabeen Footslopes Ironbark - Cypress Pine Woodland

Heath
- Myambat Narrabeen Mircomyrtus Heath

Plantation
- Planted Areas

Open Forest
- Barrington Footslopes Dry Spotted Gum Forest
- Barrington Footslopes White Mahogany Forest
- Central Hunter Bulloak Forest Regeneration
- Central Hunter Ironbark - Spotted Gum - Grey Box Forest
- Central Hunter Swamp Oak Forest
- Hunter Lowlands Red Gum Forest
- Hunter Valley River Oak Forest
- Lower Hunter Spotted Gum - Ironbark Forest
- Mt Arthur Forest Complex
- Southern Hunter Footslopes Sheltered Forest
- Upper Hunter Coastal Myall Exposed Forest
- Upper Hunter Hills Sheltered Moist Forest
- Wollombi Alluvial Red Gum - Apple Forest

0 10 20 30 km
1:600 000

FIGURE 2.2

Hunter Remnant Vegetation Mapping Project

Most remaining forest and woodland remnants on the Hunter Valley floor are small, with 87 per cent being less than 10 hectares in size, and the median remnant size being 1.6 hectares (Peake 2006). Approximately 65 per cent of all remnant vegetation on the Hunter Valley floor occurs within the relatively few remnants that are over 100 hectares in area, with the largest remnant, which is mostly within Myambat Military Area near Denman, being approximately 2250 hectares.

Since Peake (2006), additional areas of native forest and woodland have been cleared as part of mining and other approvals within the HRVP study area. The precise locations and extent of clearing since 2006 are unknown. Concurrent with this has been extensive regrowth of native vegetation across many parts of the central Hunter Valley, including in mine buffer land where grazing has been removed.

Thirty-six vegetation communities were delineated by Peake (2006) in the central Hunter Valley, comprising five rainforest communities, 16 woodlands, 13 open forest communities, one heath and one (unnatural) plantation community. Eleven are listed as TECs under the TSC Act 1995. Twenty-two of the 36 identified communities meet the criteria for listing as TECs under the TSC Act 1995 or the EPBC Act 1999 and the remaining 13 naturally-occurring vegetation communities are either restricted or limited in extent (Peake 2006). Only a small number of vegetation communities described by Peake (2006) are well-represented in the NSW conservation reserve system. Most have relatively poor representation and a few communities, that are generally restricted to the valley floor, have little or no representation in existing reserves (Peake 2006).

Peake (2006) recorded 1127 plant species in the remnant vegetation of the central Hunter Valley, 22 per cent of which were not native to the area. Twenty-five plant species were of significance (either Rare or Threatened Australian Plants (ROTAP) or listed under the TSC Act 1995 or EPBC Act 1999). Peake (2006) also recorded two previously undescribed species, 31 range extensions and seven species endemic to the Hunter Valley. Thirty-seven plant species occurring on the Hunter Valley floor are regionally rare and twelve plant populations are regionally endangered (Peake 2006). Of these populations, four are listed under the TSC Act 1995. Peake (2006) also recorded twenty noxious or nationally significant weed species, and 49 important environmental weeds.

2.6 Habitat Connectivity

Connectivity between vegetation remnants within the Proposed Modification Area and with vegetated areas outside of the Proposed Modification Area is considered to be poor. The remnant vegetation within the Proposed Modification Area is sparse and consists of one main patch of remnant woodland in the north-east of the Proposed Modification Area, surrounded by much smaller, fragmented patches of remnant and regenerating woodland. Dense Swamp Oak Forest is present along the minor drainage line within the Proposed Modification Area. At present, there is limited connectivity between vegetation remnants within the Proposed Modification Area. The main linkages are along creeklines, particularly those of Bowmans Creek to the west and of Bayswater Creek to the south; however this linkage is very narrow.

The areas surrounding LCO generally comprise fragmented valley floor woodlands and riparian forests, with native and exotic grasslands derived from previous clearing of woodland and forests.

2.7 Fauna Habitats and Species of the Region

The broad fauna habitat types of grassland, riparian, woodland/forest and aquatic habitat found within the Proposed Modification Area are representative of the broad habitat types occurring on the Hunter Valley floor. All habitats in the region have been extensively cleared or modified for agriculture, largely for cattle grazing, and mining. Communities occurring on floodplains and more fertile soils on the Hunter Valley floor have been most extensively cleared (Peake 2006). Because of the widespread clearing of habitats in the region, those remaining contain important refuges for a number of fauna species, many of which are now threatened due to habitat loss and fragmentation.

Woodland and forests of the central Hunter Valley floor support a range of fauna species. These habitats are characterised by a dry environment with little or no standing water. Habitat is provided by a moderately open canopy and a sclerophyllous understorey that ranges from very dense to sparse, while the ground cover is generally sparse and dominated by grasses and forbs.

Alluvial forests generally provide denser vegetation cover than woodland and forest habitats. The relatively larger sizes of eucalypt trees supported by the alluvial soils often also provide larger-sized hollows than those found on surrounding, drier slopes and ridges. The alluvial sites also provide ephemeral standing and moving water, with small wetlands and farm dams occurring in some areas. Aquatic habitat provided by farm dams and ephemeral creek lines and drainage lines are common across the undulating landscape surrounding the Proposed Modification Area.

Grassland habitats are dominated by a range of native and naturalised perennial grasses and forbs. The health and integrity of the vegetation largely corresponds with the grazing history, particularly grazing intensity with many grassland habitats formed as a result of the clearing of woodland well over 100 years ago. The grass and forb dominated groundcover includes log and stump cover that provides habitat for grassland mammals (small and large), birds and terrestrial reptile species. The highly scattered trees throughout the grassland provided nesting, roosting and perching habitat for bird species, roosting habitat for some micro-bat species and shade for larger grazing mammal species.

2.8 Conservation Areas

Two large national parks occur approximately 20 and 35 kilometres to the south-west and south of the Proposed Modification Area respectively (being Wollemi and Yengo National Parks) (see **Figure 2.1**). These national parks contain large areas of native vegetation and offer a wide range of good quality fauna habitats. Smaller, yet significant areas of national park also exist approximately 28 kilometres and 50 kilometres respectively to the north-east of the Proposed Modification Area (being Mt Royal and Barrington Tops National Parks). These national parks also contain significant areas of remnant vegetation and important fauna habitats. All of these conservation areas are located on the edges of the Hunter Valley, and are not generally representative of the central Hunter Valley floor.

Ravensworth State Forest and adjoining areas represents a significant link and refuge area between remnant patches of vegetation in the central Hunter Valley. Ravensworth State Forest is located approximately 8 kilometres to the east of the Proposed Modification Area (**Figure 2.1**). This forest forms an important and integral part in the preservation of the flora and fauna of the upper Hunter Valley (Umwelt 2003). Approximately 415 hectares of vegetation contiguous with Ravensworth State Forest has been set aside for in perpetuity conservation as part of the Mt Owen Biodiversity Offset Strategy (Umwelt 2003), representing a significant area of conserved habitats in the central Hunter Valley.

The Singleton Military Area, approximately 30 kilometres to the south-east, although not a formal reserve, acts as a de facto reserve effectively protecting some 6125 hectares of forest and woodland.

2.9 Upper Hunter Strategic Regional Land Use Plan and Upper Hunter Strategic Assessment

One of the key strategic policies guiding the assessment of mining development is the NSW Government's recently released Upper Hunter Strategic Regional Land Use Plan. The Upper Hunter Strategic Regional Land Use Plan (Upper Hunter SRLUP), which was approved in September 2012 and covers the Proposed Modification Area, contains the detailed direction for assessing and managing strategic land use decisions in the Upper Hunter Valley. The stated objective of the Upper Hunter SRLUP is to balance the strong economic growth in Regional NSW with the protection of valuable agricultural land and the sustainable management of natural resources. In particular, the Upper Hunter SRLUP identifies the importance of minimising the land use conflicts arising from the rapid growth of coal mining activities and the recent emergence of the coal seam gas industry.

The Upper Hunter SRLUP recognises the substantial natural heritage values of the Upper Hunter region and aims to ensure that ongoing development in the region does not compromise high value terrestrial and aquatic biodiversity. The Upper Hunter SRLUP supports the development of a Strategic Assessment under Part 10 of the EPBC Act for proposed new coal mines and mine expansions in the Upper Hunter Valley. The Strategic Assessment is being undertaken by OEH, DP&I and DSEWPC. The aims of the Strategic Assessment are to:

- resolve Commonwealth and State threatened species/biodiversity issues in one/upfront process;
- consider the impacts of all mines together and in a regional context;
- consider how rehabilitation can contribute to biodiversity conservation in a regional context;
- improve the process of finding and securing offsets; and
- target offsetting to deliver regional conservation gains.

The development of the Strategic Assessment, to be completed in 2014, is an identified action of the Upper Hunter SRLUP.

The Upper Hunter SRLUP identifies that land set aside for biodiversity offsets should not result in the significant loss or destruction of agricultural resources or industries, and that offsets can support continued agricultural production on biodiversity offset land in many instances.

The Upper Hunter SRLUP supports the development of a state-wide offsets database (to be undertaken by DP&I) to identify terrestrial biodiversity offsets associated with major project approvals. The offsets database will be used to inform future assessments so that offset areas are not compromised by further development.

3.0 Methods

3.1 Literature Review

A review of previous documents and reports relevant to the Proposed Modification Area was undertaken to inform the field survey methodology, results and impact assessment component of this report. This included regional and sub-regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys undertaken in the vicinity of the Proposed Modification Area (and broader LCO holdings) and also relevant ecological database searches. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring threatened and migratory species, endangered populations and TECs. Relevant documents are discussed below, focussing on the key findings of each assessment.

3.1.1 Hunter Remnant Vegetation Project (Peake 2006)

The Hunter Remnant Vegetation Project (HRVP) (Peake 2006) documents the distribution, composition and conservation status of vegetation communities occurring in the central Hunter Valley of NSW. Four vegetation communities were mapped within the Proposed Modification Area, comprising:

- Central Hunter Box – Ironbark Woodland;
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest;
- Central Hunter Bulloak Forest Regeneration; and
- Central Hunter Swamp Oak Forest.

Peake (2006) regarded all of the identified vegetation communities to be of conservation significance and under threat. Central Hunter Box – Ironbark Woodland and Central Hunter Ironbark – Spotted Gum – Grey Box Forest are listed as TECs.

The HRVP (Peake 2006) has been used as a basis for the regional assessment of vegetation communities and as a comparison in an impact assessment context against which the loss of vegetation communities as a result of the Project was assessed. While the HRVP utilised imagery from 2000, the report provides a thorough analysis and mapping of remnant vegetation in the central Hunter Valley.

Since the HRVP was published in 2006, additional areas of native forests and woodlands have been cleared as part of mining and other approvals within the Proposed Modification Area. Other areas are likely to have regenerated during this time. The precise locations and extent of clearing and regeneration since 2006 are unknown.

3.1.2 Greater Hunter Native Vegetation Mapping

As part of the Upper Hunter Strategic Assessment (UHSA), OEH released the Draft Greater Hunter Vegetation Map (Sivertsen *et al*. 2011) (GIS format) and associated Vegetation Classification Dataset (Excel spreadsheet), covering the entire UHSA area which includes the central Hunter Valley. The vegetation types of the Draft Greater Hunter Vegetation Map will replace the Hunter Central Rivers vegetation types currently used in the BioBanking credit calculator. While the Draft Greater Hunter Vegetation Map was produced using a number of on-ground data collection points, many parts of the map are based on modelling

results and may contain errors. The map therefore does not replace the need for on-ground vegetation community survey and mapping.

3.1.3 Annual Biodiversity Monitoring Surveys Liddell (Umwelt 2006 to 2010)

Umwelt was commissioned to undertake annual biodiversity monitoring from 2006 to 2010 in accordance with the Glencore Coal Biodiversity and Land Management Standard as well as LCO's Flora and Fauna Management Plan. During this time, Umwelt undertook flora and fauna monitoring throughout the LCO holdings. In total, nine sites were monitored during this time (although not all sites were monitored every monitoring period). The following survey techniques were undertaken at monitoring sites:

- plot-based semi-quantitative flora surveys;
- diurnal bird census;
- diurnal and nocturnal herpetological surveys;
- spotlighting surveys;
- micro-bat echolocation recording; and
- habitat assessment.

Additionally, seven dam sites were surveyed over this time for the threatened blue-billed duck (*Oxyura australis*) and thirteen nest boxes were monitored for condition and content.

As a result of monitoring the following threatened fauna species have been recorded within the LCO holdings:

- blue-billed duck (*Oxyura australis*);
- speckled warbler (*Chthonicola sagittata*);
- grey-crowned babbler (*Pomatostomus temporalis temporalis*);
- hooded robin (*Melanodryas cucullata cucullata*);
- spotted harrier (*Circus assimilis*);
- little eagle (*Hieraaetus morphnoides*);
- spotted-tailed quoll (*Dasyurus maculatus maculatus*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- eastern freetail-bat (*Mormopterus norfolkensis*);
- eastern cave bat (*Vespadelus troughtoni*);
- southern myotis (*Myotis macropus*); and
- greater broad-nosed bat (*Scoteanax rueppellii*).

The little eagle (*Hieraaetus morphnoides*) and spotted harrier (*Circus assimilis*) were recorded as part of the ecological monitoring prior to being listed as threatened species by the NSW Scientific Committee. As such, the locations of these observations within the LCO holdings were not specifically recorded at the time.

The following fauna species listed as migratory under the EPBC Act were also recorded as part of the monitoring program:

- white-bellied sea-eagle (*Haliaeetus leucogaster*);
- rainbow bee-eater (*Merops ornatus*);
- great egret (*Ardea alba*);
- satin flycatcher (*Myiagra cyanoleuca*); and
- clamorous reed warbler (*Acrocephalus stentoreus*).

Additionally the endangered flora population, the tiger orchid (*Cymbidium canaliculatum*) was identified within the LCO holdings, but not within any of the monitoring sites.

3.1.4 2011 Annual Biodiversity Monitoring Surveys Liddell (ELA 2012)

ELA was commissioned to complete the 2011 monitoring surveys in accordance with the methodology undertaken during the 2010 survey event (Umwelt 2011a). During these surveys two monitoring sites were surveyed. At these sites, the following survey techniques were undertaken:

- flora quadrats;
- diurnal bird census;
- herpetological surveys;
- micro-bat echolocation recording;
- terrestrial mammal; and
- habitat assessment.

Targeted blue-billed duck (*Oxyura australis*) surveys and nest box monitoring were also undertaken as part of this monitoring. During these surveys, the following threatened fauna species were identified:

- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- eastern freetail-bat (*Mormopterus norfolkensis*);
- southern myotis (*Myotis macropus*); and
- eastern cave bat (*Vespadelus troughtoni*).

3.1.5 Ecological Assessment of Proposed Modifications to Liddell Coal Operations (Umwelt 2006)

This Ecological Assessment was undertaken to assess six areas as part of a proposed extension of LCO. Areas investigated for this Ecological Assessment were the barrier Pit Extension, South Pit dam 13 Extension, South Pit Southern Extension, a proposed office and workshop complex, a CHPP relocation site and a proposed access road and service corridor.

Flora surveys were undertaken in July of 2006 and consisted of walkover transects surveys targeting threatened species and recording all vascular flora species encountered. Aerial photograph interpretation was also undertaken.

Fauna surveys were undertaken in July of 2006 and primarily consisted of habitat assessment, as due to the small size of the Proposed Modification Areas, detailed fauna surveys were not deemed as necessary. Targeted water bird surveys were also undertaken during August of 2006 primarily to target threatened species the blue-billed duck (*Oxyura australis*).

These surveys identified the presence of the following vegetation communities:

- Central Hunter Bulloak Forest Regeneration;
- Central Hunter Swamp Oak Forest; and
- Derived Grassland.

The following threatened fauna species were identified:

- blue-billed duck (*Oxyura australis*);
- speckled warbler (*Chthonicola sagittata*); and
- grey-crowned babbler (*Pomatostomus temporalis temporalis*).

3.1.6 Liddell Colliery Continued Operations Environmental Impact Statement (Umwelt 2001)

Umwelt was commissioned to assess potential impacts for approval of operations for the continuation of their existing open cut coal mining operation. The aim of the project was to consolidate and update existing development consent for the entire operation and the project covered an area of 1374 hectares, of which 732 hectares were previously disturbed.

Fieldwork for this impact assessment was undertaken during December 2000 and March of 2001. Initial vegetation mapping was undertaken by way of aerial photograph interpretation, followed by 13 walking transects, 15 standard 20 metre by 20 metre plots.

Fauna surveys consisted of:

- nocturnal bird call playback sessions;
- diurnal bird surveys;
- targeted diurnal reptile and amphibian searches;
- nocturnal amphibian surveys;

- Elliot A, Elliot B and cage trapping surveys;
- hair funnel surveys; and
- micro-bat echolocation surveys.

The vegetation surveys identified the following vegetation communities:

- Pastoral grassland;
- *Eucalyptus crebra*/*Eucalyptus moluccana* Woodland;
- *Allocasuarina luehmannii* Woodland;
- Riparian Vegetation; and
- Aquatic Vegetation.

The following threatened fauna species were identified in the Project Area:

- spotted harrier (*Circus assimilis*);
- little eagle (*Hieraaetus morphnoides*);
- grey-crowned babbler (*Pomatostomus temporalis temporalis*);
- eastern freetail-bat (*Mormopterus norfolkensis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*); and
- southern myotis (*Myotis macropus*).

The little eagle (*Hieraaetus morphnoides*) and spotted harrier (*Circus assimilis*) were recorded as part of the ecological monitoring prior to being listed as threatened species by the NSW Scientific Committee. As such, the specific locations of these observations within the LCO holdings were not recorded at the time.

The following fauna species listed as migratory under the EPBC Act were also recorded:

- great egret (*Ardea alba*);
- cattle egret (*Ardea ibis*);
- white-bellied sea-eagle (*Haliaeetus leucogaster*);
- white-throated needletail (*Hirundapus caudacutus*); and
- clamorous reed warbler (*Acrocephalus stentoreus*).

3.1.7 Preliminary Assessment of Assemblages Of Fish Associated With Upgrading The Bowmans Creek Rail Bridge Crossing (Roberts and Murray 2005)

Roberts and Murray (2005) undertook a before and after quantitative assessment of the fish assemblages in Bowmans Creek and two reference creeks at appropriate spatial scales to determine the impact of upgrading the Bowmans Creek rail bridge crossing. Reference sites were located in Rouchel and Glennies Creeks.

The assessment was undertaken using an Electrofisher backpack unit. The Electrofisher was used to stun the fish in open water and in submerged and emergent aquatic vegetation. Ten fish and three crustacean species were identified in the study area during the survey. Surveys within Bowmans Creek identified six fish and three crustacean species, with the introduced mosquito fish (*Gambusia holbrooki*) the most abundant species recorded in the creek, followed by long-finned eels (*Anguilla reinhardtii*).

3.2 Ecological Database Searches

In order to identify potential threatened species, endangered populations and TECs with the potential to occur in the Proposed Modification Area, a search of relevant ecological databases was completed during April 2013. These database sources comprised:

- a 10 kilometre radius search from the centre of the Proposed Modification Area of the OEH Atlas of NSW Wildlife (April 2013); and
- a 10 kilometre radius search from the centre of the Proposed Modification Area of the DSWEPC Protected Matters Database (April 2013).

Records from these database searches were combined with records derived through literature reviews and professional opinion to identify the range of potentially occurring threatened species, endangered populations and TECs for the area. The results of the database searches are compiled in **Appendix 2**.

Current lists of threatened species and key threatening processes were sourced from the OEH and DSEWPC websites.

3.3 Field Surveys

ELA has previously undertaken flora, fauna and aquatic field surveys within the Proposed Modification Area and other parts of the LCO holdings (see **Section 1.2**), with flora surveys undertaken in May and October 2011 and fauna surveys in July, October and December 2011. Aquatic surveys were undertaken by ELA on 20 and 21 July 2012.

In October 2012, Umwelt was engaged to finalise the Ecological Assessment and Biodiversity Offset Strategy for the Project, as well as to ground-truth and update the existing flora surveys and vegetation mapping. As part of this process, verification of the results of the ELA surveys was undertaken and the methodology utilised as part of this process is described in the Sections below.

3.3.1 Flora Surveys

Flora field surveys were completed by ELA across a number of periods and seasons, and a number of methodologies were employed. In addition to this, Umwelt completed two days of targeted field survey aimed at augmenting the ELA field survey and updating vegetation mapping, where necessary. The details of the flora surveys completed as part of this Project are provided in **Table 3.1** below.

Table 3.1 – Flora Field Survey Timing and Effort

Surveyors	Date of Surveys	Survey Method	Survey Effort within Proposed Modification Area
ELA	16 May 2011	Meander transects – vegetation type mapping	1 day 103 km of tracks
ELA	16, 17 and 19 May 2011	Full floristic and biometric plots Rapid Assessments	20 plots 18 rapid assessment points
ELA	4 October 2011	Targeted painted diuris (*Diuris tricolor*) surveys	1 day of targeted searching
Umwelt	30 and 31 October 2012	Full floristic and biometric plots Rapid Assessments Meander Transects	2 plots 4 rapid assessments 28 km of tracks

The methods and approaches used during the Umwelt flora survey are described in the sections below. The methods adopted by ELA as part of their surveys are broadly comparable to those detailed below. The location and type of surveys employed by both ELA and Umwelt as part of these surveys are identified in **Figure 3.1**.

3.3.1.1 Biometric Plot-based Surveys

The plot-based systematic vegetation surveys were undertaken using methods that are standard in most NSW government vegetation management agencies and elsewhere. This ensured that data collected by other surveys could be incorporated into the current work, and that the data from the current study could be analysed in an equivalent way to that collected by other recognised studies.

When undertaking systematic sampling to assist vegetation community mapping and description, plot-based (or quadrat) surveys have several distinct advantages over non-quantitative transects, including:

- providing a quantitative examination of species distribution and abundance;
- being likely to detect inconspicuous or rare species (especially forbs and grasses) within the given sampling area, as a smaller area is surveyed in a concentrated search; and
- providing a basis for any subsequent monitoring required.

Systematic survey sites were selected by considering a range of attributes that were considered to influence or determine the type of vegetation communities present. This stratification was done intuitively, but based on existing topographic, soil, vegetation and geological mapping. Other factors considered included the spacing of sites across the

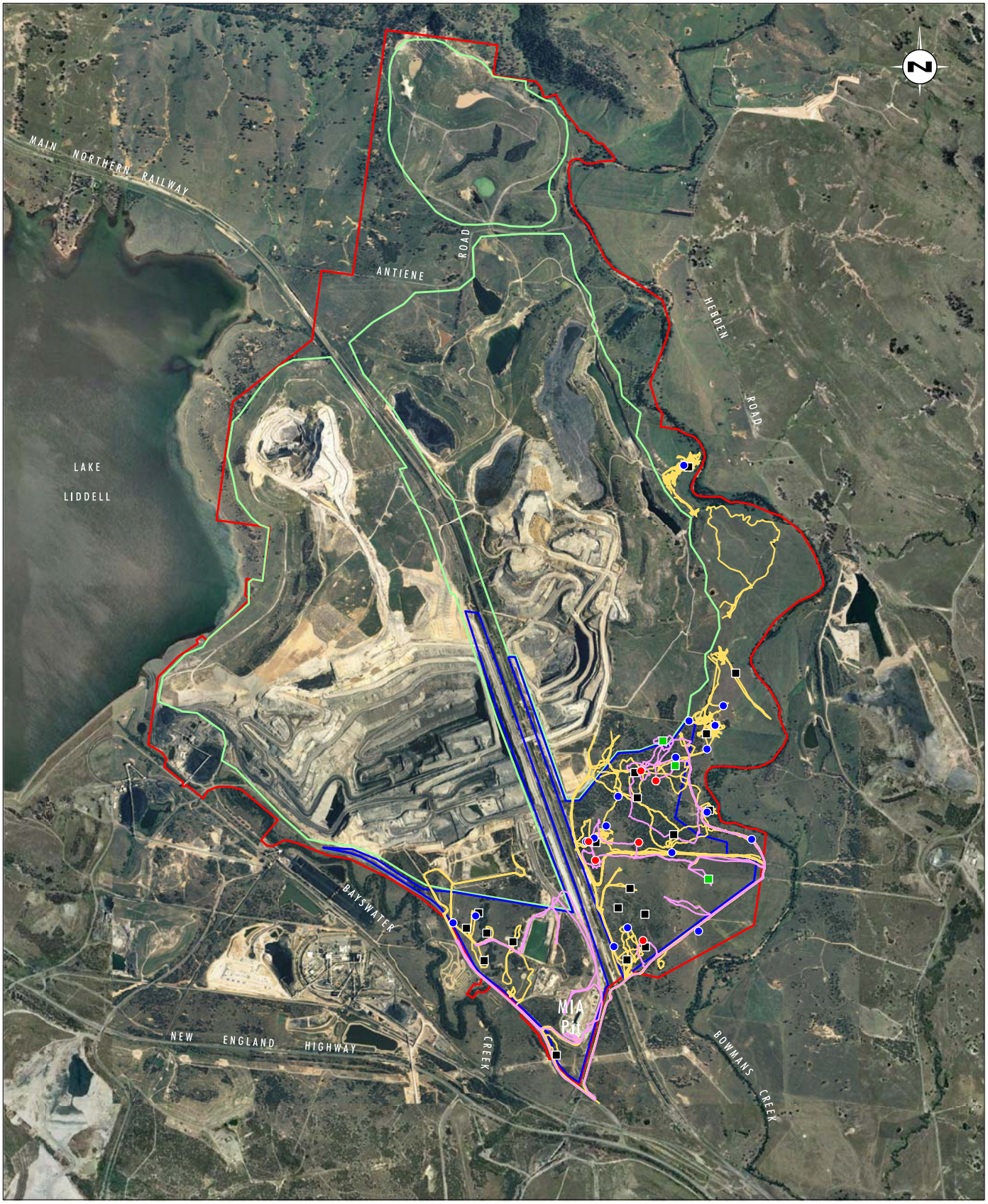


Image Source: Xstrata (2013), Google Earth (2008)
Data Source: Xstrata (2012), ELA (2011 & 2012) Umwelt (2012)

0 0.5 1.0 2km
1:40 000

Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Mining Footprint
- Proposed Modification Area
- Meander Transects (ELA 2012)
- Meander Transects (Umwelt 2012)
- Flora Quadrats (ELA 2011)
- Flora Rapid Assessments (ELA 2011)
- Flora Quadrats (Umwelt 2012)
- Flora Rapid Assessments (Umwelt 2012)

FIGURE 3.1

Flora Survey Methods

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Proposed Modification Area, as well as topographic position (see **Schematic 3.1** below) and aspect.

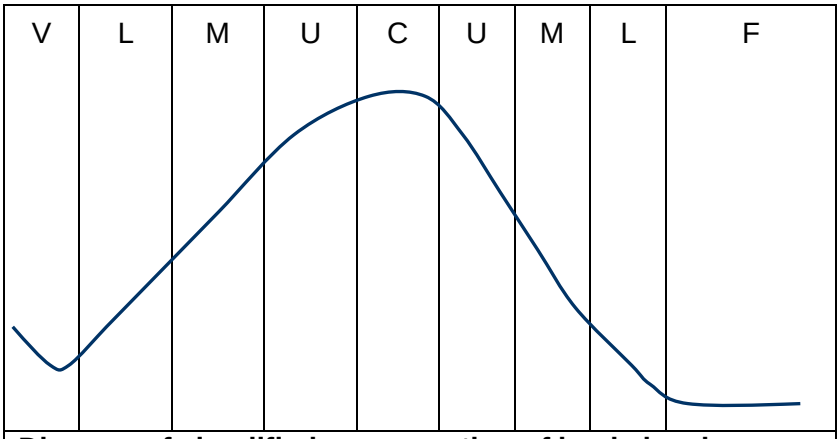

Diagram of simplified cross section of land showing:

- **crest (C)**
- **upper slope (U)**
- **mid slope (M)**
- **lower slope (L)**
- **valley (V)**
- **flat (F)**

Schematic 3.1 – Topographic Positions Sampled in the Field Survey

Data on topography, soil type and geology were sourced from existing maps. Not all stratification was done *a priori*, as the selection of survey sites in the field was undertaken to ensure that obvious variability in aspect, slope, elevation and micro-terrain were sampled.

Systematic 400 m^2 plots were used to undertake semi-quantitative sampling of vegetation. The typical dimensions of the plots are 20 x 20 metres. This plot size is used widely, including by the Royal Botanic Gardens Sydney and OEH. These plots were extended to 20 x 50 metres for habitat and condition assessment.

At each plot, two ecologists spent roughly 45 to 60 minutes searching for all vascular flora species present within the plot. Searches of each plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of the shrub, mid-understorey, canopy and emergent layers were also thoroughly examined. Effort was made to search the canopy and tree trunks for mistletoes, vines and epiphytes.

Species within the plot were assigned a cover-abundance value to reflect their relative cover and abundance in the plot. Species located outside the plot were marked as present but were not assigned a cover-abundance value. A modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore 1955 and Austin *et al*. 2000) was used to estimate cover-abundances of all plant species within each plot. **Table 3.2** shows the cover-abundance categories used.

Table 3.2 - Modified Braun-Blanquet Crown Cover-abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20% cover	-
4	20 – less than 50% cover	-
5	50 – less than 75% cover	-
6	75 – 100% cover	-

Note: * Modified Braun-Blanquet scale (Poore 1955; Austin *et al.* 2000).

All flora species that were readily identified in the field were recorded on pro forma field survey datasheets. All flora species that could not be immediately identified and samples of all threatened flora species were collected, dried and identified or sent to the National Herbarium of NSW for identification.

In addition, information was gathered on the condition of the vegetation at each of the survey sites, including fire history and the density of weeds and evidence of disturbance such as feral animals.

3.3.1.2 Rapid Assessments

Rapid vegetation assessments were completed, primarily to assist in the delineation and refinement of vegetation mapping. These assessment sites were located within each broadly mapped vegetation community to allow data collection for each community without confounding effects from adjacent communities. Dominant, common and some uncommon plant taxa were recorded within each vegetation community along meandering transects, carried out on foot, at each location.

The rapid vegetation assessments did not utilise a quantitative sampling approach as this method was designed to allow rapid collection of non-quantitative species dominance data within limited timeframes. This technique involved walking a transect and recording species found at points along the transect. Rapid vegetation assessments were selected instead of the plot-based method because it increased the amount of data that could be collected within the available survey time, thereby maximising the quality and coverage of vegetation description and mapping. This technique also facilitates the recording of general species richness, assists in the delineation of vegetation community boundaries and targets the presence of threatened and significant flora species, endangered populations and TECs.

3.3.1.3 Meander Transects and Field Reconnaissance

Meander transects and field reconnaissance was undertaken across the Proposed Modification Area while both walking and driving. This form of survey is an alternative method of flora data collection that enable the surveyor to sample flora across a much larger area than that sampled in systematic plots. However, the data collected are usually in the form of presence records, rather than semi-quantitative values, and therefore do not contribute as much to the delineation of vegetation communities. Notwithstanding this, walking transects and field reconnaissance are valuable in that they enable a wide coverage

of the area under investigation, and also facilitate the discovery of widely dispersed rare plant species and the identification of vegetation community boundaries.

3.3.1.4 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within quadrats, at rapid assessment points and along transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002) and Wheeler *et al*. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2013), the online plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens Sydney.

3.3.1.5 Biases and Limitations

The survey was influenced by seasonal factors as the survey was primarily conducted during autumn and spring; however spring and summer are peak flowering periods for many cryptic species, such as orchids.

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. In this case specimens were forwarded to the National Herbarium of New South Wales if they were considered to be of potential significance or importance.

As such, this assessment has undertaken a precautionary approach when it comes to assessing threatened species presence; and although some threatened species have not been recorded within the Proposed Modification Area, they have been recorded adjacent to the Proposed Modification Area or are considered to have the potential to occur in areas of appropriate habitat.

3.3.2 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Proposed Modification Area. Vegetation mapping involved the following key steps:

- review of mapping undertaken by Umwelt (2001 and 2006) and preliminary vegetation mapping undertaken by ELA in 2012;
- revision of vegetation community floristic delineations based on plot data; and
- revision of vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were then compared to those vegetation communities identified in the HRVP (Peake 2006). The dendrogram and vegetation community profiles provided in the HRVP report were interrogated to identify those communities that contained similar species and structural compositions to ensure that, where possible, the communities identified in the Proposed Modification Area were aligned with similar communities known to occur elsewhere in the

Hunter Valley. Communities were then named in accordance with those communities described by Peake (2006) and the corresponding Greater Hunter Native Vegetation community types.

Vegetation communities were grouped into three vegetation formations, which were based solely on structural characteristics rather than floristic components. These comprised:

- woodland (dominated by trees of 10 to 40 per cent cover and typically 6 to 20 metres height, with or without a mid-understorey or understorey);
- riparian and floodplain forest (dominated by trees of 10 to 80 per cent cover and typically 6 to 20 metres height, in a linear strip along waterways, or restricted to floodplains, with or without a mid-understorey or understorey); and
- grassland (dominated by grasses, sedges and forbs, with trees and shrubs very sparse or absent).

3.3.3 Fauna Surveys

Fauna surveys were carried out to identify the fauna species and their habitats occurring, or considered to have the potential to occur in the Proposed Modification Area, including threatened species, migratory species, endangered populations, and species of local or regional significance.

Fauna field surveys were completed by ELA across a number of periods and seasons, and a number of methodologies were employed. In addition to this, Umwelt completed four days of targeted field survey aimed at the spotted-tailed quoll (*Dasyurus maculatus maculatus*) within the Proposed Modification Area and along Bowmans Creek. The details of the fauna surveys completed as part of this Project are provided in **Table 3.3** below, however the ELA surveys are detailed further within **Appendix 1**.

Table 3.3 – Fauna Field Survey Timing and Effort

Surveyors	Date of Surveys	Survey Method	Survey Effort
ELA	5 to 7 July 2011, 24 to 28 October 2011, 13 to 15 December 2011	Arboreal hair tubes	Three tubes in 10 habitat trees over four nights per 50 hectare stratification unit
		Terrestrial hair tubes	10 large and 10 small hair tubes in pairs over 4 days and nights per 50 hectare stratification unit
		Cage trapping	24 trap nights over 3-4 consecutive nights at 4 sites.
		Remote camera surveys	At each cage trap site
		Spotlighting	1 km transect over 1 person hr repeated over 2 nights for 4 sites
		Anabat recording	Two Anabats at 4 sites over 2 nights
		Harp trapping	4 trap nights over 2 consecutive nights at 4 sites
		Diurnal bird census	20 minutes in spring and 20 minutes in winter at 4 sites
		Nocturnal call playback	At 4 sites over 2 separate nights
		Diurnal herpetofauna surveys	30 minutes for 2 nights at 4 sites

Table 3.3 – Fauna Field Survey Timing and Effort (cont.)

Surveyors	Date of Surveys	Survey Method	Survey Effort
		Nocturnal herpetofauna surveys	Walking over 1 km transect for one hour for 2 separate nights
ELA	30 November 2012 to 18 December 2012 – Targeted spotted-tailed quoll surveys	Remote camera surveys	Six remote sensing cameras over 18 days and nights
Umwelt	17 to 20 December 2012 – Targeted spotted-tailed quoll surveys	Daytime walking searches for signs of presence	4 days
		Dusk walking surveys	2 dusk periods, each of approximately 2 person hours duration
		Nocturnal spotlighting	3 nights of spotlighting, each of approximate duration 5 person hour
		Baited remote camera surveys	7 stations for 3 nights, 2 stations for two nights and 5 stations for 1 night (30 full survey nights)
	6 to 17 June 2013 – Targeted spotted-tailed quoll surveys	Baited remote camera surveys	12 stations for 11 nights
		Daytime walking searches for signs of presence	2 days
		Prey density spotlighting transects	6 transects surveyed twice over 2 nights

Due to the extent of work that had been undertaken by ELA, Umwelt did not undertake fauna surveys (with the exception of those for the spotted-tailed quoll (*Dasyurus maculatus maculatus*)) as part of the Project. However, Umwelt did undertake opportunistic observations of the Proposed Modification Area, particularly in respect to habitat and condition.

3.3.3.1 Umwelt 2012 Targeted Spotted-tailed Quoll Surveys (*Dasyurus maculatus maculatus*)

Given the repeated records of the spotted-tailed quoll (*Dasyurus maculatus maculatus*) along Bowmans Creek during previous surveys within the LCO holdings (by Umwelt (2006) and ELA (2013a)), targeted surveys were commissioned by LCO for ELA and Umwelt to further survey for this species within the Proposed Modification Area, and targeted habitats within the LCO holdings. Bowmans Creek was targeted as the highest quality habitat for this species in the immediate area.

ELA sighted a spotted-tailed quoll (*Dasyurus maculatus maculatus*) moving along Bowmans Creek on 26 November 2012 and again on 28 November 2012 running into a nearby log pile. This log pile was identified as being a potential den site and was inspected for entrance points. Six remote cameras were installed around the potential den site including facing the entrances of the den site and facing the fauna tracks that run along the riparian zone. These remote cameras were left on site between 30 November 2012 and 18 December 2012.

Additional targeted spotted-tailed quoll (*Dasyurus maculatus maculatus*) surveys were undertaken by Umwelt from 17 to 20 December 2012. These targeted areas where this species was recorded by ELA in 2012, as well as the Proposed Modification Area and the general Bowmans Creek riparian area. Umwelt surveys consisted of:

- daytime walking surveys searching for signs of presence (tracks, latrines and scats) and key habitat features (latrine sites, log piles, boulder piles and den sites);
- two 1 hour dusk surveys in potential movement corridors including Bowmans Creek and any other potential movement corridors noted during other surveys;
- nocturnal walking spotlight surveys along Bowmans Creek and remnant vegetation in the east and south-east of the LCO holdings, including woodland habitat within the Proposed Modification Area; and
- baited remote camera stations at 14 locations (seven stations for three nights, two active for two nights, and 5 active of one night). A total of 30 full survey nights were completed by these cameras.

Opportunistic records were taken throughout aspects of survey. Locations of these targeted fauna survey effort locations are provided in **Figure 3.2**.

3.3.3.2 Umwelt 2013 Targeted Spotted-tailed Quoll Surveys

Following the findings of targeted spotted-tailed quoll (*Dasyurus maculatus maculatus*) surveys undertaken by ELA (2013a) and Umwelt (2013) in 2012, additional targeted surveys were commissioned by LCO to:

- assess the importance of the Proposed Modification Area as habitat for the spotted-tailed quoll;
- assess the significance of Bowmans Creek as a potential movement corridor for the spotted-tailed quoll from LCO holdings into proposed and existing offset properties to the north, including the Mountain Block and the Ravensworth Operations Hillcrest Offset Site; and
- determine the key dietary requirements of spotted-tailed quolls in the Liddell locality.

Surveys of the Proposed Modification Area were undertaken from 6 to 17 June. Remote sensing cameras were placed in the Proposed Modification Area on 6 June and collected on 17 June. Umwelt surveys consisted of:

- daytime walking surveys searching for signs of presence (tracks, latrines and scats) and key habitat features (latrine sites, log piles, boulder piles and den sites);
- scat collection;
- nocturnal walking spotlight surveys along 500 metre by 20 metre transects to provide abundance estimates of potential spotted-tailed quoll prey species (0.5 to 5 kilograms body weight) following the methodology of Belcher and Darrant (2006), undertaken in the Proposed Modification Area; and
- baited remote camera stations at 12 locations in the Proposed Modification Area, for a total of 24 full survey nights;

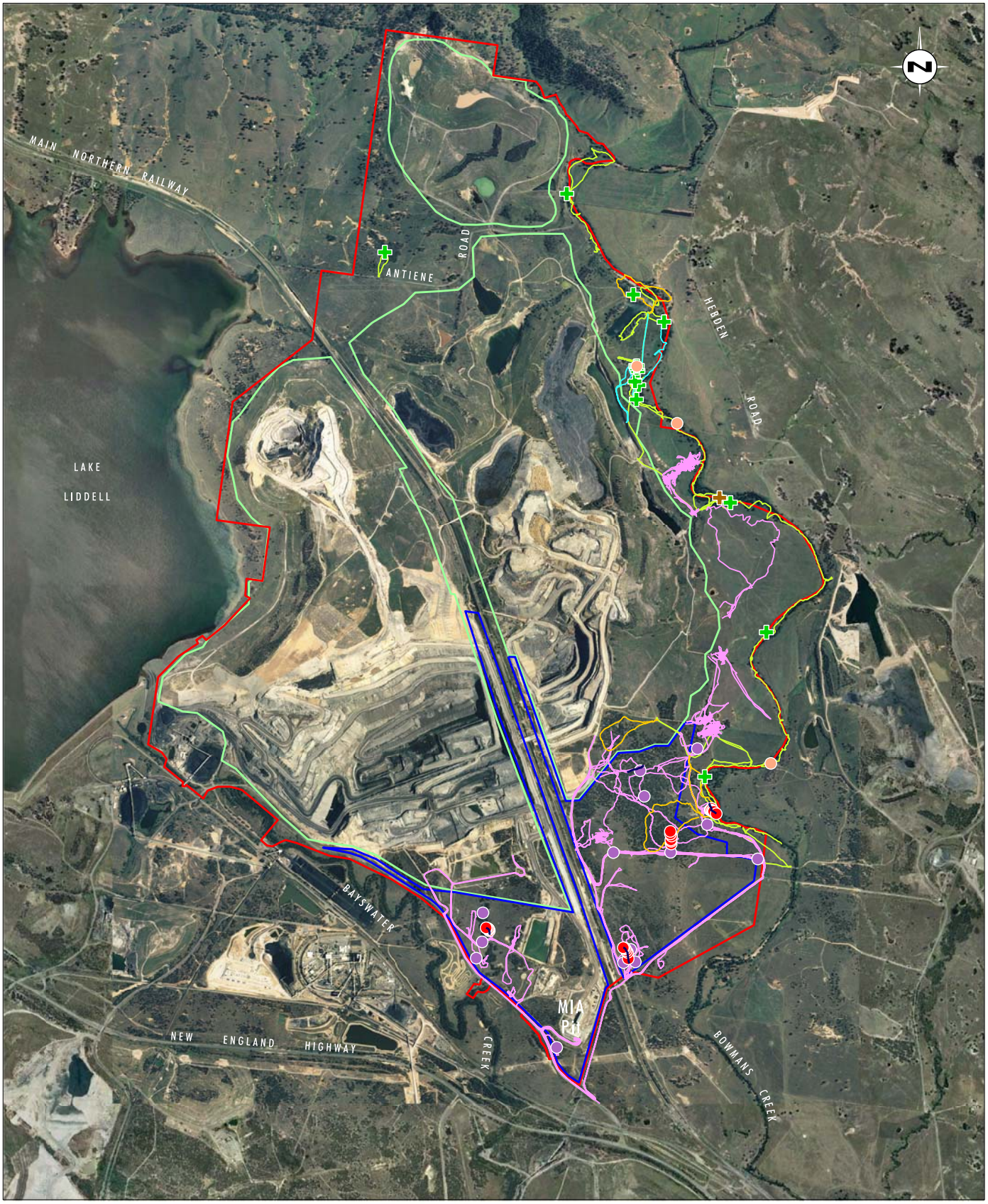

Image Source: Xstrata (2013), Google Earth (2008)
Data Source: Xstrata (2012), ELA (2013) Umwelt (2013)

0 0.5 1.0 2.0km
1:40 000

Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Mining Footprint
- Proposed Modification Area
- Umwelt Dusk Walking Transects
- Umwelt Spotlighting Transects
- Umwelt Daytime Walking Transects
- Umwelt Remote Camera Site
- ELA Remote Camera Site
- Hair Tube Transect (ELA 2013)
- Cage Traps (ELA 2013)
- Fauna Transects (ELA 2013)
- Fauna Survey Sites (ELA 2013)
- Spotted-tailed Quoll Scat Sample Collection

FIGURE 3.2

Fauna Survey Methods

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20130903 10.31

Opportunistic records were taken throughout aspects of survey. In addition to the above, further remote camera surveys and walking transects were completed along Bowmans Creek at this time to attempt to confirm usage of this area as a corridor in a north/south direction. Locations of these targeted fauna survey effort locations are provided in **Figure 3.2**.

3.3.4 State Environmental Planning Policy No. 44 – Koala Habitat Protection

Any development application in a SEPP 44 specified local government area, affecting an area of 1 hectare or greater, must be assessed under SEPP 44. Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala (*Phascolarctos cinereus*) habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 of the policy constitute 15 per cent or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat.

The species listed in Schedule 2 of the policy are listed in **Table 3.4**.

Table 3.4 – Species of Eucalypt listed in Schedule 2 of SEPP 44

Scientific Name	Common Name
Eucalyptus tereticornis	forest red gum
Eucalyptus microcorys	tallowwood
Eucalyptus punctata	grey gum
Eucalyptus viminalis	ribbon or manna gum
Eucalyptus camaldulensis	river red gum
Eucalyptus haemastoma	broad-leaved scribbly gum
Eucalyptus signata	scribbly gum
Eucalyptus albens	white box
Eucalyptus populnea	bimble box or poplar box
Eucalyptus robusta	swamp mahogany

Across the Proposed Modification Area, an assessment of the presence of koala feed tree species (as listed on **Table 3.4**) was made at 18 plots (15 by ELA and three by Umwelt) and 17 rapid assessment points (11 by ELA and six by Umwelt).

3.3.5 Aquatic Surveys

A detailed aquatic ecology and groundwater-dependent ecosystem assessment has been prepared by ELA (2013b), and has been included as an Appendix to the Environmental Assessment. Sampling occurred at five existing bore sites along Bowmans Creek, as well as three aquatic sampling sites along Bowmans Creek and a further two aquatic sampling sites along Bayswater Creek. Methods adopted to complete this assessment included:

- **Macro-invertebrate sampling** – occurred at all five aquatic sampling sites, in July 2012. The AusRivAS sampling protocol was applied for edge habitats, however no riffle habitats were present to sample. SIGNAL2 scores were used to grade the level of disturbance apparent at each site. A YSI-556 multiparameter meter was used to measure temperature, dissolved oxygen, pH and electrical conductivity at each site. Turbidity was also recorded at each site.

- **Fish sampling** – this was completed using bait traps and fyke nest left overnight at each creek. Fish were also collected as bycatch during macro-invertebrate sampling.

- **Riparian condition** – was assessed via the Riparian Channel and Environmental (RCE) inventory. This method measures 13 site descriptors, providing an overall score indicating degree of condition of the riparian zones.

- **Stygofauna sampling** – occurred at five bores tapping the alluvial aquifer for Bowmans Creek. A weighted sampling net was dropped into each bore and captured fauna were sieved and identified.

Further detail on the aquatic methods completed as part of the ELA (2013b) study can be found as an Appendix to the Environmental Assessment.

4.0 Survey Results

4.1 Flora Survey Results

The results of the flora survey, including field survey, vegetation description and mapping and desktop components are detailed in the following sections.

4.1.1 Flora Species

A total of 221 (155 native and 66 exotic) species were recorded within the Proposed Modification Area from the 20 floristic plots and eighteen rapid assessments by ELA and three floristic plots and six rapid assessments undertaken by Umwelt.

Plants were recorded from two of the four major vascular plant classes: ferns and flowering plants (refer to **Table 4.1**) and included trees, shrubs, forbs, grasses, sedges, rushes, ferns and vines. Sixty-one plant families were recorded (refer to **Table 4.1**).

Table 4.1 – Composition of Plant Classes and Families Recorded in the Proposed Modification Area

Plant class	Sub-class	Number of families	Number of species
Filicopsida (ferns)	-	1	3
Magnoliopsida (flowering plants)	Liliidae (monocots)	6	63
Magnoliopsida (flowering plants)	Magnoliidae (dicots)	54	155
Totals (all plants)		**61**	**221**

A list of all flora species recorded within the Proposed Modification Area by ELA and Umwelt is presented in **Appendix 3**. The most speciose families recorded were Poaceae (grasses) with 45 species, followed by Asteraceae (daisies) with 28 species recorded and Fabaceae with five species recorded.

The vegetation of the Proposed Modification Area was dominated by groundcover vegetation species, with typically a sparse to moderate mid-storey or canopy stratum layer.

Commonly encountered weed species during flora surveys were fireweed (*Senecio madagascariensis*), catsear (*Hypochaeris radicata*) and spear thistle (*Cirsium vulgare*), all from the Asteraceae (daisy) family. Of the 66 introduced species identified, 15 (22.7 per cent), were from the plant family Asteraceae.

Five noxious weed species (2.3 per cent of all flora species recorded) were recorded in the Proposed Modification Area. These species are listed in the NSW Government Gazette No. 166, 23 December 2005 (New South Wales Government 2005) and include:

- tiger pear (*Opuntia aurantiaca*);
- creeping pear (*Opuntia humifusa*);
- mother-of-millions (*Bryophyllum delagoense*);
- *Bryophyllum daigremontianum*; and
- African boxthorn (*Lycium ferocissimum*).

4.1.2 Threatened Flora Species and Endangered Populations

There were no threatened flora species identified in the Proposed Modification Area during flora surveys conducted by ELA and Umwelt as part of the Project or in previous surveys. A single tiger orchid (*Cymbidium canaliculatum*) was recorded in the east of the Proposed Modification Area within regenerating bulloak forest. This species is listed as an endangered population in the Hunter catchment.

Following literature and database reviews, it was determined that a number of threatened flora species and endangered populations have the potential to occur in the Proposed Modification Area, as identified in **Table 4.2** below, and further in **Appendix 2**.

Table 4.2 – Threatened Flora Species and Endangered Flora Populations with Potential to Occur in the Proposed Modification Area

Species		Status			
Common Name	**Scientific Name**	**TSC Act 1995**	**EPBC Act 1999**	**Recorded in LCO?**	**Recorded in Proposed Modification Area?**
Lobed bluegrass	*Bothriochloa biloba*	-	V	×	×
Painted diuris	*Diuris tricolor*	V, EP	-	×	×
-	*Ozothamnus tesselatus*	V	V	×	×
Tiger orchid	*Cymbidium canaliculatum*	EP	-	✓	✓

V vulnerable
EP endangered population

The following threatened flora species, EPs and TECs (as listed under the TSC Act and EPBC Act), were recorded within the Proposed Modification Area either as part of the current survey, or from other sources such as previous surveys, databases searches or literature reviews. A précis of ecological requirements for each species, endangered population and TEC is provided, sourced from the OEH Threatened Species website (http://www.environment.nsw.gov.au/threatenedspecies), unless indicated otherwise.

4.1.2.1 *Cymbidium canaliculatum* population in the Hunter Catchment

Cymbidium canaliculatum in the Hunter Catchment is listed as an endangered population under the TSC Act. The Hunter population is known to occur naturally as far south as Weston and Pokolbin in the lower Hunter, which represents its south-eastern geographic limit, but appears to be more centred in the upper Hunter, predominantly north of Singleton.

A single tiger orchid (*Cymbidium canaliculatum*) was recorded within the Proposed Modification Area, during the surveys completed by Umwelt in 2013. This was a very small plant growing in a trunk fissure in a senescing bulloak. The location of this record is provided in **Figure 4.1**.

4.2 Vegetation Mapping

Table 4.3 below summarises the vegetation communities mapped within the Proposed Modification Area by Umwelt, following consideration of the field data collected by ELA in 2011 and the conduct of verification surveys by Umwelt in 2012. Vegetation communities mapped in the Proposed Modification Area are provided in **Figure 4.1**.

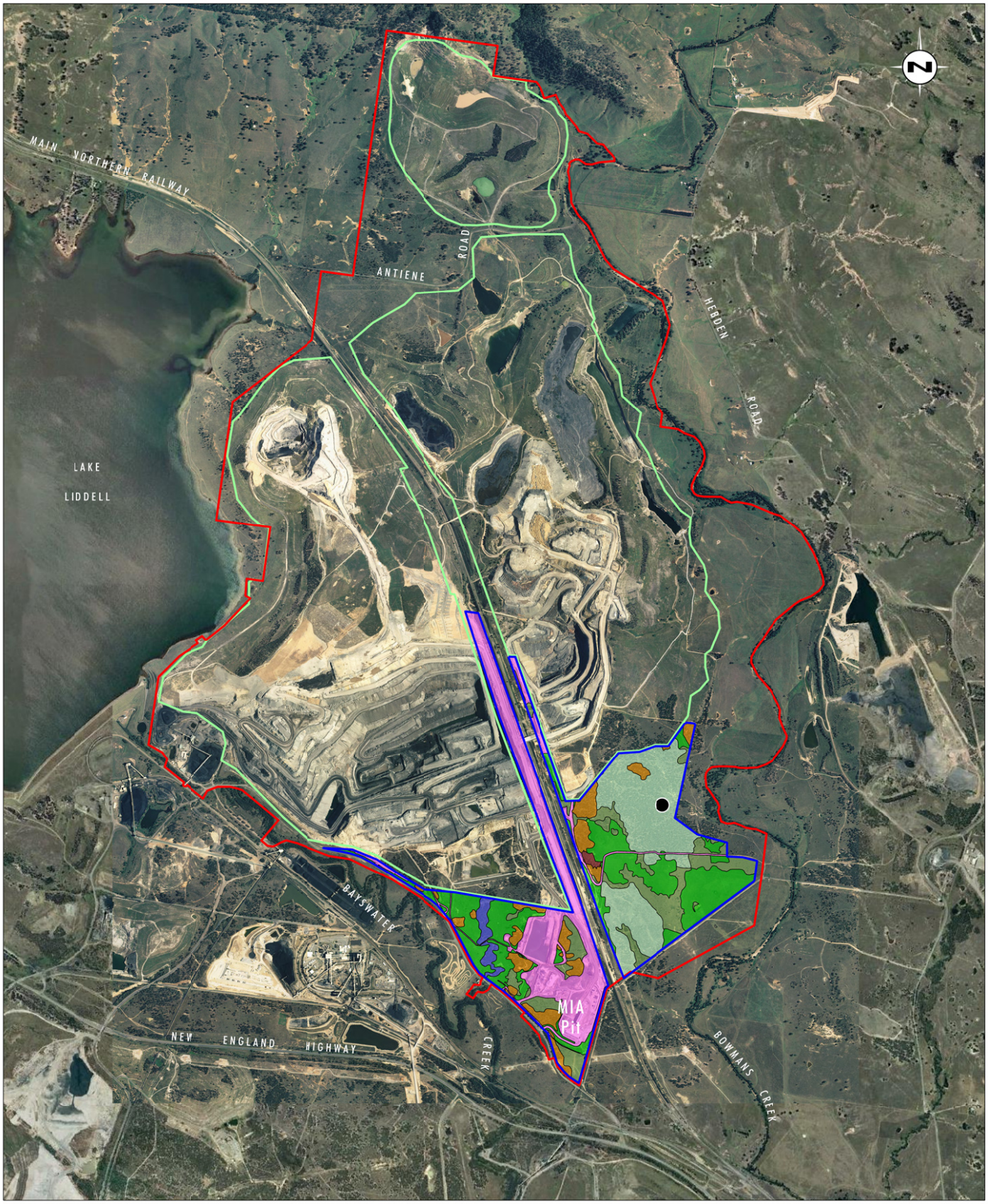

Image Source: Xstrata (2013), Google Earth (2008)
Data Source: Xstrata (2012), Umwelt (2013)

0 0.5 1.0 2km
1:40 000

Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Mining Footprint
- Proposed Modification Area
- Central Hunter Box - Ironbark Derived Native Grassland
- Central Hunter Box - Ironbark Woodland (EEC)
- Central Hunter Box - Ironbark Woodland (Regrowth) (EEC)
- Central Hunter Box - Ironbark Woodland (Rough-barked Apple Dominated) (EEC)
- Central Hunter Bulloak Forest
- Central Hunter Swamp Oak Forest
- Disturbed Land
- Tiger Orchid Endangered Population

FIGURE 4.1

Vegetation Communities and Endangered Flora Populations

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20130909 14.17

Table 4.3 – Vegetation Communities Occurring in the Proposed Modification Area

Community	Status	Extent in Proposed Modification Area (hectares)
Central Hunter Box – Ironbark Woodland	TEC (TSC)	22
Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated)	TEC (TSC)	1
Central Hunter Box – Ironbark Woodland (Regrowth)	TEC (TSC)	33
Central Hunter Box – Ironbark Derived Native Grassland	-	65
Central Hunter Swamp Oak Forest	-	5
Central Hunter Bulloak Forest	-	62
Disturbed Land	-	67
Total		**255**

Note: All values have been rounded up to the nearest whole number. All values subject to minor mapping/GIS-based variation.

Descriptions of each of the vegetation communities recorded in the Proposed Modification Area are provided below. These descriptions draw upon data obtained during field surveys and also from information contained within Peake (2006).

4.2.1 Central Hunter Box – Ironbark Woodland Variants

Four variations of this vegetation community were recorded within the Proposed Modification Area and are listed below:

- Central Hunter Box – Ironbark Woodland;
- Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated);
- Central Hunter Box – Ironbark Woodland (Regrowth); and
- Central Hunter Box – Ironbark Derived Native Grassland (DNG).

4.2.1.1 Central Hunter Box – Ironbark Woodland

The Proposed Modification Area contains 22 hectares of this vegetation type. This vegetation community is generally consistent with that described by Peake (2006). The pockets of woodland were dominated entirely by narrow-leaved ironbark (*Eucalyptus crebra*) and formed a mid-high canopy (also seen to be actively recruiting) (**Plate 4.1**). No mature grey box (*Eucalyptus moluccana*) or kurrajong (*Brachychiton populneus* subsp. *populneus*) trees were recorded in this community, however there is a potential for these to occur. A mid to dense sub-canopy of bulloak (*Allocasuarina luehmannii*) was generally recorded within the community.

The understorey of this vegetation community was somewhat variable. A sparse to mid-dense small shrub layer was present, with dominant species including leafy templetonia (*Templetonia stenophylla*), gorse bitter pea (*Daviesia ulicifolia*) and Narrawa burr (*Solanum cinereum*). Native grasses, barbed wire grass (*Cymbopogon refractus*), speargrass (*Austrostipa scabra*), *Rytidosperma tenuius* and slender bamboo grass (*Austrostipa verticillata*) were common throughout the ground layer.

PLATE 4.1

Central Hunter Box - Ironbark Woodland

The Central Hunter Box – Ironbark Woodland vegetation community conforms to the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community (EEC) listing under the TSC Act. The relevant attributes described within the NSW Scientific Committee – final determination for the EEC that are consistent with the vegetation community within the Proposed Modification Area include flora species composition, flora species assemblages and the location of the vegetation.

Central Hunter Box – Ironbark Woodland recorded within the Proposed Modification Area included a narrow-leaved ironbark (*Eucalyptus crebra*) dominated canopy layer with rough-barked apple (*Angophora floribunda*) and bulloak (*Allocasuarina luehmannii*) also occurring as sparse canopy trees and/or sub-canopy trees. Many sub-shrub and ground layer forb and grass species identified in a brief list of characteristic flora species within the final determination were also common throughout the Central Hunter Box – Ironbark Woodland community in the Proposed Modification Area and are listed in the text above. This community does not conform with any EPBC Act listed TECs.

This community has been specifically separated from the areas of Central Hunter Bulloak Forest, which had a similar group of shrub and grass species (albeit significantly lower in foliage cover) occurring in the understorey, because of the dominance of narrow-leaved ironbark (*Eucalyptus crebra*) in the canopy. Alternatively, the Central Hunter Bulloak Forest vegetation community is essentially absent of narrow-leaved ironbark (*Eucalyptus crebra*) trees or recruiting plants. This community is described in more detail below. These two communities were separated through analysis of field data recorded during the field survey and aerial photography interpretation.

The young age and small number of mature trees recorded in the canopy the Central Hunter Box – Ironbark Woodland vegetation community suggests that the area has been subject to clearing previously. Despite the vegetation recovering well, the impacts are still noticeable, particularly in the understorey. Species diversity in the sub-shrub and ground layer is typically much higher that what was recorded by ELA during 2011 and Umwelt (2012). For this reason the quality of this vegetation community is considered to be moderate.

4.2.1.2 Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated)

The Proposed Modification Area contains 1 hectare of this vegetation community. Also consistent with the Central Hunter Box – Ironbark Woodland described by Peake (2006), this vegetation community had an open mid-high canopy dominated by rough-barked apple (*Angophora floribunda*) (**Plate 4.2**). It occurred on a south facing slope in the central part of the Proposed Modification Area. As an open woodland, the cover of rough-barked apple (*Angophora floribunda*) and bulloak (*Allocasuarina luehmannii*) in the sub-canopy was less than 10 per cent.

A sparse low-shrub layer of cooba (*Acacia salicina*), blue trumpet (*Brunoniella australis*) and *Pimelea* sp. was recorded and appear to be restricted to this community. The introduced shrub species, African olive (*Olea europaea* subsp. *cuspidata*), was also recorded.

The understorey consisted of a mid-dense cover of indigenous grasses in the ground layer, including the dominant species barbed wire grass (*Cymbopogon refractus*), couch (*Cynodon dactylon*), slender bamboo grass (*Austrostipa verticillata*) and purple wiregrass (*Aristida ramosa*). Native forb species were very uncommon in this community, consisting of *Glycine tabacina* and kidney weed (*Dichondra repens*). Additionally, a sparse cover of introduced flora species was also recorded in the ground layer, including flatweed (*Hypochaeris radicata*), fireweed (*Senecio madagascariensis*), *Petrorhagia velutina*, spear thistle (*Cirsium vulgare*) and *Centaurium tenuiflorum*.

PLATE 4.2

Central Hunter Box - Ironbark Woodland (Rough-barked Apple Dominant)

This vegetation community has been mapped as a variant of the widely distributed Central Hunter Box – Ironbark Woodland (see **Figure 4.1**). As previously discussed, narrow-leaved ironbark (*Eucalyptus crebra*) is absent from the canopy and is replaced by rough-barked apple (*Angophora floribunda*). The NSW Scientific Committee's Final Determination makes specific mention of this species, as well as grey box (*Eucalyptus moluccana*), occurring and occasionally dominating or co-dominating the canopy. Therefore, this community is also considered to conform to the Central Hunter Grey Box – Ironbark Woodland EEC listed under the TSC Act. This community does not conform with any EPBC Act listed TECs.

The vegetation in this community has been subject to clearing in the past and as a result, primarily consists of younger trees with little mature vegetation present. Vegetation within this community is considered to be resilient, as seen by the diversity and density of groundcover and shrub layers, and of moderate quality.

4.2.1.3 Central Hunter Box – Ironbark Woodland (Regrowth)

The Proposed Modification Area contains 33 hectares of this vegetation community. This community comprised an open young tree canopy of narrow-leaved ironbark (*Eucalyptus crebra*) and bulloak (*Allocasuarina luehmannii*), typically less than 8 metres in height (**Plate 4.3**). It occurred as a transitional community between Central Hunter Box – Ironbark Woodland, Central Hunter Box – Ironbark DNG and Central Hunter Bulloak Forest, as shown on **Figure 4.1**.

Mature narrow-leaved ironbark (*Eucalyptus crebra*) and bulloak (*Allocasuarina luehmannii*) trees were effectively absent from this variant in comparison to surrounding stands of woodland and forest. However, the degree of recruitment of the canopy species was noticeably higher in this variant.

The community supports by a mid-dense ground layer of indigenous grasses dominated by barbed wire grass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*) and speargrass (*Austrostipa scabra*). Forb and fern species were less prevalent however common species included kidney weed (*Dichondra repens*), *Cheilanthes sieberi* subsp. *sieberi* and common everlasting (*Chrysocephalum apiculatum*). Introduced flora species were widespread in the ground layer with spear thistle (*Cirsium vulgare*), fireweed (*Senecio madagascariensis*), galenia (*Galenia pubescens*), Paddys lucerne (*Sida rhombifolia*) and barley grass (*Hordeum leporinum*) commonly occurring. Additionally, rocky outcrops were common on the tops of small rises within this community.

Central Hunter Box – Ironbark Woodland (Regrowth) is also considered to conform to the TSC Act listed Central Hunter Grey Box – Ironbark Woodland EEC. This community does not conform with any EPBC Act listed TECs.

The impacts of historical clearing are more evident within the Central Hunter Box – Ironbark Woodland (Regrowth) vegetation community due to the reduced presence of mature trees. The reduced presence of mature narrow-leaved ironbark (*Eucalyptus crebra*) and bulloak (*Allocasuarina luehmannii*) trees reduces the quality of the vegetation to low.

4.2.1.4 Central Hunter Box – Ironbark Derived Native Grassland

The Proposed Modification Area contains 65 hectares of this vegetation community. Cleared of all mature trees and shrubs, this community occurs in the form of derived native grassland (DNG) (**Plate 4.4**). Regenerating narrow-leaved ironbark (*Eucalyptus crebra*) and bulloak (*Allocasuarina luehmannii*) occurred but contributed less than 5 per cent foliage cover across the community.

PLATE 4.3

Central Hunter Box - Ironbark Woodland (Regrowth)

PLATE 4.4

Central Hunter Box - Ironbark Derived Native Grassland

The understorey of the Central Hunter Box – Ironbark DNG community was very similar in composition to that of Central Hunter Box – Ironbark Woodland (Regrowth). The community was characterised by a dense cover of indigenous grasses with barbed wire grass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*) and speargrass (*Austrostipa scabra*) being prominent. Forb and fern species were common but low in cover and dominant species included kidney weed (*Dichondra repens*), *Cheilanthes sieberi* subsp. *sieberi* and common everlasting (*Chrysocephalum apiculatum*).

The proportion of introduced flora species within the community varied from sparse to dense. These variations occurred at a smaller scale than was feasible to map as separate communities. Dominant weeds within the Central Hunter Box – Ironbark DNG community included barley grass (*Hordeum leporinum*), Paddys lucerne (*Sida rhombifolia*), fireweed (*Senecio madagascariensis*), galenia (*Galenia pubescens*) and creeping pear (*Opuntia humifusa*).

Central Hunter Box – Ironbark DNG is closely related to Central Hunter Box – Ironbark Woodland, as it is likely to have been derived from this community. Unlike its parent woodland community Central Hunter Box – Ironbark Woodland, the DNG community is not considered to conform to the TSC Act listed Central Hunter Grey Box – Ironbark Woodland EEC. The species composition in the ground layer is typically consistent with the community description; however the NSW Scientific Committee's final determination for the EEC does not identify grassland variations as part of the EEC. The Final Determination states:

> Central Hunter Grey Box – Ironbark Woodland typically forms a woodland dominated by Eucalyptus crebra (Narrow-leaved Ironbark), Brachychiton populneus subsp. populneus (Kurrajong) and Eucalyptus moluccana (Grey Box).

The NSW Scientific Committee does not specifically identify grassland forms as being included within the EEC final determination and while it is noted that DNGs may have potential to regenerate to be consistent with the Central Hunter Grey Box – Narrow-leaved Ironbark Woodland EEC, grassland areas are not explicitly covered by the EEC listing and are not considered to form part of the EEC. Therefore, it is considered that Central Hunter Box – Ironbark DNG does not conform to any EEC listed under the TSC Act and similarly does not conform to any TECs listed under the EPBC Act.

The quality of the Central Hunter Box – Ironbark DNG vegetation community is considered to be low. It is somewhat degraded as a result of grazing and subsequently is dominated by introduced species. This community has recovered the least from historical clearing out of all woodland vegetation communities in the Proposed Modification Area.

4.2.2 Central Hunter Bulloak Forest

The Proposed Modification Area contains 62 hectares of this vegetation community. Central Hunter Bulloak Forest occurred throughout the Proposed Modification Area and occupied similar landscapes to Central Hunter Box – Ironbark Woodland (refer to **Figure 4.1**). Two sub-communities were present, being Central Hunter Bulloak Forest and Central Hunter Bulloak Forest (regrowth). Peake (2006) describes a community consistent with that mapped in the Proposed Modification Area of the same name i.e. Central Hunter Bulloak Forest.

Central Hunter Bulloak Forest consists of a dense canopy of both young and mature bulloak (*Allocasuarina luehmannii*) (**Plate 4.5**). Mature bulloak (*Allocasuarina luehmannii*) trees occur within this vegetation community, however they are uncommon. Likewise, young narrow-leaved ironbark (*Eucalyptus crebra*) trees occurred in the canopy but at very low frequency (i.e. not co-dominant).

PLATE 4.5

Central Hunter Bulloak Forest

Central Hunter Bulloak Forest was characterised by a very sparse understorey. With the exception of heavily recruiting bulloak (*Allocasuarina luehmannii*) and the occasional leafy templetonia (*Templetonia stenophylla*) and dolly bush (*Cassinia aculeata*), the shrub layer was virtually absent. The ground layer was highly variable, ranging from completely bare soil and organic bulloak needle material to a variable cover of grasses and forbs. Where present, grasses were dominated by barbed wire grass (*Cymbopogon refractus*), purple wiregrass (*Aristida ramosa*), slender bamboo grass (*Austrostipa verticillata*), *Rytidosperma tenuius*, wallaby grass (*Rytidosperma fulvum*) and red grass (*Bothriochloa decipiens*). The following indigenous forb species also occurred in low numbers: lemon beauty heads (*Calocephalus citreus*), *Glycine tabacina*, *Cheilanthes sieberi* subsp. *sieberi* and yellow burr-daisy (*Calotis lappulacea*).

Additionally, several introduced flora species also occurred in low numbers through this community including creeping pear (*Opuntia humifusa*), tiger pear (*Opuntia aurantiaca*), fireweed (*Senecio madagascariensis*) and onion grass (*Romulea rosea*).

The Central Hunter Bulloak Forest (regrowth) variation consists of the same species assemblages as the Central Hunter Bulloak Forest community. The characteristic differences between the two communities are that the regrowth variant has a younger, lower and more open canopy. In turn, this contributes to an understorey of greater foliage cover.

Central Hunter Bulloak Forest and its regrowth do not conform with any TSC Act or EPBC Act TECs.

The habitat quality in both the Central Hunter Bulloak Forest and its regrowth variant is considered to be low. There were very few mature bulloak (*Allocasuarina luehmannii*) trees observed and the understorey vegetation strata remains modified as a result of historical clearing.

4.2.3 Central Hunter Swamp Oak Forest

The Proposed Modification Area contains 5 hectares of this vegetation community. The Central Hunter Swamp Oak Forest mapped within the Proposed Modification Area occurred along Chain of Ponds Creek, a tributary of Bayswater Creek in the south west of the Proposed Modification Area (refer to **Figure 4.1**). The community is consistent with Central Hunter Swamp Oak Forest as described by Peake (2006).

The canopy was dense and dominated by swamp oak (*Casuarina glauca*) to a height of approximately 18 metres (**Plate 4.6**), with an emergent forest red gum (*Eucalyptus tereticornis*) occasionally recorded. Shrubs were generally absent from this community; however introduced species such as African boxthorn (*Lycium ferocissimum*) were recorded.

The ground cover vegetation was generally dense and dominated by grasses, forbs and ferns such as weeping grass (*Microlaena stipoides* var. *stipoides*), whiteroot (*Pratia purpurascens*), slender bamboo grass (*Austrostipa verticillata*), kidney weed (*Dichondra repens*), climbing saltbush (*Einadia nutans*) and *Glycine tabacina*. Introduced species such as galenia (*Galenia pubescens*), *Juncus acutus* and fireweed (*Senecio madagascariensis*) were commonly recorded in the understorey.

As the Central Hunter Swamp Oak Floodplain Forest supports mature swamp oak (*Casuarina glauca*) trees, as well as some mature forest red gum (*Eucalyptus tereticornis*) trees it is considered to be of moderate habitat quality. Despite the relatively disturbed understorey this community is unlikely to have been cleared to the same extent as the remaining vegetation within the Proposed Modification Area.

PLATE 4.6

Swamp Oak Forest

4.2.3.1 Assessment of Swamp Oak Floodplain Forest EEC

The Proposed Modification Area supports 5 hectares of Central Hunter Swamp Oak Forest. A comprehensive analysis of this vegetation community was undertaken to determine if it conformed to the *Swamp Oak Floodplain Forest of the North Coast, Sydney Basin and South East Corner Bioregions EEC*, listed under the TSC Act.

The TSC Act (section 4(1)) defines an ecological community as 'an assemblage of species occupying a particular area'. This definition embodies three requirements (Preston & Adam 2004a):

1. the constituents of a community must be species;

2. the species need to be brought together into an assemblage; and

3. the assemblage of species must occupy a particular area.

The following text provides an analysis of Central Hunter Swamp Oak forest within the Proposed Modification Area in relation to these three requirements, together with additional matters that pertain to the identification of the Swamp Oak Floodplain Forest EEC.

Constituent Species

Section 4(1) of the Act adopts a pragmatic and inclusive definition of a species as including 'any defined sub-species and taxon below subspecies and any recognisable variant of a sub-species or taxon' (NSW Scientific Committee 2012).

The species recorded within Central Hunter Swamp Oak Forest within the Proposed Modification Area comprise species, and/or taxa below species, as required by the Act.

Assemblage of Species

An assemblage of species involves the bringing together or gathering into a location or locations the identified species (Preston & Adam 2004a). Species co-occurrence is central to the existence of an assemblage of species, with an important aspect of co-occurrence being the notion that a common, albeit variable, group of species occur within the distribution of a community (NSW Scientific Committee 2012). It is common to use structurally dominant species, those most abundant or with greatest height or biomass, to form abbreviated descriptions of assemblages, however, the occurrence of one or two dominant species, of itself, is not evidence of the existence of an ecological community (NSW Scientific Committee 2012). The emphasis of description and diagnosis of ecological communities should address overall species composition of the assemblage, rather than occurrence of selected species (dominant or otherwise) (NSW Scientific Committee 2012). Unlike species, there is no currently accepted typology of ecological communities (Preston & Adam 2004a).

The NSW Scientific Committee (2012) states that descriptions of the assemblage of species

> ...would usually aim to include frequently occurring species, those that may be locally abundant, though not necessarily present throughout the distribution of the community, and species whose occurrence may help to distinguish the community from other similar communities.

The NSW Scientific Committee (2004) lists 45 species as characterising the assemblage of species for Swamp Oak Floodplain Forest EEC. As part of ecological investigations for the Project, two systematic 20 x 20 metre floristic plots were sampled in Central Hunter Swamp Oak Forest. Of these, swamp oak (*Casuarina glauca*) was recorded in both plots. Lesser joyweed (*Alternanthera denticulata*) was present in one plot out of the two. Common couch (*Cynodon dactylon*) was present in one of the two plots. Indian pennywort (*Centella asiatica*) was recorded during a random meander near to one of the plots. No other species listed in the Final Determination were recorded from these plots. Thus, in total four species (10 per cent) of the species listed in the Final Determination, were present. In many cases the plot data showed that many *genera* listed in the Final Determination are present, however the *species* present in the Proposed Modification Area are typically inland species, while the Final Determination lists coastal species of those genera.

Particular Area

The particular area defines the location(s) at which species of the assemblage co-occur. According to Preston & Adam (2004a), this represents the 'natural habitat in which the assemblage of species occurs or has historically occurred and is capable of recurring if measures are taken to restore or allow the habitat to recover.' It therefore excludes captive or cultivated occurrences because they are not within the 'natural habitat' of the community (NSW Scientific Committee 2012). In Final Determinations the particular area of an ecological community is described by identifying the bioregions in which it occurs and the local government areas in which it has been recorded.

In relation to the particular area of the Swamp Oak Floodplain Forest EEC, the NSW Scientific Committee (2004) states that the community occurs within the NSW North Coast, Sydney Basin and South East Corner Bioregions. The Proposed Modification Area is situated within the Sydney Basin Bioregion.

Supplementary Descriptors

The NSW Scientific Committee (2012) states that:

> Although not legally required, information about 'supplementary descriptors' (section 4.2.3) may also assist in the interpretation of the particular area occupied by an ecological community. For example, environmental conditions such as typical climate, terrain, substrates and other abiotic, biotic or ecological factors that influence the community can assist in drawing inferences about its likely occurrence at particular locations (Preston & Adam 2004b).

In relation to supplementary descriptors the NSW Scientific Committee (2004) includes the following key information pertaining to the Swamp Oak Floodplain Forest EEC:

- Occurs on grey-black clay-loams and sandy loams.
- Occurs where the groundwater is saline or sub-saline.
- Occurs on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains.
- Generally occurs below 20 metres (rarely above 10 metres) elevation.
- The structure may vary from open forests to low woodlands, scrubs or reedlands with scattered trees.

Of the above supplementary descriptors, the Central Hunter Swamp Oak Forest present in the Proposed Modification Area is nowhere less than 90 metres above sea level. Although the Final Determination does not rule out the presence of the EEC at this elevation (through the use of the word 'generally' in relation to occurring below 20 metres), the use of the term 'rarely above 10 metres' suggests occurrences at 80 metres elevation would be highly unlikely or remarkable, and therefore improbable or impossible.

The Central Hunter Swamp Oak Forest occurring in the Proposed Modification Area generally occurs within very small closed flats (e.g. up to several metres in width) within incised creek channels, as well as along the top of incised creek channels. These creeks ultimately drain in to the Hunter River, which itself enters the Tasman Sea 90 kilometres to the south-east. The Final Determination does not define what a 'coastal floodplain' is. The NSW *Coastal Protection Act 1979* refers to maps of the 'coastal zone' which, among other things, limit the landward extent of the coastal zone to 1 kilometre landward of the open coast high water mark; and a distance of 1 kilometre around all bays, estuaries, coastal lakes, lagoons and islands.

Notwithstanding the lack of definition around the term 'coastal' in relation to floodplains, OEH has produced a series of predictive maps that model the likely distribution of coastal floodplains. This includes creek flats within the Proposed Modification Area. Despite this, the models are merely informative and not definitive, and thus there remains no definitive interpretation of the term 'coastal floodplain'.

Conclusion

The Central Hunter Swamp Oak Forest present in the Proposed Modification Area does not conform to the Swamp Oak Floodplain Forest EEC. Although the particular area of the EEC, and some of the supplementary descriptors, presented in the Final Determination are inclusive of the EEC's presence, the EEC can be ruled out on the following points: a) partly based on the clear intent of the Scientific Committee in limiting the EEC's occurrence to 'rarely above 10 metres elevation'; and b) firmly based on the very restricted number of species listed in the Final Determination that are present at the site (being about 10 per cent).

4.2.4 Disturbed Land

Disturbed Land included roads, water management infrastructure and surface infrastructure areas and did not contain any vegetation or habitat. Approximately 67 hectares of the Proposed Modification Area comprises Disturbed Land.

4.3 Fauna Survey Results

4.3.1 Fauna Species Recorded

Fauna surveys undertaken by ELA (2013a) resulted in the identification of a total of 109 fauna species, including seven amphibians, 67 avian species, 29 mammal species and six reptile species. A full list of all fauna species recorded by ELA in the Proposed Modification Area is provided in **Appendix 1**.

With the exception of targeted spotted-tailed quoll (*Dasyurus maculatus maculatus*) surveys, Umwelt did not undertake detailed fauna survey work within the Proposed Modification Area as part of this Project. However, Umwelt did make opportunistic fauna sightings throughout other surveys undertaken. In addition to the fauna species recorded by ELA as part of their surveys (**Appendix 1**), Umwelt opportunistically recorded one additional mammal species and one additional amphibian species. These are identified in the relevant sections below.

4.3.1.1 Amphibians

Eight frog species were recorded in the Proposed Modification Area (seven by ELA and one additional species by Umwelt), comprising four ground frog species of the family Myobatrachidae and four tree frogs from the family Hylidae. The most commonly encountered frog species was the common eastern froglet (*Crinia signifera*) and the eastern dwarf tree-frog (*Litoria fallax*).

No threatened frog species were recorded during surveys of the Proposed Modification Area.

4.3.1.2 Reptiles

Six reptile species were recorded within the Proposed Modification Area from four different families, being the Cheloniidae (turtles), Scincidae (skinks), Agamidae (dragons) and Varanidae (monitors). Reptiles indentified included the eastern bearded dragon (*Pogona barbata*) and lace monitor (*Varanus varius*).

No threatened reptile species were recorded during surveys of the Proposed Modification Area.

4.3.1.3 Birds

Sixty-seven bird species have been identified in the Proposed Modification Area from a total of 32 families. The most speciose family identified was the Acanthizidae (Australasian warblers) with eight species, followed by the Meliphagidae (honeyeaters) with six species recorded. Some of the more frequently observed bird species were the Australian raven (*Corvus coronoides*), eastern rosella (*Platycercus adscitus eximius*), noisy miner (*Manorina melanocephala*), superb fairy-wren (*Malurus cyaneus*) and willie wagtail (*Rhipidura leucophrys*), all of which are considered to be common woodland bird species in the Hunter region.

A number of threatened bird species have been recorded within the LCO holdings over many years of ecological survey. Four species listed as vulnerable species under the TSC Act were recorded within the Proposed Modification Area during surveys undertaken by ELA (2013a) and by Umwelt during 2013 and previous surveys, these being:

- grey-crowned babbler (*Pomatostomus temporalis temporalis*);
- brown treecreeper (*Climacteris picumnus victoriae*);
- speckled warbler (*Chthonicola sagittata*); and
- eastern grass owl (*Tyto longimembris*).

In addition to these, the following threatened birds have been recorded elsewhere within the LCO holdings, but not within the Proposed Modification Area:

- hooded robin (*Melanodryas cucullata cucullata*) approximately 100 metres to the east of the Proposed Modification Area;
- blue-billed duck (*Oxyura australis*) approximately 500 metres to the north of the Proposed Modification Area during 2005, 2006, 2007 and 2009;
- Australian painted snipe (*Rostratula benghalensis australis*) along Bowmans Creek; and
- spotted harrier (*Circus assimilis*) approximately 750 metres to the north of the Proposed Modification Area.

The location of threatened bird species is shown on **Figure 4.2**.

The little eagle (*Hieraaetus morphnoides*) has also been recorded within the LCO landholdings (Umwelt 2001); however this was prior to it being listed as threatened under the TSC Act and consequently its specific location was not recorded.

No species were identified that are listed as threatened under the EPBC Act; however the rainbow bee-eater (*Merops ornatus*) is listed under the EPBC Act as a migratory species under the JAMBA convention. The following additional migratory species have been identified within the wider LCO during previous monitoring events and as part of other impact assessments; however their exact locations were not recorded and consequently are not provided on **Figure 4.2**.

- great egret (*Ardea alba*);
- cattle egret (*Ardea ibis*);
- white-bellied sea-eagle (*Haliaeetus leucogaster*);
- white-throated needletail (*Hirundapus caudacutus*);
- clamorous reed warbler (*Acrocephalus stentoreus*); and
- satin flycatcher (*Myiagra cyanoleuca*).

4.3.1.4 Mammals

Thirty-two mammal species have been recorded in the Proposed Modification Area during ELA field surveys, from a total of 11 different families. The most speciose family recorded was the Vespertilionidae (also known as vesper bats), followed by the Macropodidae (kangaroos and wallabies) and the Molossidae (free-tailed bats) each with three species recorded. Eight introduced species were recorded (refer to **Appendix 1**). One additional mammal species was recorded opportunistically by Umwelt in the Proposed Modification Area being the common wallaroo (*Macropus robustus*).

The most commonly recorded native terrestrial mammal was the eastern grey kangaroo (*Macropus giganteus*) and the most commonly recorded arboreal mammal was the common brushtail-possum (*Trichosurus vulpecula*). Typically encountered micro-chiropteran species were the *Mormopterus* 'Species 4', chocolate wattled bat (*Chalinolobus morio*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) and the greater broad-nosed bat (*Scoteanax rueppellii*).

A total of six threatened micro-bat species have been recorded in the Proposed Modification Area by ELA (2013a) and during previous surveys undertaken by Umwelt, being:

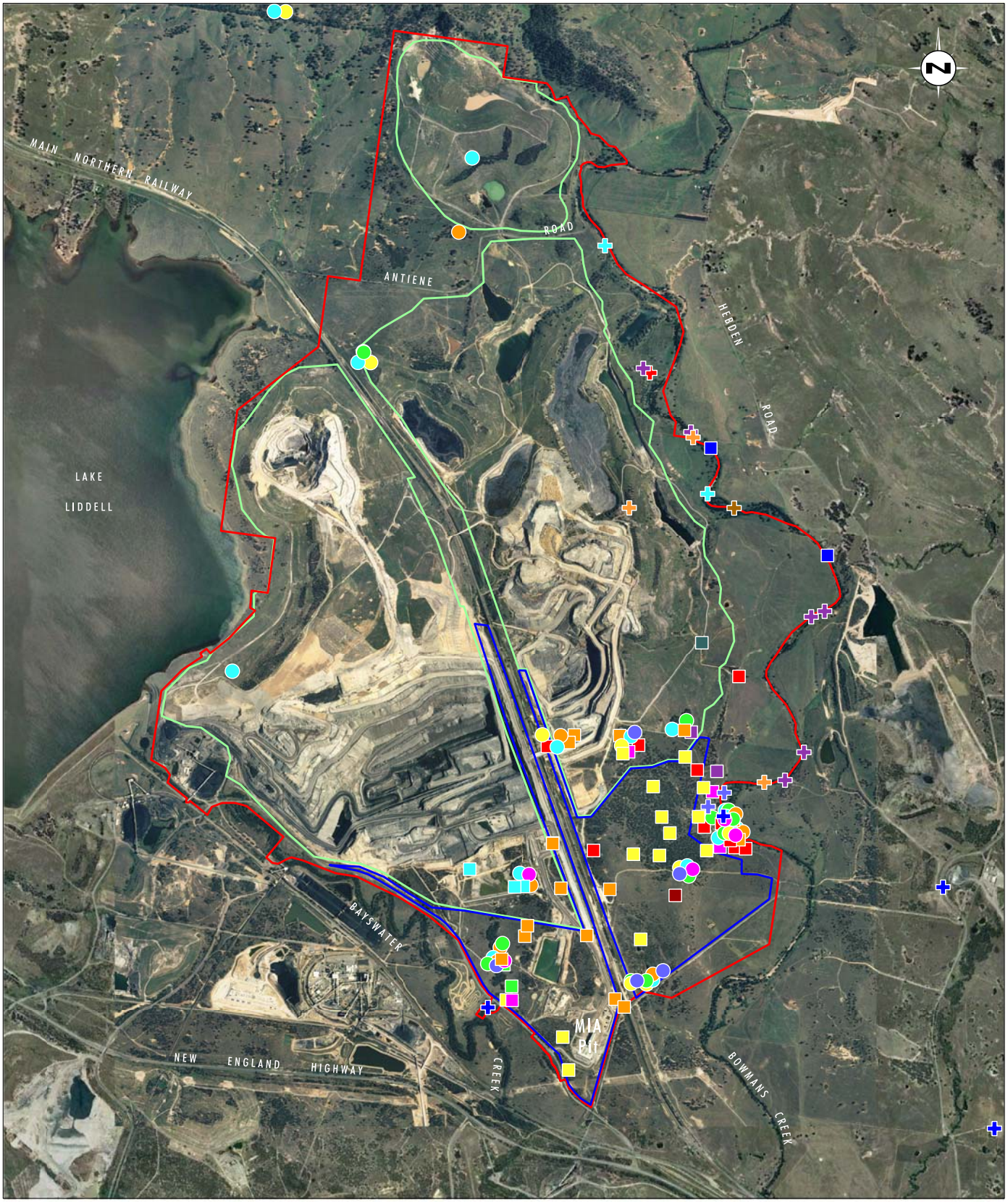


Image Source: Xstrata (2013), Google Earth (2009)
Data Source: Xstrata (2012), ELA (2012), NPWS Atlas (2011), Umwelt (2006, 2012), Ecological (2012) and Enright Land Management (2013)

0 0.5 1.0 2km
1:40 000

Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Mining Footprint
- Proposed Modification Area
- Blue-billed Duck
- Brown Treecreeper
- Eastern Bentwing-Bat
- Eastern Cave Bat
- Eastern False Pipistrelle
- Eastern Freetail Bat
- Grass Owl
- Greater Broad-nosed Bat
- Grey-crowned Babbler
- Grey-crowned Babbler Nest
- Hooded Robbin
- Painted Snipe
- Rainbow Bee-eater
- Southern Myotis
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll - Latrine Site
- Spotted-tailed Quoll - Scats
- Spotted-tailed Quoll - Tracks
- Spotted-tailed Quoll - Visual Sighting
- Spotted-tailed Quoll - Den Site
- Spotted-tailed Quoll Record (Enright Land Management 2013)
- Bionet Spotted-tailed Quoll Records (Since 1990)

FIGURE 4.2

Threatened Fauna Recorded

File Name (A4): R02/3122_019.dgn
20130828 16.13

- eastern freetail-bat (*Mormopterus norfolkensis*);
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- southern myotis (*Myotis macropus*);
- greater broad-nosed bat (*Scoteanax rueppellii*); and
- eastern cave bat (*Vespadelus troughtoni*).

A number of records of the spotted-tailed quoll (*Dasyurus maculatus maculatus*) have been recorded from the LCO holdings, however not from within the Proposed Modification Area, despite targeted surveys. These records have included visual records, scat records, latrine sites, tracks and a confirmed den site along Bowmans Creek.

4.3.2 Threatened Fauna

A table of all threatened fauna species known to occur in the local area based upon literature and database reviews, surveys, and local knowledge is provided in **Appendix 2**. **Table 4.4** below lists the threatened fauna species recorded within the Proposed Modification Area, or nearby within the LCO holdings. The Proposed Modification Area is not considered to provide habitat for any listed endangered fauna populations.

Table 4.4 – Threatened Fauna Species Recorded within or in Proximity to the Proposed Modification Area

Species Name		Status			
Common name	**Scientific name**	**TSC Act 1995**	**EPBC Act 1999**	**Recorded in LCO?**	**Recorded in Proposed Modification Area?**
Blue-billed duck	*Oxyura australis*	V	-	✓	×
Australian painted snipe	*Rostratula benghalensis australis*	E	E, M	✓	×
Spotted harrier	*Circus assimilis*	V	-	✓	Unknown*
Little eagle	*Hieraaetus morphnoides*	V	-	✓	Unknown*
Eastern grass owl	*Tyto longimembris*	V	-	✓	✓
Hooded robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-	✓	×
Brown treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-	✓	✓
Speckled warbler	*Chthonicola sagittata*	V	-	✓	✓
Grey-crowned babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	-	✓	✓
Rainbow bee-eater	*Merops ornatus*	-	M	✓	✓
Great egret	*Ardea alba*	-	M	✓	Unknown**
Cattle egret	*Ardea ibis*	-	M	✓	Unknown**

Table 4.4 – Threatened Fauna Species Recorded within or in Proximity to the Proposed Modification Area (cont.)

Species Name		Status			
Common name	**Scientific name**	**TSC Act 1995**	**EPBC Act 1999**	**Recorded in LCO?**	**Recorded in Proposed Modification Area?**
White-bellied sea-eagle	*Haliaeetus leucogaster*	-	M	✓	Unknown**
White-throated needletail	*Hirundapus caudacutus*	-	M	✓	Unknown**
Clamorous reed warbler	*Acrocephalus stentoreus*	-	M	✓	Unknown**
Satin flycatcher	*Myiagra cyanoleuca*	-	M	✓	Unknown**
Spotted-tailed quoll (SE mainland population)	*Dasyurus maculatus maculatus*	V	E	✓	×
Southern myotis	*Myotis macropus*	V		✓	✓
Eastern cave bat	*Vespadelus troughtoni*	V		✓	✓
Greater broad-nosed bat	*Scoteanax rueppellii*	V		✓	✓
Eastern false pipistrelle	*Falsistrellus tasmaniensis*	V		✓	✓
Eastern freetail-bat	*Mormopterus norfolkensis*	V		✓	✓
Eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	V		✓	✓

* Denotes species observed onsite prior to being listed under the TSC Act, hence location of record unknown.
** Species was recorded within the LCO during a past report and precise location was not recorded.
Notes: E = endangered
M = migratory
V = vulnerable

The following threatened species (as listed under the TSC Act and EPBC Act) were recorded within the Proposed Modification Area or LCO either as part of the current survey, or from other sources such as annual monitoring surveys, databases searches or literature reviews. The location of each of the threatened species is shown on **Figure 4.2**. A précis of ecological requirements for each species is provided, sourced from the OEH Threatened Species website (http://www.environment.nsw.gov.au/threatenedspecies), and site specific information unless indicated otherwise. Details of the number and location of records for each species are provided also, as well as any other relevant ecological information relating to these records. Detailed assessments of significance for these species are provided in **Appendices 4** and **5**.

4.3.2.1 Blue-billed Duck – *Oxyura australis*

The blue-billed duck is listed as vulnerable under the TSC Act. This species prefers areas of deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. This species is partly migratory, with short distance movements between breeding swamps and over-wintering lakes with some long-distance dispersal to breed during spring and early summer.

The blue-billed duck has been recorded in the LCO during the 2005, 2006, 2007 and 2009 monitoring events, however none of these records are from the Proposed Modification Area. The closest records of this species to the Proposed Modification Area occur within 400 metres. The small amounts of aquatic habitat of the Proposed Modification Area are of generally poor quality for this species. Several dams are present, however these are lacking in the dense vegetation that this species requires. It is likely that if this species were to use the habitats provided by the Proposed Modification Area, that it would be as a stopover location whilst moving between areas of more appropriate habitat.

4.3.2.2 Australian Painted Snipe – *Rostratula benghalensis australis*

The Australian painted snipe is listed as Endangered under the TSC Act and Endangered under the EPBC Act. The preferred habitat of this species includes fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. There are few records of this species in the Hunter Valley, with most records occurring in more coastal locations.

Three individuals of this species were recorded by Umwelt in 2012, in dense ground cover within the riparian corridor of Bowmans Creek. These records were from two locations approximately 2 kilometres north-west of the Proposed Modification Area (**Figure 4.2**), within the LCO Approved DA Boundary. This species has not been recorded within the Proposed Modification Area.

Habitat for the species within the Proposed Modification Area is considered to be marginal and limited to small degraded farm dams only. The habitat within nearby Bowmans Creek is highly modified and in poor condition. This migratory species is likely to move throughout the area and as such, if the species were to occur in the Proposed Modification Area it would likely only be in passing moving between areas of more appropriate habitat.

4.3.2.3 Spotted Harrier – *Circus assimilis*

The spotted harrier is listed as vulnerable under the TSC Act. The species is known to occur throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania.

The spotted harrier has been recorded within the LCO opportunistically during the 2009 monitoring event, during surveys undertaken from the 2001 EA (Umwelt 2001), and additionally by Umwelt during 2013 surveys. The 2009 and 2001 records were prior to the species being listed as threatened as such their locations were not recorded at the time the observations were made; locations of these records are assumed to occur within the Proposed Modification Area. The location of the 2013 record is presented on **Figure 4.2**

The Proposed Modification Area is considered to comprise foraging habitat for this species as part of a wider foraging range in surrounding habitats.

4.3.2.4 Little Eagle – *Hieraaetus morphnoides*

The little eagle is listed as vulnerable under the TSC Act. The species is known to occur throughout the Australian mainland and occurs as a single population in NSW. The little eagle is typically identified in open eucalypt forests, woodlands and open woodlands.

This species was recorded within the LCO during the 2007 monitoring program (Umwelt 2007) and during surveys undertaken for the 2001 EIS (Umwelt 2001). Both records were prior to the species being listed as threatened as such their locations were not recorded at the time the observations were made. As the exact locations of these records are unknown this species is assumed to occur within the Proposed Modification Area.

The Proposed Modification Area provides suitable foraging habitat for the species. Potential nesting habitat occurs within the Proposed Modification Area with some appropriately tall trees identified; however nesting has not been previously recorded. The Proposed Modification Area is considered to comprise likely foraging habitat for this species as part of a wider foraging range in surrounding habitats.

4.3.2.5 Eastern Grass Owl – *Tyto longimembris*

The eastern grass owl is listed as vulnerable under the TSC Act. This owl is known to occur in all mainland states of Australia, but is most common in north and north-eastern Australia. The eastern grass owl is typically identified in tall grassy habitats which can include grass tussocks, swamp areas, grassy plains or sedges on floodplains.

The eastern grass owl was identified by Umwelt during 2013 fauna surveys in Central Hunter Box – Ironbark Derived Native Grassland in the central east of the Proposed Modification Area. No records of this species have been made in the Proposed Modification Area, the broader LCO or have been known to occur within 20 kilometres of the Proposed Modification Area previously (Bionet 2013).

This record is atypical for the Hunter Valley as this species typically occurs in coastal areas, however it is known to experience fluctuations in population and distribution in response to prey species populations (particularly that of rodents). It is unlikely that the Proposed Modification Area provides a resident population of this species as the species is highly mobile and likely to have only been identified in response to a fluctuation in prey densities.

4.3.2.6 Hooded Robin (south-eastern form) – *Melanodryas cucullata cucullata*

The hooded robin (south-eastern form) is listed as vulnerable under the TSC Act. The south-eastern form of the species is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west. The hooded robin is typically found in lightly timbered woodland, mainly dominated by acacia and/or eucalypts.

The hooded robin was identified within the LCO during the 2009 monitoring period (Umwelt 2010a) as well as during surveys undertaken by ELA in 2011 (ELA 2013a). Both of these records were made within 100 metres of the Proposed Modification Area. Although this species has not been regularly recorded, it is considered likely that it is part of a resident population that likely utilises the Proposed Modification Area as part of a wider foraging range in surrounding habitats.

4.3.2.7 Brown Treecreeper (eastern subspecies) – *Climacteris picumnus victoriae*

The brown treecreeper (eastern subspecies) is listed as vulnerable under the TSC Act. It is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range.

This species was recorded on numerous occasions within the Proposed Modification Area by ELA (2013a) during targeted surveys of the Proposed Modification Area. These records were in the west of the Proposed Modification Area in the Swamp Oak Forest. It is likely that this species occurs as part of a resident population, with the Proposed Modification Area likely to

comprise foraging and potential nesting habitat for this species as part of a wider foraging range in surrounding habitats.

4.3.2.8 Speckled Warbler – *Chthonicola sagittata*

The speckled warbler is listed as vulnerable under the TSC Act. In NSW, this species occupies eucalypt and cypress woodlands, generally on the western slopes of the Great Dividing Range.

The species has been recorded on numerous occasions during the 2006 Ecological Assessment (Umwelt 2006), ELA surveys (ELA 2013a), and regularly during monitoring events. It has been recorded throughout the Proposed Modification Area, particularly in areas of Central Hunter Grey Box Ironbark Woodland. The Proposed Modification Area is considered to comprise foraging and likely breeding habitat for this species.

4.3.2.9 Grey-crowned Babbler (eastern subspecies) – *Pomatostomus temporalis temporalis*

The grey-crowned babbler (eastern subspecies) is listed as vulnerable under the TSC Act. In NSW, the eastern subspecies occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW.

The grey-crowned babbler has been recorded throughout the Proposed Modification Area and is known to breed there. Records of this species have been made within the LCO since the 2001 EIS (Umwelt 2001) and on a regular basis since this time. As this species has been recorded with regularity and is known to breed there, it is considered likely that the Proposed Modification Area provides habitat for a resident population.

4.3.2.10 Rainbow Bee-eater – *Merops ornatus*

The rainbow bee-eater is listed as a migratory species under the EPBC Act. The preferred habitat of this species is open forests and woodlands, shrublands, and cleared or semi-cleared areas (commonly farmland). These areas are usually close to permanent water, however, during migration this bird may fly over areas of non-preferential habitat. The rainbow bee-eater is distributed throughout most of mainland Australia as well as several near-shore islands.

This bird has been recorded within the LCO during annual monitoring (Umwelt 2010a), and has been recorded in the Proposed Modification Area by ELA (2013a). It is likely that the Proposed Modification Area provides both breeding and foraging habitat for this species, these may include cleared areas as well as vegetated areas, given that this species build their nests at the end of long burrows.

4.3.2.11 Great Egret – *Ardea alba*

The great egret (*Ardea alba*) is listed as a migratory species under the EPBC Act. This species typically inhabits areas of shallow, flowing water, but also uses damp grasslands and watered area. The great egret (*Ardea alba*) is distributed throughout the world and is common throughout most areas of Australia with the exception of extremely arid areas.

This bird was recorded within the LCO during annual monitoring (Umwelt 2007); it has not been recorded in the Proposed Modification Area. As this species has only been recorded on one occasion within the broader LCO and as the habitats provided by the Proposed Modification Area are considered to be marginal in quality for this species. It is considered

that this species is an irregular visitor and would likely only uses the site as a fly-over when moving between areas of more appropriate habitat.

4.3.2.12 Cattle Egret – *Ardea ibis*

The cattle egret (*Ardea ibis*) is listed as a migratory species under the EPBC Act. The cattle egret (*Ardea ibis*) can be found in grasslands, wetlands and woodlands. This species is commonly sighted at garbage dumps, pastures and croplands (especially where poor drainage is present). This species is distributed throughout Asia, Africa, Europe and Australia. It is most commonly found in north-eastern Western Australia, the Northern Territory and in south-eastern Australia from Bundaberg Queensland through to Port Augusta, South Australia.

This species was identified within the wider LCO during surveys undertaken for the 2001 EIS (Umwelt 2001). The exact location of this species was not recorded at the time of these surveys and as a consequence could not be mapped. As this species has only been recorded on one occasion within the broader LCO and as the habitats provided by the Proposed Modification Area are considered to be marginal in quality for this species, it is considered that this species is an irregular visitor and would likely only uses the site as a fly-over when moving between areas of more appropriate habitat.

4.3.2.13 White-bellied Sea-eagle – *Haliaeetus leucogaster*

The white-bellied sea eagle (*Haliaeetus leucogaster*) is listed as a migratory species under the EPBC Act. This species is typically sighted perched in tall trees and soaring above water bodies and land and is found distributed across Australia, China, India, Indonesia, New Guinea, and south-east Asia. It is typically found near the coast.

This species was identified in the wider LCO during surveys undertaken for the 2001 EIS (Umwelt 2001) and during the 2007 and 2010 (Umwelt 2007 and 2011) monitoring events. This species may be utilising the habitats of the Proposed Modification Area for foraging, however is unlikely to be roosting there due to a general lack of the tall trees that this species prefers. It is likely that this species is a regular visitor to the Proposed Modification Area, however is likely to only be using the habitats present as part of a wider forging range.

4.3.2.14 White-throated needletail – *Hirundapus caudacutus*

The white-throated needletail (*Hirundapus caudacutus*) is listed as a migratory species under the EPBC Act. This species is only in Australia approximately between the months of October and May. It forages upon flying insects and drinks whilst in flight. Feeding is typically associated with rising thermal currents typical with storm fronts and bushfires.

This species has only been recorded on one occasion within the broader LCO (Umwelt 2001); it has not been recorded since this time. This species is likely to rarely use the habitats of the Proposed Modification Area, and when it does occur is likely to be the result of irregular weather patterns or extreme weather conditions such as bushfire etc. This species does not breed in Australia and as a consequence there is no potential for it to be utilising the available habitats for breeding.

4.3.2.15 Clamorous Reed Warbler – *Acrocephalus stentoreus*

The clamorous reed warbler (*Acrocephalus stentoreus*) is listed as a migratory species under the EPBC Act. This species prefers dense vegetation, particularly alongside water, particularly in thick reed beds as well as tall crops, bamboo thickets and lantana. The clamorous reed warbler (*Acrocephalus stentoreus*) is found throughout Australia in area of

suitable habitat. Outside of Australia, it is also found from New Guinea to south-eastern Africa.

This species was identified in the wider LCO during the 2005 monitoring event (HLA Envirosciences 2005) and during surveys undertaken for the 2001 EIS (Umwelt 2001). Given that this species has not been recorded since 2005, there is potential that this species is no longer present within the LCO or is an irregular visitor. There is a general paucity of appropriate habitat for this species occurring within the Proposed Modification Area, and it is unlikely that this species would be exclusively dependent upon habitats provided by the Proposed Modification Area.

4.3.2.16 Satin Flycatcher – *Myiagra cyanoleuca*

The satin flycatcher (*Myiagra cyanoleuca*) is listed as a migratory species under the EPBC Act. This species can be found in both Australia and New Guinea. In Australia it is distributed along the east coast from Cape York through to Tasmania, also covering parts of south-eastern South Australia. In these areas, this species typically inhabits wet areas of tall forests, particularly in gullies. This species moves north in the winter and is seldom seen in New South Wales, Tasmania, Victoria or South Australia during these times.

This species has been recorded on one occasion within the broader LCO during the 2007 monitoring event (Umwelt 2007). The Proposed Modification Area is unlikely to be providing anything other than a fly-over area or stop-over location whilst moving between areas of more appropriate habitat as there are no area of wet tall forest within the Proposed Modification Area.

4.3.2.17 Spotted-tailed Quoll – *Dasyurus maculatus maculatus*

The spotted-tailed quoll (*Dasyurus maculatus maculatus*) is listed as vulnerable under the TSC Act and as endangered under the EPBC Act. There are a number of records of this species in the general locality (defined here as the middle Foy Brook area, which comprises the land to the east and north-east of Lake Liddell and to the north of the New England Highway), including records from LCO, the Ravensworth Operations Hillcrest Offset Site and regular records nearby at nearby Mt Owen Complex.

At Mt Owen, this species has been recorded annually between 1994 and 2013 (except 1998, 1999 and 2005) in Ravensworth State Forest and surrounding woodland and forest communities, including mine rehabilitation and within existing Mt Owen offset areas. There have also been a number of unconfirmed sightings of the species within the Mt Owen active mine area. Additional records of this species exist along Bowmans Creek during ecological monitoring at LCO (Umwelt 2008) and in the Ravensworth Operations Hillcrest Offset Area (Umwelt 2010b) (at least three recorded latrine sites). Records in the locality are generally concentrated on Bowmans Creek and Ravensworth State Forest, however also extend into the more disturbed areas (from operational mining, power stations or cleared agricultural areas) surrounding these.

Surveys undertaken by ELA during November 2012 at LCO identified the presence of one female spotted-tailed quoll (*Dasyurus maculatus maculatus*) and two joeys at a den site located near to Bowmans Creek (**Figure 4.2**). A larger individual (believed to be a male) was also sighted near to this area by ELA. Umwelt additionally recorded a latrine site, positive identifications of quolls via remote camera, tracks and several scats along the length of Bowmans Creek and its surroundings occurring within the LCO DA boundary. It is noted however that these recordings were all outside the Proposed Modification Area.

A variety of survey methods have resulted in positive identification of this species in the middle Foy Brook area, including hair tube sampling, spotlighting, remote camera surveys, latrine searches, cage trapping and predator scat searches. Additionally, recent radio-tracking undertaken by Thiess in Mt Owen has shown a resident male occurring in Ravensworth State Forest and mine rehabilitation to the north and east of North Pit (Peter York pers. comm.). Other non-tagged individuals have also been recorded during remote camera surveys (Peter York pers. comm.).

All of the natural and derived native vegetation communities in the local area provide potential foraging habitat for the spotted-tailed quoll (*Dasyurus maculatus maculatus*). These include derived native grassland, woodland, forest, riparian, rainforest and rehabilitated vegetation. More complex habitats (e.g. rainforest and forest) are preferable and of higher value to the spotted-tailed quoll. The various habitats of the Proposed Modification Area are likely to form part of the home range of the breeding female identified at LCO, and also possibly an overlapping (although generally larger) male home range. The Proposed Modification Area itself does not contain known den or breeding sites for the spotted-tailed quoll (*Dasyurus maculatus maculatus*); however den where breeding is known to have occurred is located approximately 1.75 kilometres to the north of the Proposed Modification Area.

There are few woodland areas within the central Hunter Valley lowlands (the main Hunter Valley) that are of sufficient size to support the home range of this species. It is recognised that for a habitat generalist such as the quoll it is difficult to define a regional population. It is likely that the fragmented habitats of the Hunter Valley floor (as well as major road, rail and other infrastructure networks crossing it) would limit genetic exchange from the Barrington Tops area in a southerly direction, thus providing a likely genetic barrier to individuals of this species in the Wollemi/Yengo National Parks areas. The Barrington Tops and Mount Royal Range areas provide reasonable geographic features with which to bound the population to the north, although there is likely to be no firm discontinuity in species records between the Proposed Modification Area and habitats to the north of Barrington Tops. For the purpose of this assessment, it is taken that a regional population of this species is focused on the footslopes to the south and west of the Barrington Tops and that this is likely to be genetically distinct and fragmented from those on the southern side of the Hunter Valley. This area comprises some 1800 km^2 of land, of which approximately 48 per cent is wooded, with about 52 per cent comprising agricultural lands. This regional population includes the middle Foy Brook local population identified earlier.

The general outcomes of the spotted-tailed quoll surveys completed in the Proposed Modification Area, Bowmans Creek, Mountain Block and Hillcrest Offset Area include the following:

- None of the surveys completed (included comprehensive remote camera surveys) have recorded the spotted-tailed quoll within the Proposed Modification Area.

- This species has been recorded on numerous occasions near to the Proposed Modification Area, along Bowmans Creek and in Mountain Block to the north.

- A minimum of six individual spotted-tailed quolls have been identified (via photographs) at three locations on Bowmans Creek and at four locations at Mountain Block. A high level of activity was observed during the survey period, with 52 separate camera station visits attributed to a spotted-tailed quoll.

- Latrine sites have been identified at eight locations at Mountain Block, including one large and regularly used latrine at the top of the hill. A total of six individual spotted-tailed quolls were identified as using this latrine between 6 and 17 June, with multiple individuals visiting the latrine during a single 24 hour period on three occasions. Scat samples were collected from seven latrines for dietary analysis.

- A den site containing fresh scats was identified under a boulder amongst rock outcropping near the large latrine in Mountain Block. This was monitored with a remote sensing camera and recorded individuals investigating, entering and leaving the den on several occasions.

- Movement of an individual from Mountain Block south along Bowmans Creek was recorded on 8 June, however it is likely that other individuals also move along the creek on a regular basis.

- The female recorded in 2012 was not identified in the northern section of Bowmans Creek or Mountain Block, but was recognised from a remote camera station placed by Enright Land Management approximately 400 metres east of where Umwelt recorded her in 2012.

- Scat samples were collected from four latrine sites along Bowmans Creek, including three previously known and one newly discovered latrine. One previously known latrine showed a high level of activity with many fresh scats and multiple rocks used.

- Three latrine sites, including a large and recently used one, were recorded in the Ravensworth Operations Hillcrest Offset Site. A remote sensing camera was placed on one of these latrines, however no spotted-tailed quolls were recorded using the latrine during the survey period. Scat samples were collected from two of these latrines for dietary analysis.

Dietary Analysis

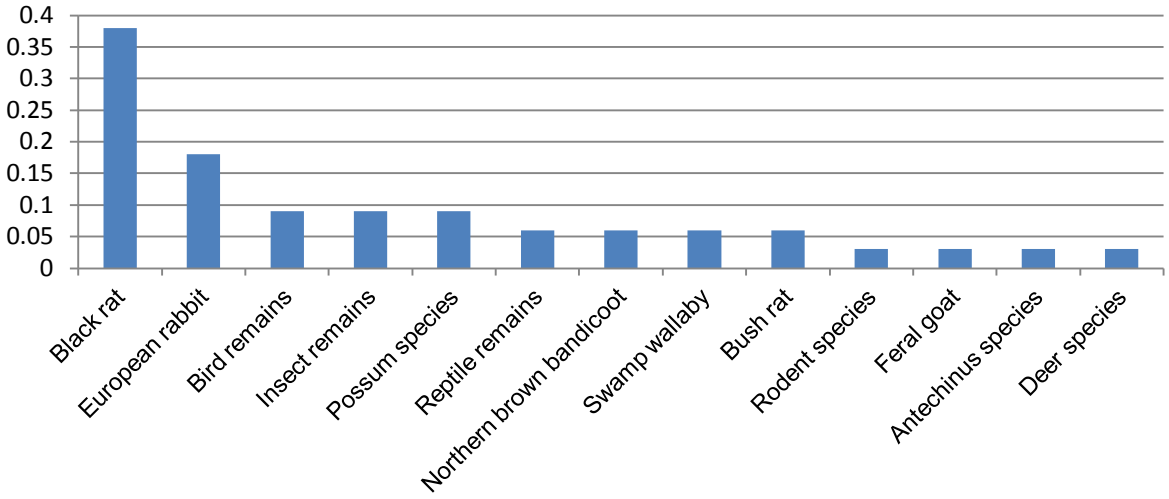
Scat collection was made at 15 locations during surveys, including eight locations in Mountain Block, four locations on Bowmans Creek and three locations in the Ravensworth Operations Hillcrest Offset Site. These samples, along with an additional seven scat samples collected by Umwelt on Bowmans Creek in 2012, were sent to Barbara Triggs for expert analysis, the results of which are shown **Table 4.5**.

Table 4.5 – Scat Samples Collected in 2012 and 2013

Species	Number of Scats
Spotted-tailed quoll	5
Spotted-tailed quoll/red fox	7
Red fox	11
Dog	2

A total of five scat samples were confidently attributed to a spotted-tailed quoll. A further seven samples could not be confidently attributed to either the spotted-tailed quoll or red fox due to the similarities of scats left by those species. The remaining samples were attributed to the red fox and wild dogs.

Content analysis of scat samples was undertaken to provide a dietary analysis of carnivores in the Liddell locality. While 52 per cent of scats analysed were attributed to species other than the spotted-tailed quoll, due to a similar predatory nature, fox and dog scats were considered to provide a representative sample of prey species likely to be selected by the spotted-tailed quoll in the area.



Graph 4.1 – Frequency of Occurrence of Prey Remains in Scats Collected During 2012 and 2013

Dietary analysis of scats shows that the black rat (*Rattus rattus*) and European rabbit (*Oryctolagus cuniculus*) are recorded most frequently in predator scats in the Liddell locality. A minimum of 10 other fauna species are included in varying degrees, comprising reptiles, birds, small and medium sized mammals, and large mammals. These results are similar to those recorded for the spotted-tailed quoll in other studies (Belcher and Darrant 2006; Belcher *et al*. 2007; Glenn and Dickman 2006).

The high frequency of black rat and European rabbit remains in scats suggest that these species are important prey species in the locality.

Prey Density Surveys

The Proposed Modification Area was found to contain potential prey species at an average density of 1.5 individuals per hectare (comprising three species). This density is not regarded as high quality foraging habitat (Belcher and Darrant 2006), however it is moderately high and there is a reasonable likelihood that the spotted-tailed quoll utilises the Proposed Modification Area as part of a larger foraging range. Records of the breeding female spotted-tailed quoll have been made nearby in Bowmans Creek by Umwelt in 2012 and by Enright Land Management in 2013. This individual is likely to utilise habitat within the Proposed Modification Area as part of its home range.

4.3.2.18 Southern Myotis - *Myotis macropus*

The southern myotis is listed as vulnerable under the TSC Act. The species is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria and roost close to water in caves mine shafts, hollow-bearing trees, under bridges and in dense foliage.

This species has been recorded throughout the Proposed Modification Area during ELA surveys (ELA 2013a) as well as in the wider LCO during annual monitoring events. The Proposed Modification Area is considered to comprise potential foraging and roosting habitat for this species as part of a wider foraging range in surrounding habitats.

4.3.2.19 Eastern Cave Bat – *Vespadelus troughtoni*

This eastern cave bat is listed as vulnerable under the TSC Act. The eastern cave bat is a cave-roosting bat that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. This species has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals, and is occasionally found along cliff-lines in wet eucalypt forest and rainforest.

The eastern cave bat has been recorded in the broader LCO by Umwelt (2010), as well as by ELA (2013a) at three separate sites within the Proposed Modification Area and one location in the LCO but outside of the Proposed Modification Area.

Given that this species relies on caves for roosting, it is likely that the records of this species within the Proposed Modification Area were of foraging bats only, as there is no appropriate roosting habitat for this species within the Proposed Modification Area. It is likely that this species uses the Proposed Modification Area as part of a wider foraging range.

4.3.2.20 Greater Broad-nosed Bat - *Scoteanax rueppellii*

The greater broad-nosed bat is listed as vulnerable under the TSC Act. The species is mainly found in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland and extends to the coast over much of its range. The species mainly roosts in tree hollows, but also in buildings.

The greater broad-nosed bat has been recorded on one occasion within the broader LCO by Umwelt (2010), as well throughout the Proposed Modification Area by ELA (2013a). There is potential hollow roosting habitat for this species within the Proposed Modification Area, however these are considered to be generally scarce. This species is considered likely to use Proposed Modification Area as part of a wider forging area.

4.3.2.21 Eastern False Pipistrelle – *Falsistrellus tasmaniensis*

The eastern false pipistrelle is listed as Vulnerable under the TSC Act. This species prefers moist habitats, with trees over 20 metres high and generally roosts in eucalypt tree hollows or under bark.

This species has been recorded within the broader LCO by Umwelt (2010) during monitoring, as well as throughout the Proposed Modification Area by ELA (2013a). Although there is a small extent of potential hollow roosting habitat for this species within the Proposed Modification Area, it is considered likely that this species only utilises the habitats of the Proposed Modification Area as part of a wider foraging range.

4.3.2.22 Eastern Freetail-bat - *Mormopterus norfolkensis*

The eastern freetail-bat (*Mormopterus norfolkensis*) is listed as vulnerable under the TSC Act. The species is found along the east coast from south Queensland to southern NSW and roosts mainly in tree hollows and bark.

The eastern freetail-bat (*Mormopterus norfolkensis*) has been regularly recorded within the broader LCO during annual monitoring by Umwelt (2007, 2008 and 2010) and within the southern areas of the Proposed Modification Area by ELA (2013a). The Proposed Modification Area is considered to comprise foraging habitat and potential roosting habitat for this species as part of a wider foraging range in surrounding habitats.

4.3.2.23 Eastern Bentwing-bat - *Miniopterus schreibersii oceanensis*

The eastern bentwing-bat is listed as vulnerable under the TSC Act. The species is found along the east and north-west coasts of Australia and roosts in caves, tunnels, buildings and other man-made structures.

The eastern bentwing-bat has been recorded widely across the broader LCO area by Umwelt during the 2006, 2008, 2009 and 2010 monitoring periods as well as within the Proposed Modification Area by ELA (2013a). Given the paucity of appropriate breeding habitat within the Proposed Modification Area, it is considered that this species only uses the Proposed Modification Area as foraging habitat; however is a regular user.

4.3.3 Fauna Habitat

As part of their fauna assessment works as part of this Project, ELA provided detailed descriptions of fauna habitat types recorded within the Proposed Modification Area. These are provided below, as reproduced from **Appendix 1**.

4.3.3.1 Woodland

The woodland habitat type is generally dominated by *Eucalyptus crebra* (Narrow-leaved Ironbark) in the upper stratum and *Allocasuarina luehmannii* (Bull Oak) and *Acacia salicina* (Cooba) in the mid stratum; however some areas have a canopy dominated by Bull Oak and others by Narrow-leaved Ironbark. The shrub layer is sparse but the ground cover is dense with native forbs, sedges, ferns and grasses including *Dichondra repens* (Kidney Weed), *Chrysocephalum apiculatum* (Common Everlasting), *Lomandra filiformis* (Wattle Mat-rush), *Cheilanthes sieberi* (Poison Rock Fern), *Cymbopogon refractus* (Barbed Wire Grass), *Aristida ramosa* (Purple Wiregrass), *Eragrostis brownie* (Brown's Lovegrass) and *Cynodon dactylon* (Couch). The weed species *Opuntia humifusa* (Creeping Pear) and *Senecio madagascariensis* (Fireweed) were prevalent.

There was a general paucity of hollow resources (recorded at a low rate of 2 per hectare) and fallen logs within this habitat type, however sheltering resources are provided by dense Bulloak. The woodland type provides habitat (foraging, roosting and breeding) for a range of threatened fauna species, particularly woodland birds and microchiropteran bats.

4.3.3.2 Regrowth

The regrowth type is dominated by regrowth *Allocasuarina luehmannii* over a diverse groundlayer similar to that present in the woodland habitat type. The regrowth type provides reduced fauna habitat compared to that available within the adjacent woodland, however resources for foraging and roosting for a number of threatened fauna species, particularly woodland birds and microchiropteran bats still exist.

4.3.3.3 Riparian Forest

This habitat type is present as a low to tall forest dominated by *Casuarina glauca* (Swamp Oak) and occasionally also *Eucalyptus tereticornis* (Forest Red Gum) in the upper stratum. The mid layer is sparse but the ground cover is dense with native low lying shrubs, forbs and grasses including *Maireana microphylla* (Small-leaf Bluebush), *Einadia nutans* (Climbing Saltbush), *Oxalis perennans, Pratia purpurascens* (Whiteroot), *Austrostipa verticillata* (Slender Bamboo Grass), *Cynodon dactylon, Microlaena stipoides* (Weeping Grass) and *Panicum* sp.. The native mistletoe *Amyema cambagei* was commonly observed and weed species were also prevalent including *Aster subulatus* (Wild Aster), *Bryophyllum daigremontianum*, *Ehrharta erecta* (Panic Veldtgrass), *Galenia pubescens* (Galenia), *Juncus acutus* (Spike Rush), *Senecio madagascariensis, Sida rhombifolia* (Paddy's Lucerne) and *Solanum nigrum* (Black-berry Nightshade).

The riparian forest habitat type provides habitat (foraging, roosting and breeding) for a range of threatened fauna species, particularly woodland birds and microchiropteran bats. Hollow resources (recorded at a rate of 7 per hectare) were more abundant within this habitat type compared with the adjoining woodland. This habitat type also provides connectivity across the landscape.

4.3.3.4 Riparian Woodland

This habitat type is present as a tall woodland dominated by *Casuarina cunninghamiana* (River Oak) in the upper stratum. The mid layer is sparse but the ground cover is dense, dominated by native grasses including *Austrostipa verticillata, Chloris ventricosa* (Plump Windmill Grass) and *Sporobolus creber* (Western Rat-tail Grass) and weed species including *Bidens subalternans* (Greater Beggar's Ticks), *Conyza bonariensis* (Flaxleaf Fleabane), *Galenia pubescens, Lepidium africanum, Opuntia aurantiaca, Pennisetum clandestinum* (Kikuyu), *Senecio madagascariensis, Setaria parviflora* and *Sida rhombifolia.*

The riparian woodland type provides similar habitat values to the riparian forest type with greater connectivity across the landscape, however hollow resources (recorded at a rate of 5 per hectare) were slightly lower than the riparian forest habitat type.

4.3.3.5 Grassland

The grassland habitat generally lacks any shrub or canopy strata but has a diverse groundlayer similar to that present in the woodland habitat type. The grassland type provides reduced fauna habitat to that available within the adjacent woodland and regrowth, however resources for foraging for a number of threatened fauna species, particularly woodland birds and microchiropteran bats still exist.

4.3.3.6 Creeks, Drainage Lines and Farm Dams

In addition to the above habitat types, Umwelt described the aquatic habitat of the Proposed Modification Area. Ephemeral creeks and drainage lines within the Proposed Modification Area occurred with and without associated riparian woodland habitat. Drainage lines often had deeply incised banks and typically have very little flow. Riparian vegetation was dominated by grasses and sedges including the exotic weed sharp rush (*Juncus acutus*).

Small sized farm dams occurred scattered throughout the Proposed Modification Area, most commonly occurring within grassland habitat areas. Farm dam quality was variable ranging from low quality dams with no emergent or bank vegetation to moderate quality dams with emergent and bank vegetation. No dams were identified that would have been considered to consist of good quality habitat.

This formation provides habitat primarily for amphibian species and long-necked turtles, as well as a drinking resource for other fauna species.

4.3.4 SEPP 44 (Koala Habitat) Assessment Results

No potential koala habitat was recorded within the Proposed Modification Area as defined by SEPP 44 as Schedule 2 species listed under the policy were either not recorded or recorded in densities less than 15 per cent of all overstorey species within each community.

Furthermore, no koalas were identified during extensive walking or driving spotlight searches (refer to **Section 3.3.3**) in the Proposed Modification Area and the species has not been recorded during annual fauna monitoring surveys. The species was tentatively recorded during the Mt Owen monitoring in 1995 through the collection of scats resembling those of the koala (Forest Fauna Surveys and Newcastle Innovation 2012). It is now considered likely that these scats were misidentified (Forest Fauna Surveys and Newcastle Innovation 2012).

4.3.5 Aquatic Ecology Results

A detailed aquatic ecology and groundwater-dependent ecosystem assessment has been prepared by ELA (2013b), and has been included as **Appendix 1** to the Environmental Assessment.

4.3.5.1 Aquatic Species

A summary of the key aquatic species results has been included below:

- **Macro-invertebrate sampling** – 32 macro-invertebrate taxa recorded across all sites. Sites with the highest diversity (17 taxa each) were both downstream sites along Bayswater and Bowmans Creeks. The site with the lowest diversity (6 taxa) was the upstream Bayswater Creek site.

- **Fish sampling** – three fish species were recorded, being mosquito fish (*Gambusia holbrooki*), marbled eels (*Anguilla reinhardtii*) and flathead gudgeons (*Philypnodon grandiceps*).

- **Riparian condition** – the RCE scores for all sites along Bowmans Creek were 34, while the sites at Bayswater Creek returned scores of 30 and 37. The vegetation along these creeks was heavily dominated by river oak (*Casuarina cunninghamiana*), as well as a number of weed species.

- **Stygofauna sampling** – 10 stygofauna taxa were collected from the bores along Bowmans Creek.

In addition to the above, a female platypus (*Ornithorhynchus anatinus*) was captured at the southern-most sampling site along Bowmans Creek.

Generally, the two sites at Bayswater Creek were described as being in poor condition, with heavy sediment loads, bank erosion, high electrical conductivity scores, fine black dust and low dissolved oxygen scores. The riparian zone was assessed as being in moderate condition. The SIGNAL2 scores indicated poor condition. All three species are tolerant of relatively poor conditions and are known from similar streams throughout the Hunter Valley.

Bowmans Creek was in relatively good condition, with all physico-chemical variables falling within ANZECC guidelines for lowland rivers in NSW (ELA 2013b). Impacts from cattle access were noted in the form of erosion of the bank and creekbed. Average SIGNAL2 scores indicate a moderate ecological condition.

No threatened aquatic species were collected during this survey, and none are known from the reach of Bowmans Creek. ELA (2013b) identifies that the threatened southern purple spotted gudgeon (*Mogurnda adspersa*) was reported from Goorangoola Creek, in the Glennies Creek Catchment east of Bowmans Creek (MPR 2009). This species is listed as endangered under the *Fisheries Management Act 1994*. Bowmans Creek has suitable habitat in its upstream reaches, but no southern purple spotted gudgeons are known from this creek from this or previous studies.

4.3.6 Groundwater-dependent Ecosystems

Ten stygofauna taxa were collected from the bores along Bowmans Creek, however none of these taxa are endemic (ELA 2013b). Most occur along the Hunter River alluvial aquifer, and in the aquifers associated with many tributary stream. Despite this, it is likely that most of the alluvial aquifer of Bowmans Creek contains stygofauna, and so is considered to be a groundwater-dependent ecosystem.

Stands of *Eucalyptus camaldulensis* (river red gum) occur downstream of the site (MPR 2009). This species generally occurs on river floodplains and has some dependence on alluvial groundwater. However, no stands of river red gum or other groundwater-dependent vegetation communities were located onsite (Umwelt 2006).

Apart from aquifer ecosystems, the only other groundwater-dependent ecosystem occurring on-site is the river baseflow system and associated hyporheic zone of Bowmans Creek. There are strong hydrological links between Bowmans Creek and the surrounding aquifer, which is likely to be important in moderating stream nutrient concentrations, thermal patterns, and water chemistry (Boulton *et al.* 1998).

Further detail on the aquatic and groundwater-dependent ecosystem assessment results can be found in the aquatic ecology and groundwater-dependent ecosystem assessment prepared by ELA (2013b), which has been included as **Appendix 1** to the Environmental Assessment.

5.0 Impact Assessment

The Project will result in the clearing of approximately 188 hectares of native vegetation (including woodland, forest and derived native grassland). This area is known to provide habitat for 10 threatened fauna species, one endangered flora population and 56 hectares of TEC as listed under the TSC Act. No threatened flora species have been recorded within the Proposed Modification Area.

The clearing associated with the Project and assessed as part of this Ecological Assessment includes 123 hectares of native woodland, forest and riparian vegetation. In addition to the loss of native vegetation communities, the Project will result in the loss of approximately 65 hectares of derived native grassland.

In addition to actions undertaken by LCO to avoid and minimise impacts on ecological values (refer to **Section 5.1**) within the Proposed Modification Area, and broader LCO holdings, significant impact mitigation measures and a Biodiversity Offset Strategy are proposed to ameliorate the impact of the Project on ecological values.

5.1 Project Changes to Avoid and Minimise Impacts

The potential impacts of the Project on the ecological values of the Proposed Modification Area were recognised early in project planning. LCO has undertaken detailed concept and pre-feasibility studies into the proposed mining operation and as part of this process numerous alternative mine and infrastructure plans were considered. Minimising environmental and community impacts and maximising economic resource recovery have been major considerations in the evaluation of alternative options.

The proposed original limit of open cut mining associated with the Entrance Pit was reduced in the vicinity of Bowmans Creek, primarily to minimise disturbance of a Sensitive Archaeological Landscape (SAL) identified in the Cultural Heritage Assessment as much as possible. This avoidance of the creekline has also avoided sensitive riparian vegetation and threatened species habitat. LCO has ensured that the limit of open cut mining is a minimum 150 metres from the mapped alluvial boundary associated with Bowmans Creek.

The original Project also included an additional tailings dam in the northern portion of the LCO DA boundary, and would have involved the disturbance of an established rehabilitated area. This dam was subsequently removed from the Project, with tailings to be disposed of in the South Pit final void, reducing the area of land to be cleared as a result of the Project.

Additionally, the Project will not extend outside of the confines of the existing approved DA boundary.

5.2 Summary of Ecological Impacts

The LCO holdings have been under continuous mining operation since the 1950s, and therefore they comprise a highly disturbed landscape. The remaining native vegetation within the LCO is highly fragmented and comprises patches of primarily regrowth vegetation of moderate condition only. The remnant vegetation within LCO (excluding that within the Proposed Modification Area) is very minimal, comprising a narrow strip of riparian vegetation along the western side of Bowmans Creek, small patches of remnant woodland close to operational areas, derived native grassland and grazing pasture (particularly in the eastern and northern parts of the LCO) and current rehabilitation works. There is very little existing

connectivity to vegetation adjoining the LCO, however there is existing remnant vegetation adjoining the northern parts of the LCO that features in the rehabilitation planning for this Project.

The ecological values identified in the Proposed Modification Area that have been considered in determining the impact of the Project and the development of impact mitigation and biodiversity offsetting requirements include:

- known threatened species habitat comprising:
    - 123 hectares of native woodland, forest and riparian vegetation which (while being regrowth and of moderate condition only) is known habitat for a number of threatened woodland bird and micro-bat species, including the brown treecreeper (*Climacteris picumnus victoriae*), grey-crowned babbler (*Pomatostomus temporalis temporalis*), speckled warbler (*Chthonicola sagittata*), southern myotis (*Myotis macropus*); greater broad-nosed bat (*Scoteanax rueppellii*); eastern false pipistrelle (*Falsistrellus tasmaniensis*); eastern bentwing-bat (*Miniopterus schreibersii oceanensis*); eastern cave bat (*Vespadelus troughtoni*); and eastern freetail-bat (*Mormopterus norfolkensis*);
    - 65 hectares of derived native grassland vegetation containing known habitat for threatened species the eastern grass owl (*Tyto longimembris*);
    - likely important habitat for the spotted-tailed quoll (*Dasyurus maculatus maculatus*). The species has been recorded many times within the LCO holdings (although not within the Proposed Modification Area itself), as well as more widely in the local area. Of increased significance of these records is a confirmed breeding event within 2012, from a den site located along Bowmans Creek, within the LCO holdings;
    - a single individual of the tiger orchid (*Cymbidium canaliculatum*), an endangered population in the Hunter Valley;
- 123 hectares of native woodland, forest and riparian vegetation, comprising:
    - 22 hectares of the Central Hunter Box – Ironbark Woodland EEC;
    - 1 hectare of the Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated) EEC;
    - 33 hectares of the Central Hunter Box – Ironbark Woodland (Regrowth) EEC;
    - 5 hectares of Central Hunter Swamp Oak Forest;
    - 62 hectares of Central Hunter Bulloak Forest; and
- 65 hectares of Central Hunter Box – Ironbark Derived Native Grassland.

Based on the ecological values of the Proposed Modification Area and wider LCO holdings (as above), the Project is likely to result in impact on ecological values. Although impact mitigation has been incorporated into the Project (see **Section 6.0**), a Biodiversity Offset Strategy is proposed to address the residual impacts of the Project. The Project will result in the removal of approximately 188 hectares of native vegetation.

The above habitat contains known records for ten threatened fauna species and one endangered flora population. No threatened flora species have been recorded within the Proposed Modification Area.

Given the highly fragmented nature of the vegetation within the Proposed Modification Area, and the isolated nature of the majority of the vegetation within the LCO DA boundary to adjoining vegetation, it is unlikely that the Project will result in a reduction in connectivity throughout the LCO, or the broader region.

5.3 Indirect and Off-site Impacts

The Project involves an extension of existing open cut mining operations in a south-easterly direction from current mining activities in both the Entrance Pit and South Pit (see **Figure 1.2**). There are currently no changes proposed to currently approved production levels, mining methods, mining equipment or operating hours. There would therefore be no increase in mining related activities in the general area.

The main sources of potential indirect impact relating to the Project include dust, noise and groundwater impacts. The existing vegetation in the Proposed Modification Area is currently fragmented with only poor connectivity outside of LCO. The Project will remove this isolated patch of remnant vegetation, however is unlikely to disrupt local corridor function, as the narrow riparian corridor along Bowmans Creek will not be impacted.

The proposed extension of open cut mining associated with the Project is towards Bowmans Creek. However, whilst the Entrance Pit will be extending closer to a portion of Bowmans Creek, existing mining operations at Liddell have been undertaken for many years in parallel with the creek, and the proposed extension is a continuation of this as is evident on **Figure 1.2**. The proposed extent of the Entrance Pit at its closest point will be approximately 160 metres from Bowmans Creek, consistent with existing approved operations, which at various locations have come within 110 metres of the creek within the approved mining footprint. Therefore, given that there are no changes proposed to production levels, mining equipment or mining methods, and that the proposed Entrance Pit extension will be no closer to the creek than previously approved open cut mining activities, the indirect impacts as a result of the Project are not anticipated to be different to that currently approved.

With regards to specific indirect impacts as a result of the Project, particularly in relation to noise, the Noise Assessment conducted by Global Acoustics (2013) concluded that since the Project will see LCO continuing to dump in similar locations to the operations of the last two years, and that LCO will be required to continue to meet the existing noise criteria for the life of the mine, similar noise levels could therefore be reasonably expected as a result of the Project. Similarly, an increase in lighting and dust related indirect impacts on ecological communities and species is not anticipated given that the Project will involve a continuation of mining in parallel with Bowmans Creek at the same production levels and operating hours as are currently approved.

The Aquatic Ecology and Groundwater Dependent Ecosystem Assessment (ELA 2013b) indicated drawdown of a maximum of 1.4 metres for a relatively small section of the alluvial aquifer associated with Bowmans Creek as a result of the Project, with drawdown expected of 0.5 to 1 metre extending for up to 3 kilometres. This is not expected to result in any significant impacts on the aquifer, aquatic ecological features or groundwater dependent ecosystems, as there will be at least 8 metres of saturated sediments remaining over the majority of the aquifer (ELA 2013b).

Section 5A of the EP&A Act requires the assessment of indirect impacts as part of several of the factors that form part of the seven-part test process, however factor (a) is particularly relevant to indirect impacts. Factor (a) requires an assessment of *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*. Factor (c) requires an assessment of *whether the action proposed 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. The Department of Environment and Climate Change (DECC) (now OEH) (2007) *Threatened Species Assessment Guidelines* define the 'local population' as the population that occurs in the 'study area' and also defines the 'study area' as the area directly affected by the proposal and any additional areas that are likely to be affected by the proposal, either directly or indirectly. The DECC (2007) *Threatened Species Assessment Guidelines* indicate that the study area should extend as far as is necessary to take all potential impacts into account. The same approach has been adopted in order to define the *local occurrence* of an ecological community.

Indirect impacts should be, and have been as part of the Ecological Assessment, considered on a case by case basis, because the potential for indirect impacts on each species, community or population is different. It is not possible to accurately produce a map showing the expected indirect impacts caused by the Project. The area over which indirect impacts such as noise and dust pollution could impact on ecological communities, endangered populations and species is unique to each indirect impact type and to the ecological community, endangered population or species potentially affected. For example indirect impacts from dust will vary according to wind strength and direction and will also vary over time (from hourly to across seasons). Additionally indirect impacts may extend beyond the Project disturbance footprint to varying distances depending on the ecological community, endangered population or species affected. While impacts on some species may be relatively localised, impacts on other species may extend a considerable distance from the impact area. For example impacts on a fauna species in one locality that reduce foraging efficiency could result in decreased survivorship of individuals within a population that may be contained within a remnant woodland patch or that extends across a number of patches. Indirect impacts should therefore be considered on a case by case basis, and were so within this Ecological Assessment.

Assessments of the direct and indirect impacts of the Project on all threatened species, endangered populations and TECs were undertaken on a case-by-case basis in both this document, and as part of the seven-part tests undertaken (see **Appendix 4**).

The most pertinent example of this approach is the precautionary assessment approach adopted for the spotted-tailed quoll (*Dasyurus maculatus maculatus*). While the Project will not directly impact the known breeding den within the LCO holdings, the loss of 123 hectares of moderate quality and 65 hectares of lower quality foraging habitat for this breeding female from the Proposed Modification Area could have the potential to threaten future breeding success of this species in the immediate area. Based on the application of the precautionary principle it was concluded that as a result of this indirect impact, the Project has the potential to result in a significant impact on this species. This conclusion has been reached without confirmation of direct use of the habitats of the Proposed Modification Area by this species, despite detailed surveys.

5.4 Impact of the Project on Flora Species

A total of 221 flora species were recorded in the Proposed Modification Area, of which 29.9 per cent were not native to the area. The diversity of species recorded in the Proposed Modification Area is not considered likely to be greater than in surrounding areas due to the extent of clearing for agriculture, expansion of mining operations and lack of natural regeneration occurring in the Proposed Modification Area. None of the species that were recorded are considered to be locally or regionally uncommon or significant.

The Project is not expected to result in a significant adverse impact on the floristic diversity of the local area or region, primarily as a result of the generally low condition and floristic diversity of the vegetation within the Proposed Modification Area, particularly when compared to nearby high quality, intact communities in Ravensworth State Forest and its adjacent Mount Owen Biodiversity Offset Areas.

In order to ameliorate the loss of species diversity from within the Proposed Modification Area, rehabilitation on site will target the reestablishment of native vegetation communities and will involve the use of native flora species of suitable local provenance (wherever possible) to promote increased biodiversity in rehabilitation (refer to **Section 6.2**).

One individual of the tiger orchid (*Cymbidium canaliculatum*) was recorded within the Proposed Modification Area. This individual is representative of the endangered population listed under the TSC Act, and is addressed further in **Section 5.7.1** below.

5.5 Impact of the Project on Vegetation Communities

The Proposed Modification Area is dominated by Central Hunter Bulloak Forest and Derived Native Grassland, with small areas of woodland and forest occurring. The Project will result in the loss of the following vegetation communities:

- 22 hectares of Central Hunter Box – Ironbark Woodland (conforming to the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (listed under the TSC Act));
- 1 hectare of Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated) (conforming to the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (listed under the TSC Act));
- 33 hectares of Central Hunter Box – Ironbark Woodland (Regrowth) (conforming to the Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (listed under the TSC Act);
- 65 hectares of Central Hunter Box – Ironbark Derived Native Grassland;
- 62 hectares of Central Hunter Bulloak Forest;
- 5 hectares of Central Hunter Swamp Oak Forest; and
- 67 hectares of Disturbed Land.

The Disturbed Land component comprises over 22 per cent of the Proposed Modification Area that will be impacted, and this area comprises land that has been subject to disturbance (clearing, earthworks and construction/operation of mining-related infrastructure) to the extent that it offers no reasonable ecological habitat.

The Project will result in the removal of approximately 22 hectares of Central Hunter Box – Ironbark Woodland, 1 hectare of Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated) and 33 hectares of Central Hunter Box – Ironbark Woodland (Regrowth) all of which conform to Central Hunter Grey Box Ironbark Woodland TEC. Interrogation of the data presented by the Hunter Remnant Vegetation Project (Peake 2006) shows that the mapped extent of this community across its distribution in 2006 was approximately 14,800 hectares. Therefore the Project represents a loss of approximately 0.38 per cent of the extant distribution of this community.

The impact of the Project on Central Hunter Box – Ironbark Woodland and its mapped variants in the Proposed Modification Area is assessed further in **Appendix 4**. The assessment of significance has determined that the loss of 56 hectares of the community (and its variants) is unlikely to result in the removal of a significant area of known habitat of the TEC in a regional context.

Approximately 62 hectares Central Hunter Bulloak Forest will be removed as a result of the Project. The loss of 62 hectares of Central Hunter Bulloak Forest is not expected to be significant from a local or regional perspective and the community is likely to readily re-establish unassisted across retained grassland habitats within the broader LCO holdings.

The Central Hunter Box – Ironbark Derived Native Grassland community identified within the Proposed Modification Area is a degraded community that has been significantly affected by past clearing, grazing practices and mining activities such that it is dominated by introduced species in many areas. The removal of 65 hectares of this vegetation as part of the Project is considered unlikely to be significant from a local or regional perspective, due to the dominance of derived native grassland communities in the Hunter Valley.

The loss of approximately 5 hectares of Central Hunter Swamp Oak Forest associated with Chain of Ponds Creek, a tributary of Bayswater Creek is not considered significant from a local or regional perspective. Riparian vegetation in the central Hunter Valley has also been historically cleared and fragmented. Agricultural activities have lead to high levels of weed infestation and erosion due to livestock access. Interrogation of the data presented by the Hunter Remnant Vegetation Project (Peake 2006) shows that the mapped extent of this community across its distribution in 2006 was approximately 1217 hectares. Therefore the Project represents a loss of approximately 0.41 per cent of the current distribution of this community.

The Project incorporates significant habitat reinstatement objectives (refer to **Section 6.3**) with the aim to recreate both vegetation communities and fauna habitats. The recreation of vegetation communities and the conservation of similar communities as part of the Biodiversity Offset Strategy (refer to **Section 7.0**) will counterbalance the loss of native vegetation communities currently occurring within the Proposed Modification Area.

5.6 Impact of the Project on Fauna Habitat and Fauna Species

The Proposed Modification Area is located in a region that has been subject to a long history of vegetation clearing for agricultural purposes such as grazing and for open cut coal mining. This has led to the current condition where the vegetation of the region is highly fragmented and disturbed.

Although they are not large in size, are of only moderate condition and are highly disconnected from larger areas of higher quality habitat, the fauna habitats present within the Proposed Modification Area are important in this fragmented landscape. This is primarily justified by the recorded presence of ten recorded threatened fauna species within these habitats.

Detailed ameliorative measures will be implemented as part of the Project to minimise impacts on fauna species and habitats. Such measures include a substantial Biodiversity Offset Strategy, the re-establishment of terrestrial habitat such as log piles, fallen timber and boulder piles where able; the revegetation of mining areas with native vegetation communities, erection of nest boxes and implementation of pre-clearing surveys to reduce the impact on native fauna, particularly threatened species. The proposed impact mitigation strategy and Biodiversity Offset Strategy is discussed in detail in **Sections 6.0** and **7.0**.

5.6.1 Woodland/Forest Habitats

The removal of approximately 123 hectares of woodland and forest habitat within the Proposed Modification Area represents a moderate loss of fauna habitat. The majority of this habitat will be foraging habitat in the form of canopy vegetation, tree trunks and large branches and bark subsurfaces. Associated with the tree canopies of this habitat are generally low to moderate levels of leaf litter coverage, as well as some fallen timber. Such features, while not in abundance, form an important foraging resource for the fauna species recorded in the Proposed Modification Area. The sparse shrub layer contributes to the reduced condition of this vegetation, therefore simplifying the habitat niches available for exploitation in this habitat type.

Low levels of tree hollows were observed in these habitat types, however those present provide roosting and nesting habitat for hollow-dependent species. Most were small hollows, thus being of most potential benefit to micro-bats and smaller hollow-dependent birds. This dearth of hollow resources is primarily due to the general paucity of structurally mature vegetation in the local area, as a result of previous clearing and land practices. The woodland/forest habitat is likely to be most valuable to the non hollow-dependent threatened species such as the grey-crowned babbler (*Pomatostomus temporalis temporalis*), hooded robin (*Melanodryas cucullata cucullata*) and speckled warbler (*Chthonicola sagittata*). This vegetation formation would also be valuable to those hollow-dependent species that are sufficiently mobile to travel between areas containing roosting hollows and this valuable foraging resource. Such species would include the micro-bat species eastern freetail-bat (*Mormopterus norfolkensis*), eastern false pipistrelle (*Falsistrellus tasmaniensis*) and eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

The spotted-tailed quoll (*Dasyurus maculatus maculatus*) is also likely to make use of this habitat type, as a foraging resource, and as a movement corridor (riparian habitat). This species has not been recorded within the Proposed Modification Area, however its known breeding use nearby within the LCO holdings and its habitats increases the importance of all potential foraging and movement habitat types for this species. The ongoing monitoring records of this species along the Bowmans Creek riparian corridor (as evidenced by visual sightings, scats, tracks, active latrines and an active den site) suggests this area is of most importance to the species, and this area will not be impacted by the Project. The loss of potential foraging habitat for this species from within the Proposed Modification Area is, however, is of importance.

In summary, the loss of 123 hectares of woodland and forest habitat has the potential to have a significant impact on threatened woodland-dependent fauna species recorded within the Proposed Modification Area.

5.6.2 Derived Native Grassland Habitat

The removal of approximately 65 hectares of derived native grassland habitat within the Proposed Modification Area represents a moderate loss of fauna habitat. Grassland habitat is most likely to provide open foraging habitat for fauna species occurring in adjoining vegetated patches. It is likely that these open areas provide foraging habitat for a number of threatened fauna species, however this would be as sub-optimal, modified habitat only. Such habitat is most likely to benefit species that favour woodland margins and open areas such as the hooded robin (*Melanodryas cucullata cucullata*), as well as species that would benefit from ecotones for foraging, such as the little eagle (*Hieraaetus morphnoides*). The loss of this habitat as a result of the Project will impact the known record of the eastern grass owl (*Tyto longimembris*). This record is atypical for the Hunter Valley as it is typically known from coastal areas, however it is known to experience fluctuations in population and distribution in response to prey species populations (particularly that of rodents). It is likely

that this is an irruptive record and not a resident individual. This species has not been recorded in the LCO or Mt Owen areas, despite many years of ecological monitoring.

Areas of derived native grassland occur extensively across the central Hunter Valley area and will not be significantly impacted by the removal of 65 hectares by the Project.

5.6.3 Aquatic Habitat

Small sized farm dams occurred scattered throughout the Proposed Modification Area, most commonly within grassland habitat areas. Farm dam quality was variable ranging from low quality dams with no emergent or bank vegetation to moderate quality dams with emergent and bank vegetation. No dams were identified that would have been considered to comprise good quality habitat.

The Project will result in the loss of a number of small farm dams and the highly modified Chain of Ponds Creek from within the Proposed Modification Area. Significant numbers of larger farm dams and ephemeral and permanent aquatic habitat will remain unaffected in the wider LCO holdings and aquatic species and habitats and the native fauna species dependent on those habitats will not be significantly impacted.

5.7 Impact of the Project on Threatened Species, Populations and Ecological Communities

The basic principles of reducing impacts from a Project on threatened species are to:

1. avoid direct impacts and retain habitat;

2. minimise impacts where ever possible;

3. mitigate or ameliorate impacts; and as a last resort; and

4. compensate or offset for any unavoidable impacts.

Section 5.1 describes the impact avoidance measures implemented during project planning. The following sections provide a detailed assessment of the significance of impacts related to the Project on threatened species, endangered populations and TECs using the relevant tests of significance under State (EP&A Act) and Commonwealth (EPBC Act) legislation. The following assessments do not take into account the mitigation measures documented in **Section 6.0** or the Biodiversity Offset Strategy described in **Section 7.0**.

The precautionary principle has been consistently applied when assessing the potential impacts of the Project on threatened and migratory species, endangered populations and TECs. The EP&A Regulation defines the precautionary principle as:

> Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
>
> In the application of the precautionary principle, public and private decisions should be guided by:
>
> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
> (ii) an assessment of the risk-weighted consequences of various options.

Further, the EPBC Act Significant Impact Guidelines 1.1 states the following:

> When deciding whether or not a proposed action is likely to have a significant impact on a matter of national environmental significance, the precautionary principle is relevant. Accordingly, where there is a risk of serious or irreversible damage, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on a matter of national environmental significance.

In light of the above, where there was lack of scientific certainty, the maximum reasonable potential impact was assumed. This adoption of this approach is shown in the outcome of the impact assessment for the spotted-tailed quoll (*Dasyurus maculatus maculatus*), which has not been recorded within the Proposed Modification Area, however has been considered to be potentially significantly impacted due to predicted indirect impacts. The development of mitigation and offset strategies were based on the outcomes of the impact assessment. The precautionary principle was also applied in the development of the mitigation and offset strategies to ensure that uncertainties were compensated for with more robust mitigation or more substantial offset outcomes.

The following assessments are undertaken based on the impacts of the Project within the Proposed Modification Area and not the wider LCO holdings.

5.7.1 Threatened Species Assessed Under the Environmental Planning and Assessment Act 1979

The potential level of impact on threatened species and TECs was assessed using the 'seven part test' as detailed in Section 5A of the EP&A Act. To achieve this, the 'Assessment of Significance' used for this project is divided into the following four key components, each with its own specific questions:

- threatened species;
- endangered populations;
- threatened ecological communities; and
- key threatening processes.

An assessment of significance was undertaken using an initial screening process to identify species that may be potentially impacted by the Project (**Appendix 2**), with a consequential full assessment of the likely significance of impacts being completed for these species (**Appendix 4**). The Assessment of Significance does not take into account the full range of impact mitigation strategies and biodiversity offsets proposed for the Project, rather it considers the impacts of the Project without any mitigation or offsetting consistent with the requirements of state significant impact assessment guidelines (DECC 2007). The Assessment of Significance was completed for the threatened species listed in **Table 5.1**, either due to recorded presence or presence of potential habitat in the Proposed Modification Area, records in the broader LCO holdings, and potential sensitivity to the Project.

Table 5.1 – Threatened and Migratory Species, Endangered Populations and TECs Subject to Assessments of Significance

Species	TSC Act Status
Threatened Flora Species	
painted diuris (*Diuris tricolor*)	V
Ozothamnus tesselatus	V
Endangered Populations	
tiger orchid (*Cymbidium canaliculatum*) in the Hunter Catchment	EP
painted diuris (*Diuris tricolor*) in the Muswellbrook LGA)	EP
Threatened Ecological Communities	
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC
Threatened and Migratory Fauna Species	
green and golden bell frog (*Litoria aurea*)	E
blue-billed duck (*Oxyura australis*)	V
freckled duck (*Stictonetta naevosa*)	V
Australian painted snipe (*Rostratula benghalensis australis*)	E
spotted harrier (*Circus assimilis*)	V
little eagle (*Hieraaetus morphnoides*)	V
glossy black-cockatoo (*Calyptorhynchus lathami*)	V
swift parrot *(Lathamus discolor*)	E
little lorikeet (*Glossopsitta pusilla*)	V
powerful owl (*Ninox strenua*)	V
masked owl (*Tyto novaehollandiae*)	V
eastern grass owl (*Tyto longimembris*)	V
brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*)	V
speckled warbler (*Chthonicola sagittata*)	V
regent honeyeater (*Anthochaera phrygia*)	CE
black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*)	V
hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*)	V
scarlet robin (*Petroica boodang*)	V
flame robin (*Petroica phoenicea*)	V
grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)	V
varied sittella (*Daphoenositta chrysoptera*)	V
diamond firetail (*Stagonopleura guttata*)	V
spotted-tailed quoll (*Dasyurus maculatus maculatus*)	V
squirrel glider (*Petaurus norfolcensis*)	V
grey-headed flying-fox (*Pteropus poliocephalus*)	V
yellow-bellied sheathtail bat (*Saccolaimus flaviventris*)	V
eastern freetail-bat (*Mormopterus norfolkensis*)	V
little bentwing-bat (*Miniopterus australis*)	V
eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)	V
eastern long-eared bat (*Nyctophilus timoriensis*)	V

Table 5.1 – Threatened and Migratory Species, Endangered Populations and TECs Subject to Assessments of Significance (cont.)

Species	TSC Act Status
large-eared pied bat (*Chalinolobus dwyeri*)	V
eastern false pipistrelle (*Falsistrellus tasmaniensis*)	V
southern myotis (*Myotis macropus*)	V
greater broad-nosed bat (*Scoteanax rueppellii*)	V
eastern cave bat (*Vespadelus troughtoni*)	V

CE Critically Endangered Species
E Endangered Species
V Vulnerable Species
EP Endangered Population
EEC Endangered Ecological Community

The Project will result in the loss of important remnant habitat for a range of woodland-dependent threatened species recorded in the Proposed Modification Area and wider LCO holdings. The loss of 123 hectares of woodland/forest habitat and 65 hectares of derived native grassland is considered likely to result in the reduction in the local populations of the various threatened species recorded in the Proposed Modification Area.

While the habitat within the Proposed Modification Area is isolated and of moderate condition only, it does support known habitat for a number of threatened fauna species, and their ongoing persistence within the LCO is likely to be threatened (directly and indirectly) as a result of the Project. The size of this remnant is considered sufficient to support those woodland-dependent species that are known to be threatened by habitat fragmentation and isolation. Based on the threatened species assessment detailed in **Appendix 4**, the Project is considered to result in a potential significant impact on the following threatened species:

- spotted-tailed quoll (*Dasyurus maculatus maculatus*);
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- speckled warbler (*Chthonicola sagittata*);
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*); and
- hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*).

The Project will potentially result in a significant impact on several threatened fauna species. These species have been categorised as 'potentially significantly impacted' as there are a range of factors that reduce the certainty as to whether the Project will result in a significant impact. These factors include (but are not limited to) certainty regarding the importance of habitat utilisation in the Proposed Modification Area; susceptibility to the impacts of isolation and fragmentation (including lack of mobility); known hollow-dependence; and the uncertainty regarding the local population of these species occurring within and beyond the Proposed Modification Area. The potential for a significant impact cannot be ruled out based on current knowledge and therefore, following application of the precautionary principle, these species are considered to be potentially significantly impacted (without mitigation or offsetting).

While the Project will not directly impact the known breeding den within the LCO holdings, the loss of 123 hectares of moderate quality and 65 hectares of lower quality foraging habitat for this breeding female from the Proposed Modification Area is considered to have the potential to threaten future breeding success of this species in the immediate area.

The assessment of significance conducted for each of the threatened species recorded in the Proposed Modification Area or considered likely to be potentially impacted is included in **Appendix 4**.

5.7.2 Threatened Species Assessed Under the Fisheries Management (FM) Act 1994

No threatened aquatic species or ecological communities were previously known from the Proposed Modification Area, and none were collected along Bowmans Creek as part of the ELA aquatic surveys (2013b). The Hunter River and its tributaries do not provide known habitat for any threatened species listed under the FM Act. As a result, this assessment concludes that no threatened aquatic species, populations or EECs have potential to occur within the Proposed Modification Area.

In relation to groundwater-dependent ecosystems (GDE), the ELA report (2013b) identifies the presence of a GDE in the form of the alluvial aquifer of Bowmans Creek, and its associated stygofaunal community. Impacts from the Project are anticipated to result in drawdown of a maximum of 1.4 metres for a relatively small section of the aquifer, with drawdown expected of 0.5 to 1 metre extending for up to 3 kilometres. This is deemed by ELA (2013b) to be:

> not expected to result in any significant impacts on aquatic ecological features or groundwater dependent ecosystems, as there will be at least 8 m of saturated sediments remaining over the majority of the aquifer. The estimated loss in groundwater flow is not expected to significantly alter the flow of Bowmans Creek. The creek currently experiences periods of no flow, so as long as periodic flow occurs, there will be no long-term impacts on aquatic communities since most species have strategies that allow them to migrate to refuge areas or persist in desiccation-resistant life stages.

5.7.3 SEPP 44 Assessment

The Proposed Modification Area is not considered to be core koala habitat as defined under SEPP 44, and the preparation of a Koala Plan of Management is not required. SEPP 44 does not place any constraints on the Project.

5.7.4 Critical Habitat

The nearest area of declared or pending critical habitat occurs in Wollemi National Park with areas declared (and pending) as critical habitat for the Wollemi pine (*Wollemia nobilis*). Wollemi National Park is approximately 20 kilometres to the south-west of the Proposed Modification Area, the Project will not impact on the areas recommended for declaration or declared as critical habitat for the Wollemi Pine (*Wollemia nobilis*).

The Project will not impact on any other areas of declared critical habitat.

5.7.5 Key Threatening Processes

There are currently 44 key threatening processes (KTPs) (including those pending finalisation) listed under the schedules of the TSC Act, FM Act and EPBC Act. The following key threatening processes are relevant to the potential impacts of the Project and are discussed in detail where relevant within the Tests of Ecological Significance for individual species.

- bushrock removal (TSC Act);
- clearing of native vegetation (TSC and EPBC Act);
- human-caused climate change (TSC, FM and EPBC Act);
- loss of hollow-bearing trees (TSC Act);
- alteration to the natural flow regimes of rivers, streams, floodplains and wetlands (TSC Act);
- degradation of native riparian vegetation (FM Act);
- the installation and operation of in-stream structures and other mechanisms that alter natural flow regimes of rivers and streams (TSC and FM Act); and
- removal of dead wood and dead trees (TSC Act).

5.7.6 Threatened Species Assessed under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Sustainability, Environment, Water, Population and Communities is required for any action that may have a significant impact on matters of national environmental significance (MNES). These matters are:

- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Great Barrier Reef Marine Park; and
- nuclear actions.

The EPBC Act lists criteria which are used to determine whether an action is likely to have a significant impact on MNES. The following MNES in **Table 5.2** were recorded in the Proposed Modification Area or were considered to have potential to occur in the Proposed Modification Area and were subject to further assessment in **Appendix 5**. The EPBC Act Assessment of Significance does not take into account the full range of impact mitigation strategies and biodiversity offsets proposed for the Project, rather it considers the impacts of the Project without any mitigation or offsetting consistent with the requirements of Commonwealth significant impact assessment guidelines (DEWHA 2009).

Table 5.2 – Matters of National Environmental Significance Subject to Assessment of Significance

Species	EPBC Act Status
Threatened Flora Species	
Bothriochloa biloba	V
Ozothamnus tesselatus	V
Threatened and Migratory Fauna Species	
green and golden bell frog (*Litoria aurea*)	V
Australian painted snipe (*Rostratula benghalensis australis*)	E + MIG
swift parrot (*Lathamus discolor*)	E
regent honeyeater (*Anthochaera phrygia*)	E + MIG
spotted-tailed quoll (*Dasyurus maculatus maculatus*)	E
grey-headed flying-fox (*Pteropus poliocephalus*)	V
eastern long-eared bat (*Nyctophilus timoriensis*)	V
large-eared pied bat (*Chalinolobus dwyeri*)	V
New Holland mouse (*Pseudomys novaehollandiae*)	V
great egret (*Ardea alba*)	MIG
cattle egret (*Ardea ibis*)	MIG
white-bellied sea-eagle (*Haliaeetus leucogaster*)	MIG
white-throated needletail (*Hirundapus caudacutus*)	MIG
fork-tailed swift (*Apus pacificus*)	MIG
rainbow bee-eater (*Merops ornatus*)	MIG
satin flycatcher (*Myiagra cyanoleuca*)	MIG
clamorous reed warbler (*Acrocephalus stentoreus*)	MIG

E Endangered Species
V Vulnerable Species
MIG Migratory Species

Although no threatened flora species listed under the EPBC Act have been recorded within the Proposed Modification Area, two were considered to have potential to occur being *Bothriochloa biloba* and *Ozothamnus tesselatus*. Each is listed as vulnerable species under the EPBC act. The assessments of significance undertaken for these species (**Appendix 5**) concluded that the project will not pose a significant impact to EPBC Act listed threatened flora species.

One threatened fauna species listed under the EPBC Act, the spotted-tailed quoll (*Dasyurus maculatus maculatus*), is known to occur within 500 metres of the Proposed Modification Area and is considered likely to use the habitats of the Proposed Modification Area as part of its wider foraging range. There is a local population of spotted-tailed quolls making regular use of the various habitat types within the local Foy Brook area. A known female breeding den site occurs to the west of Bowmans Creek within the LCO and about 1.75 kilometres to the north of the Proposed Modification Area. A number of known male den sites are located nearby at Mount Owen.

The presence of this local population is of importance as there are few areas within the central Hunter Valley lowlands (the main Hunter Valley) that are of sufficient size to support the home ranges of this species and that contain such a concentration of known records, including confirmed breeding dens.

The Project will directly impact on 188 hectares of potential foraging habitat for this local population (123 hectares of which is considered to be of moderate quality consisting of woodland/forest habitat and a further 65 hectares which is considered to be of lower quality habitat consisting of grassland vegetation); however it will not directly impact on the known breeding den site. There is the potential for indirect impacts, through the removal of potential foraging habitat, to disrupt the ongoing use of the den site by the breeding female.

In summary, the Project could reduce the area of occupancy of the species and has a real chance or possibility to disrupt the breeding cycle of a local population (thus causing minor flow-on affects to the regional population).

There is considered to be a potential significant impact to the spotted-tailed quoll resulting from the Project, however due to a general paucity of information on this species, the degree of impact is uncertain. Despite this uncertainty, the application of the precautionary principle suggests that the provision of biodiversity offsets is appropriate to compensate for the potential impacts. This will provide long term conservation of alternate areas of habitat for the species. The Biodiversity Offset Areas and other potential on-site impact mitigation measures will be developed as part of the on-going development of the Project.

The other threatened fauna species identified in **Table 5.2** above have not been recorded in the Proposed Modification Area but have potential to occur in the Proposed Modification Area. Assessments of significance undertaken for these species concluded that the Project would be unlikely to have a significant impact on any of these species.

One migratory species, the rainbow bee-eater (*Merops ornatus*), is known to occur in the Proposed Modification Area and seven others have been recorded within the wider LCO and were consequently considered to have potential to occur. These species were considered in the Assessment of Significance provided in **Appendix 5**. The Proposed Modification Area is not considered to provide habitat for an important population of any migratory species, as defined by the EPBC Act impact assessment guidelines, and a significant impact on migratory species is not predicted to occur.

5.8 Cumulative Impacts

As discussed in **Section 2.4**, the Proposed Modification Area and the surrounding LCO holdings have been subject to a range of historic disturbances from land clearing, agriculture and mining. The history of land clearing, agriculture and mining has resulted in an incremental loss of vegetation and fauna habitat across the broader locality Ravensworth locality. This cumulative loss of habitat has placed further pressure on local threatened flora and fauna species.

Recent surrounding developments such as the Ravensworth Operations Project, Ashton Coal Project, Mount Owen and Glendell expansions have resulted in the incremental loss of a range of fauna and flora habitats in the central Hunter Valley. The incremental loss of these habitats in the central Hunter Valley has resulted in the most sizeable remnant supporting fauna habitats with a reasonable degree of ecological integrity occurring in the Ravensworth State Forest/Mt Owen area. In acknowledgement of the impacts to these habitats losses, recently approved developments have been required to undertake substantial biodiversity mitigation and offsetting actions, together with significant habitat rehabilitation programs.

The cumulative impact of the Project is taken into consideration in the assessments of significance documented in **Appendices 4** and **5**. For certain threatened species and ecological communities, where more recent knowledge is available than what was presented in the Final Determinations or Listing Advice, these have been taken into consideration in the impact assessment process. Threats to species listed under the TSC Act, FM Act and EPBC Act include those that are cumulative in nature, and the assessments undertaken implicitly consider the contribution of cumulative impacts on these species.

The overall cumulative impact of the Project is addressed in the Environmental Assessment.

6.0 Impact Mitigation and Management Strategies

LCO has sought to avoid and minimise potential impacts on the ecological values of the Proposed Modification Area throughout the planning phases of the Project. This has included avoidance and minimisation of key vegetation communities and associated fauna habitats. These avoidance measures were described in **Section 5.1**.

The ecological impact assessment documented in **Section 5.0** has concluded that, without mitigation and offsetting, the Project has the potential to have a significant impact on the:

- spotted-tailed quoll (*Dasyurus maculatus maculatus*);
- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- speckled warbler (*Chthonicola sagittata*);
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*); and
- hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*).

LCO has committed to the design and implementation of a comprehensive mitigation strategy to mitigate the unavoidable impacts of the Project. Further to this, a comprehensive biodiversity offset strategy has been developed, which includes the protection and enhancement of native vegetation and threatened species habitat, to develop a positive long-term outcome for the threatened species and key ecological features affected by the Project. The proposed biodiversity offset strategy is documented in **Section 7.0**.

This section details the mitigation strategies that are designed to minimise impacts on significant ecological features in the areas to be disturbed as part of the Project.

6.1 Actions to Maintain Ecological Value in the LCO Holdings

LCO currently complete a number of general ecological management actions across the LCO holdings as identified in the Liddell Landscape Management Plan (Umwelt 2013). As part of the requirements of this Plan, the following specific control measures are considered to be integral to the protection and preservation of the ecological features of the LCO holdings:

- rehabilitation of post-mined and other disturbed areas to vegetation communities consistent with extant vegetation communities;
- use of native species of suitable local provenance (wherever possible) in rehabilitation works, and planning for the linkage and integration of rehabilitation areas with existing vegetated areas to improve ecological function and provide appropriate fauna habitat;
- ongoing monitoring and maintenance of all revegetation works and habitat enhancement activities;
- a comprehensive tree-felling procedure to minimise impacts of clearing on native fauna and flora;
- fencing and access control;

- weed control and feral animal control in accordance with existing practices across the LCO holdings;
- ensuring appropriate erosion and sediment controls are implemented to ensure minimal impact on remnant vegetation and aquatic habitats;
- inclusion of an adaptive management approach if a previously unrecorded or assessed threatened species is identified in the Proposed Modification Area during operations; and
- ecological monitoring programs.

The Liddell Coal Landscape Management Plan (Umwelt 2013) will be updated in order to capture the specific ecological impact mitigation and management strategies that have been determined as part of the Project.

6.1.1 Fencing and Access Control

Areas of retained vegetation outside of the Proposed Modification Area will be appropriately protected from human-induced impacts such as damage to vegetation from vehicles or trampling, increased rubbish dumping and alteration to normal fauna behaviour patterns due to human presence. Fencing and access control will be used to protect existing vegetation from accidental disturbance and will clearly demarcate areas of vegetation to be retained. In areas where fencing is deemed as being unsuitable, appropriate signage will be used in its place.

Any new fencing used within the Proposed Modification Area or rehabilitation areas will use no barbed wire on the upper strands, and as little barbed wire generally as possible. This will ensure as minimal impact on native species as possible. The minimal usage of barbed wire from fencing will minimise potential injury or death of fauna species, particularly macropods and gliding or flying mammals and threatened micro-bats. Fencing design will also consider the use of as few wire strands as practical to reduce potential for fauna entanglement.

6.1.2 Weed Control

Weed species could be inadvertently brought into the Proposed Modification Area with imported materials, machinery, or allowed to invade naturally through removal of native vegetation. The presence of weed species has the potential to be a major hindrance to rehabilitation and regeneration activities and the potential to enhance edge effects on remnant vegetation outside of the Proposed Modification Area. In addition to this, the presence of weed species has the potential to significantly decrease the value of vegetation to native species, particularly threatened species. Weed management in the Proposed Modification Area will prioritise:

- weed species and their target areas;
- treatment of entire infestations where possible;
- re-treatment of recurring infestations at regular intervals;
- annual monitoring of key weed infestations;
- annual monitoring for new infestations;
- mapping of key weed infestations following monitoring to track progress and focus control activities where necessary; and
- prompt rehabilitation of land post disturbance.

6.1.3 Feral Animal Control

Introduced fauna species such as foxes, rabbits, pigs, dogs and feral cats could increase within the LCO as a result of alteration to existing land uses. Foxes, feral cats and wild dogs represent a substantial threat to the ongoing persistence of the spotted-tailed quoll (*Dasyurus maculatus maculatus*) in the LCO holdings, as well as the broader Foy Brook area. Targeted and intensive control of such predators will be a key factor in mitigating current impacts on this species in the local area.

Current management practices for the management of these species within the LCO holdings will be reconsidered with a specific focus on the protection of the spotted-tailed quoll (*Dasyurus maculatus maculatus*) population in this area. Particular focus will be paid to adopting feral animal control measures (particularly foxes and wild dogs) that have minimal direct or indirect impact on this species.

Regular monitoring of revegetation and regeneration areas will be undertaken to determine the impact of feral animals, particularly on vegetation establishment. Feral animal control works will be undertaken periodically to ensure the suppression of feral animals, and will consider ecological impacts.

The existing Landscape Management Plan will be reviewed and expanded to include the feral animals identified as occurring in the Proposed Modification Area.

6.1.4 Bushfire Management

The vegetation that will be retained within the LCO holdings will require appropriate bushfire management to protect life and property, while providing necessary protection to the significant ecological features identified. The existing Liddell Bushfire Management Plan (Umwelt 2011b) will be updated as a result of this Project, and will allow for the application of fire research knowledge to generate ecological outcomes through the appropriate use of fire as an ecological management tool.

The updated Bushfire Management Plan will consider:

- exclusion of planned bushfire from revegetation and regeneration areas to allow replanted and regenerating communities to mature to a stage where they are able to withstand bushfire and regenerate naturally following such an event (nominally at least 15 years, but dependent on the success of plant establishment and the vegetation community present);

- consideration of the sensitivities of threatened species and TECs to bushfire and appropriate bushfire planning and management in relation to known occurrences of these. This will include specific focus on appropriate bushfire planning for protecting habitat for the spotted-tailed quoll (*Dasyurus maculatus maculatus*), which is known to be particularly sensitive to inappropriate fire regimes (Long and Nelson 2004);

- the use of ecologically appropriate fire regimes (be they related to burn frequency, duration or intensity), as these have the potential to impact negatively on significant ecological features;

- asset protection; and

- appropriate incorporation of all relevant ecological requirements into an updated Bushfire Management Plan.

6.1.5 Adaptive Management

A strong positive feedback loop between monitoring and adaptive management will be established. The management of the ecological components of the Project will be responsive to any new ecological data that may arise through the ecological monitoring of the Proposed Modification Area, or any other studies completed as part of the Project. This will enable a flexible approach to the management requirements of the Project, allowing ongoing feedback and refinement of the management strategy.

Additional general management strategies that will be employed across the Proposed Modification Area will include:

- staff education – all LCO personnel and contractors will be informed of ecological values of the Proposed Modification Area; particularly in relation to TECs and threatened fauna as well as what to do in the event of encountering injured wildlife; and
- topsoil management – topsoil stripped during clearing will be appropriately stockpiled for use in the rehabilitation process.

6.2 Rehabilitation and Corridor Establishment

As part of the Project, a detailed post-mining land use plan has been prepared (see **Figure 6.1**) to provide an indication of post-mining landform, rehabilitation focus, habitat enhancement and corridor linkages proposed as part of the Project. As part of this plan, previously-mined areas will be rehabilitated progressively and as soon as is practicable to mitigate time during which fauna is displaced as well as assisting in the prevention of erosion and assist in bank stabilisation. This plan also includes planning for the construction of ecological corridors within the post-mining Proposed Modification Area and broader LCO holdings, to improve the current poor levels of vegetated connectivity within the LCO holdings, and to adjoin remnant vegetation in the local area. This plan also includes regeneration and habitat enhancement of a corridor along Bowmans Creek (covering both previously-mined and non-mined lands) within the LCO, with the specific purpose of enhancing existing habitat, and providing additional habitat for the spotted-tailed quoll (*Dasyurus maculatus maculatus*).

6.2.1 Post-Mining Land Use Design Objectives

The nominated end land use for LCO is primarily grazing, with habitat corridors consisting of trees, shrubs and groundcover. The rehabilitation strategy aims to emulate the pre-mining grazing areas, enhance local and regional ecological linkages and provide for sustainable land use options. The proposed rehabilitation strategy for the Project, as shown in **Figure 6.1** has been developed in consideration of a number of factors including site opportunities and constraints, ecological and rural land use values and existing strategic land use objectives. In particular, the strategy considers the integration of rehabilitation at LCO with the strategies developed for surrounding operations within the Greater Ravensworth Area.

The overall objectives of the proposed post-mining land use design at LCO include:

- to provide opportunities for future agricultural activities such as sustainable grazing;
- to contribute to effective native corridors through the area which promote fauna movements between Ravensworth Operations, Mount Owen Complex, Lake Liddell and the Ravensworth Operations Hillcrest Offset Area;

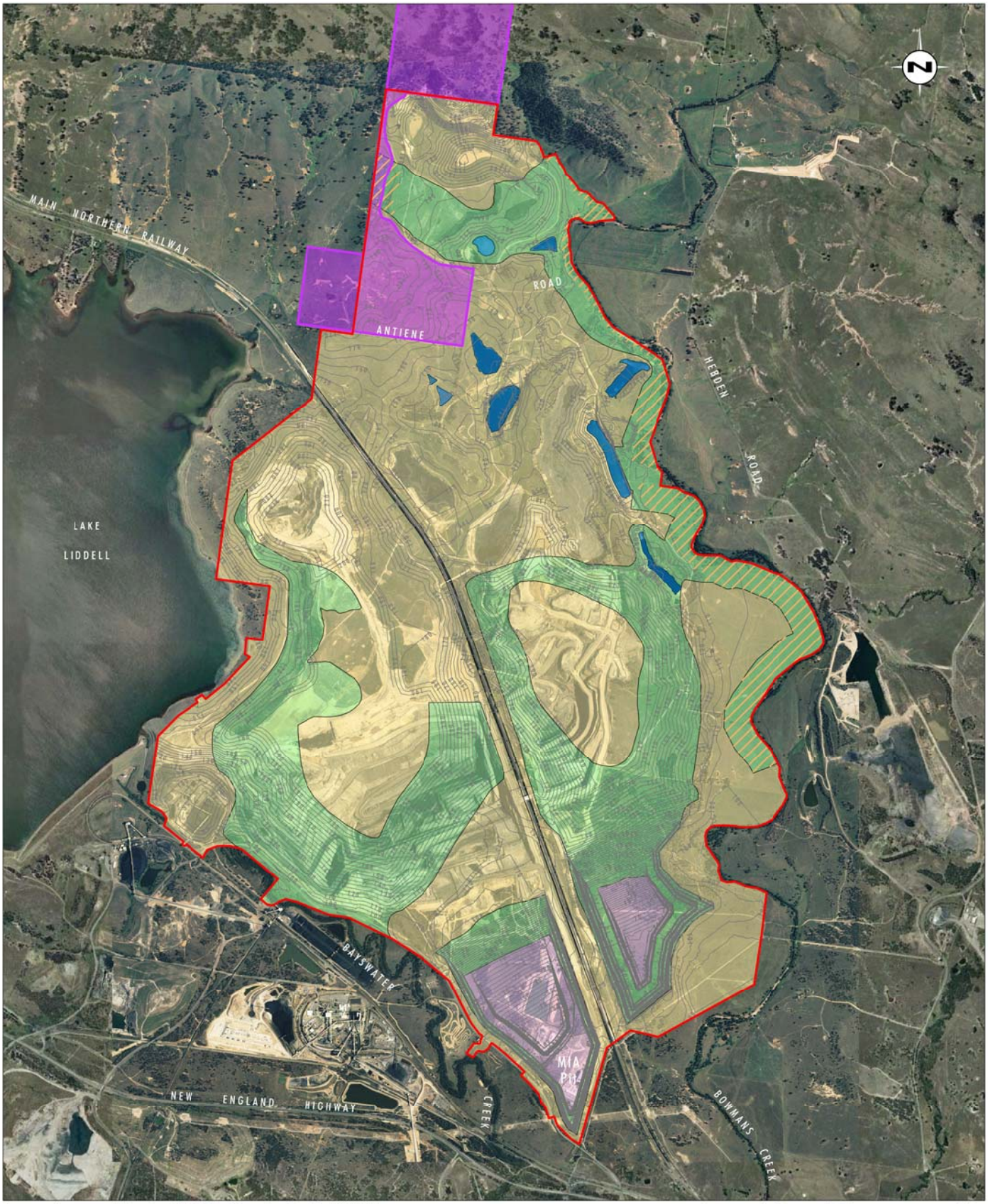


Image Source: Xstrata (2013), Google Earth (2008)
Data Source: Xstrata (2012), ELA (2012)
Note: Contour Interval 5m

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Legend

- Liddell Coal Approved DA Boundary
- Native Woodland
- Grassland for Stabilisation
- Open Grassland (potential grazing areas) with Pockets of Native Vegetation
- Dams
- Contour
- Spotted-tailed Quoll Corridor Habitat Enhancement on Non-Mined Land
- Mountain Block Offset Area

FIGURE 6.1

Liddell Coal Proposed Post-Mining Land Use Design

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- to maintain and provide additional suitable habitat for the spotted-tailed quoll (*Dasyurus maculatus maculatus*), particularly along the Bowmans Creek riparian corridor, and to increase landscape linkages to facilitate the movement of this species along Bowmans Creek to the offset areas to the north;

- to improve the visual amenity of the area; and

- not to preclude other potential post mining land use options should they be determined to be viable and preferable as part of the detailed mine closure planning process that commences at least five years prior to the planned cessation of mining.

Considering the above, the key assumptions that relate to the proposed post-mining land use and rehabilitation strategy for the Proposed Modification Area and broader LCO holdings are outlined below:

- Habitat enhancement works will be undertaken for the spotted-tailed quoll (*Dasyurus maculatus maculatus*) along the existing Bowmans Creek riparian corridor (planned works being approximately 200 metres wide along the majority of its length), which is outside of the disturbance area from LCO's mining operations. The current vegetation communities of this corridor are provided in **Figure 6.2**. This will include a mixture of tree plantings and habitat structures such as log piles (such as that containing the known female den site) constructed adjacent to the creekline on non-mine disturbed land. It will be the intention to link this area with native vegetation corridors established on rehabilitated mine land to facilitate movement of the spotted-tailed quoll (*Dasyurus maculatus maculatus*) and other fauna species to other remnant native vegetation area in the region such as the Hillcrest Offset Area managed by Glencore Coal's Ravensworth Operations. Management actions within this Offset Area are currently defined within the Draft Offset Area Management Programme, and (to date) have included baseline ecological monitoring, detailed planning of required revegetation and vegetation reconstruction works and pest and weed control works.

- Native woodland areas to be established across the slopes of overburden spoils and higher portions of the lowwalls associated with the final voids as the steepness of these areas and the nature of the substrate is likely to provide limited potential for sustainable grazing. The location of these woodland areas has been designed to promote fauna movement through LCO for linkages to Ravensworth Operations, Mount Owen Complex (including Ravensworth State Forest and its associated biodiversity offset areas), Lake Liddell and the Ravensworth Operations Hillcrest Offset Area.

- Planting/seeding of native vegetation (canopy, mid-canopy and groundcover) on the highwall benches to improve long term visual amenity of void.

- The lower portions of the lowwalls will be established initially with exotic grassland species with the objective to stabilise these areas until they are submerged by surface and groundwater that is predicted to accumulate in the final voids.

- The proportion of native vegetation at Mountain Block has been increased, particularly as steep slopes in this area provide significant limitations to sustainable grazing. The establishment of native vegetation in this area will provide a valuable linkage to the Ravensworth Operations Hillcrest Offset Area and Bowmans Creek.

- Flatter areas on site, including the tops of overburden areas and tailings dams to be established to open grassland with pockets of native vegetation. Depending on outcomes of final land use analysis to be completed as part of detailed closure planning process five years from closure, there is the potential that these flatter areas could be used for sustainable agricultural purposes such as grazing.

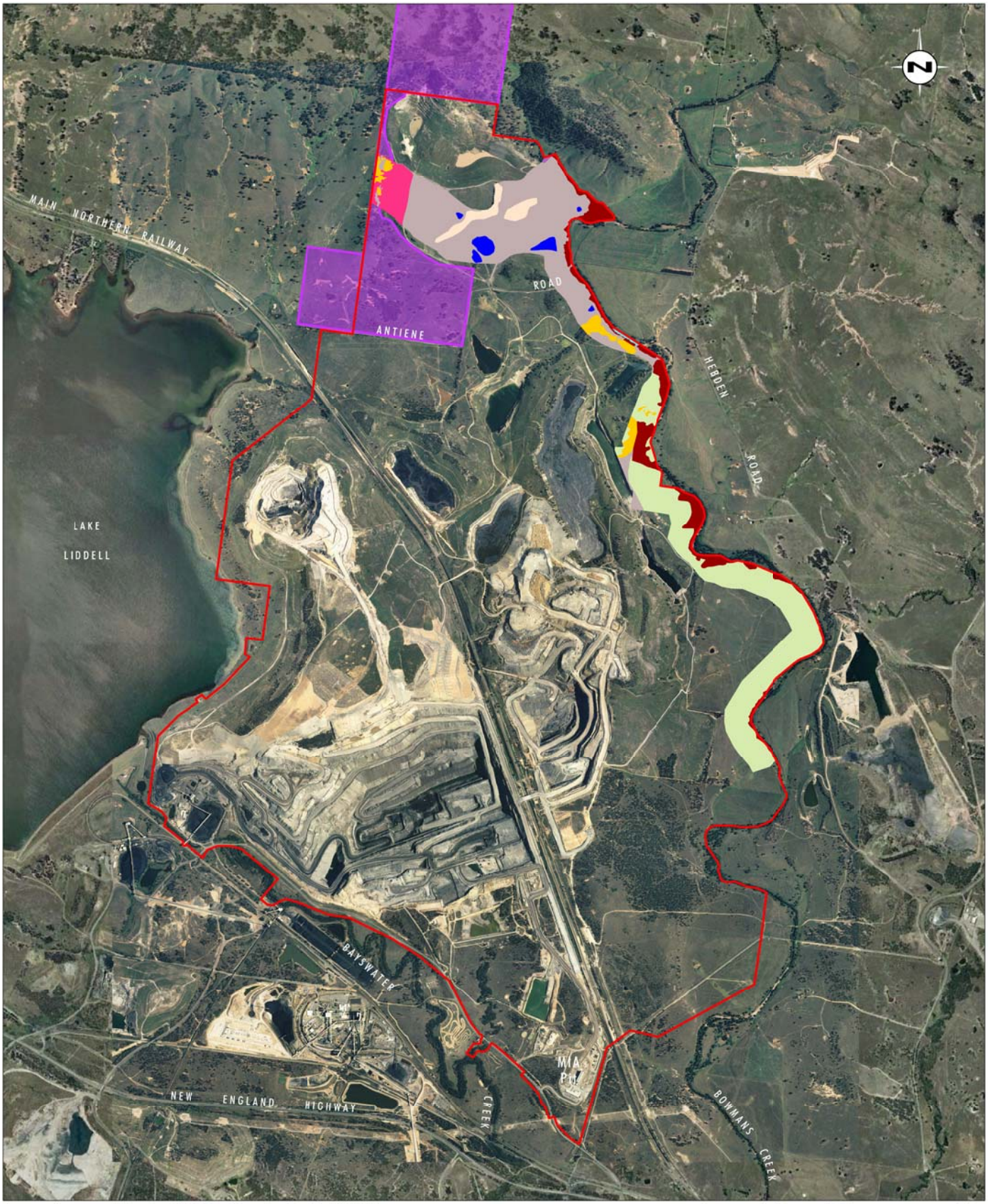

Image Source: Xstrata (2013), Google Earth (2008)
Data Source: Xstrata (2012), ELA (2012)

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Legend

- Liddell Coal Approved DA Boundary
- Mountain Block Offset Area
- Dam
- Derived Native Grassland
- Disturbed Land/Introduced Grassland
- Hunter Valley River Oak Forest
- Narrow-leaved Ironbark - Bullaok Open Forest
- Narrow-leaved Ironbark - Bullaok Open Forest DNG
- Narrow-leaved Ironbark - Spotted Gum Woodland
- Rehabilitation
- Water Body

FIGURE 6.2

Vegetation Communities of Bowman's Creek Corridor

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6.2.2 Post-Mining Land Use Rehabilitation Strategy

Rehabilitation of post-mining areas will be completed as soon as practicable after shaped areas become available. The rehabilitation strategy will primarily involve the establishment of areas of grassland for potential future agricultural activities such as grazing. In addition, native vegetation corridors will be established to promote regional fauna movement. In addition to the rehabilitation of post-mining areas, restoration of the Bowmans Creek riparian corridor (on a mixture of previously-mined and non-mined disturbed land) and in the northwest portion of the site will be designed to augment habitat for the spotted-tailed quoll.

6.2.2.1 Native Woodland Establishment

Rehabilitated woodland areas will be created to contain flora species assemblages characteristic of the dominant vegetation communities impacted by the Project. Revegetation of the post-mining landscape, including native woodland areas will focus on establishing vegetation that is predominantly consistent with the Central Hunter Box – Ironbark Woodland vegetation community.

To a lesser extent, revegetation activities should also target the establishment of vegetation that is predominantly consistent with the following vegetation communities adjacent to Bowmans Creek:

- Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated); and
- Hunter Valley River Oak Forest.

In regards to rehabilitation of areas adjacent to Bayswater Creek, revegetation activities should target the establishment of vegetation that is predominantly consistent with the Central Hunter Swamp Oak Forest vegetation community.

A seed collection and handling program aimed at maximising the viability and diversity of local seed in the revegetation mix will be implemented as part of the rehabilitation program. As a priority, revegetation will involve the use of local provenance seed that will either be utilised for direct seeding or for the propagation of tubestock for planting. However, where adverse seasonal conditions (i.e. drought) or other factors may affect the availability of local provenance seed, supplementation with non-local provenance seed may be required.

Revegetation will primarily involve direct seeding of native species along with a suitable cover crop or other organic material (e.g. mulch, brush matting or organic growth medium) as required to prevent soil loss and add biomass to the profile. A range of other techniques including the planting of tubestock may also be utilised where appropriate over isolated areas associated with steep slopes.

6.2.1 Establishment of Sustainable Agricultural Areas

Areas that may be established as open grassland or for potential viable and sustainable agricultural use have been identified in the flatter portions of the proposed final landform as shown in **Figure 6.1**. Revegetation may involve the use of both native and suitable exotic pasture species for the establishment of grasslands in these areas with pockets of native vegetation, which may ultimately be utilised as shelter for livestock.

In regards to the establishment of grazing areas, revegetation techniques will be consistent with local agricultural practices and are likely to involve sowing with grasses and legumes appropriate to the district and recognised as suitable for grazing. A similar mix may also be used in areas such as steeper slopes to prevent scouring and subsequent soil loss.

6.2.2 Corridor Habitat Enhancement

In regards to restoration of the riparian corridor along Bowmans Creek, revegetation activities should target the establishment of a riparian strip that is predominantly consistent with the Hunter Valley River Oak Forest vegetation community. Outside of the riparian strip, the remainder of this corridor should focus on restoration of the Central Hunter Box – Ironbark Woodland (Rough-barked Apple dominated), to complete the corridor. In relation to the non-mined land situated on the northwest portion of the site, restoration of native woodland areas should focus on establishing vegetation that is predominantly consistent with the Central Hunter Box – Ironbark Woodland vegetation community.

These native vegetation communities are all likely to provide suitable habitat for the spotted-tailed quoll. Measures such as the establishment of log piles/boulder piles for potential denning habitat will also be undertaken to further enhance the habitat for this species. It is noted that the known breeding den located along Bowmans Creek is within one such constructed timber pile.

Prior to the commencement of restoration activities in these areas, mapping of baseline ecological condition will be undertaken in order to confirm the scope of ecological management works required. The details of the scope of works will be developed in consideration of the following principles:

- all planting or seeding within revegetation areas will be designed with structural and floristic diversity suitable to meet the benchmark vegetation community targets;
- where practicable, revegetation will involve the use of local provenance seed that will either be utilised for direct seeding or for the propagation of tubestock for planting;
- revegetation areas will be subject to a formal care and maintenance program that will be developed to include the control of weeds, replacement of failed plantings, bushfire protection etc.;
- education of LCO workforce to raise levels of awareness regarding the spotted-tailed quoll; and
- revegetation areas will be subject to formal monitoring program (success/failure, as well as floristic monitoring) that will be developed to include a feedback loop to achieve continual improvement in the methodology and results.

Table 6.1 shows the indicative revegetation areas that will be completed over the life of the Project. The rehabilitation program implemented will be continually reviewed over the life of the Project with the aim of achieving an effective, sustainable rehabilitation outcome. These indicative areas may therefore change as an outcome of this detailed rehabilitation program.

Table 6.1 – Indicative Revegetation Areas

Revegetation Type	Indicative Area to be Achieved (Hectares)
Native Woodland	731
Open Grassland with Pockets of Native Vegetation	1247
Bowmans Creek Riparian Corridor (for Spotted-tailed Quoll Habitat)	183

Note: All values have been rounded up to the nearest whole number. All values subject to minor mapping/GIS-based variation.

Within the Bowmans Creek riparian corridor, the proportion of non-mined areas versus previously-mined areas is 91 hectares to 92 hectares, respectively.

Within each target vegetation community, the density of plantings will be varied to create a variegated landscape to increase the value of rehabilitation for local fauna species. The range of densities for each vegetation community will remain within the documented natural variation levels of each vegetation community.

6.2.2.1 Preliminary Rehabilitation Criteria

Completion criteria are objective target levels or values assigned to a variety of indicators (i.e. slope, species diversity, groundcover etc.), which can be measured against to demonstrate progress and ultimate success of rehabilitation. As such, they provide a defined end point, at which point in time rehabilitation can be deemed successful and the lease relinquishment process can proceed.

The preliminary rehabilitation completion criteria for the Project are outlined in **Table 6.2**. The criteria have been developed considering site specific issues and objectives, Glencore standards and the outcomes of the 2005 ACARP study entitled 'Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on the Coal Mines in the Hunter Valley.

These completion criteria, which may be subject to refinement as the Project progresses, including through consultation with the relevant stakeholders, will be utilised to demonstrate achievement of rehabilitation objectives. The achievement (or otherwise) of the completion criteria will be monitored and reported within the annual reports to be submitted to relevant government agencies.

Table 6.2 – Preliminary Project Rehabilitation Completion Criteria

Aspect	Objective	Preliminary Closure Criteria
Decommissioning	• All infrastructure removed, unless otherwise agreed with relevant stakeholders, and the site left in a safe, non-polluting and stable state.	• All mine-related infrastructure such as buildings, water management infrastructure, road, powerlines, boreholes and other infrastructure have been removed unless agreed with relevant stakeholders for their retention. • All sites have been assessed by a suitably qualified expert as not containing contaminants above the relevant criteria for the proposed final land use.
Landform Establishment	• Landform suitable for final land use and compatible with surrounding landscape as sustainable native ecosystem.	• Rehabilitated slopes are generally 10 degrees except low walls where slopes are less than 18 degrees. • Landform/slope is commensurate with the post mining land capability committed to for each domain. • No significant erosion is present that would constitute a safety hazard or compromise the capability of supporting the end land use. • Drainage structures are stable and there is no evidence of overtopping or significant scouring as a result of runoff. • Surface layer is free of any hazardous materials. • Any final void and associated highwall has been assessed by a qualified geotechnical engineer to validate that it is stable and does not pose a safety risk. • Tailings and reject emplacement areas will be capped and reshaped and be free draining. • Runoff water quality from rehabilitation areas is within the range of water quality data recorded from analogue sites and does not pose a threat to downstream water quality.
Growing Media Development	• Growing media is capable of supporting sustainable vegetation growth.	• The rehabilitation surface is a suitable growing medium. • Soil pH to be in the range of analogue sites. • Monitoring demonstrates soil profile development in rehabilitated areas (e.g. development of organic layer, litter layer). • Growth media properties are commensurate with the post- mining land capability committed to for each domain,

Table 6.2 – Preliminary Project Rehabilitation Completion Criteria (cont.)

Aspect	Objective	Preliminary Closure Criteria
Ecosystem Establishment (native woodland)	• Revegetation is sustainable for the long term and only requires maintenance that is consistent with the intended final land use.	• Revegetation areas contain flora species assemblages characteristic of the desired native vegetation communities. • Native woodland areas comprise of a canopy cover in the range of 10 per cent to 30 per cent. • Second generation trees are present or likely to be, based on monitoring in comparable older rehabilitation sites (i.e. evidence of fruiting of native species observed). • More than 75 per cent of trees are healthy and growing as indicated by long term monitoring. • There is no substantial weed infestation such that management requirements are similar to reference native vegetation sites. • Appropriate bushfire hazard controls have been implemented on the advice from the NSW Rural Fire Service.
Ecosystem Development (native woodland corridors)	• Woodland corridors will provide habitat value in the future	• Rehabilitated areas provide a range of vegetation structural habitats (e.g. eucalypts, shrubs, ground cover, developing litter layer, etc.) to encourage use by native fauna species.
Corridor Habitat Enhancement	• Woodland and riparian corridors provide habitat that is suitable for foraging and denning by the spotted-tailed quoll	• Rehabilitated areas provide a range of contiguous structural habitats (e.g. native trees, shrubs, ground cover, developing litter layer, native grassland etc.) suitable for foraging, and habitat (e.g. log piles, boulder piles etc) suitable for denning by the spotted-tailed quoll.
Open grassland and sustainable agricultural use areas (i.e. grazing)	• Revegetation is sustainable for the long term and only requires maintenance that is consistent with the intended final land use.	• In areas returned to broad-acre grazing, grazing returns are sustainable and pastures have similar yields to nearby properties. • Pasture species to consist of grasses and legumes appropriate to the district and recognised as suitable for grazing. • Weed and feral animal populations are appropriately managed. • Pockets of native vegetation contain flora species assemblages characteristic of the desired native vegetation communities. • More than 75 per cent of trees are healthy and growing as indicated by long term monitoring.

The preliminary rehabilitation completion criteria will be reviewed and revised throughout the Project life through consideration of the results of rehabilitation monitoring programs; any relevant research trials; and consideration of stakeholder feedback. It is envisaged that this process will occur as part of the development of the Mining Operations Plan (MOP) and subsequent annual report that are submitted to relevant government agencies and made available to the community. The completion criteria will be finalised as part of the detailed mine closure planning process and presented in the Final Closure Plan for approval by the relevant government agencies.

The gradual achievement (or otherwise) of these completion criteria will be assessed and discussed in the annual report, which will include the identification of any failures of the criteria, and measures taken to address any such issues. Proposed rehabilitation monitoring is discussed in **Section 4.0**.

6.2.3 Monitoring of Rehabilitation Works

Rehabilitation performance will be monitored to ensure that target vegetation is establishing and to determine the need for any maintenance and/or contingency measures. Rehabilitation/regeneration will be monitored in existing remnant vegetation, agricultural land and temporary rehabilitated areas. The objectives of the program will be to:

- assess the long term stability and functioning of re-established ecosystems and or agricultural areas on mine affected land;
- assess rehabilitation performance against the closure criteria; and
- facilitate continuous improvement in rehabilitation practices.

LCO will record the details of each rehabilitation campaign so that they are available for later interpretation of rehabilitation monitoring results with the aim of continually improving rehabilitation standards on site. The key monitoring parameters to be recorded include the following:

- landform design details;
- drainage design details;
- substrate characterisation;
- site preparation techniques (e.g. topsoil and source, time of sowing, soil ameliorants used etc.);
- revegetation methodologies (e.g. rate and type of fertiliser, cover crop and rate, seed viability including watering and weed management);
- weather conditions;
- photographic records; and
- initial follow-up care and maintenance works (including watering and weed management).

The monitoring program will be continued within rehabilitated as well as non-mined areas until it can be demonstrated that rehabilitation has satisfied the closure criteria. Information from this monitoring program will also be used to refine closure criteria as required.

As part of future ecological monitoring programs, LCO will ensure appropriate monitoring of rehabilitated landscapes, including specific denning habitat features, to ascertain if the area is being used by the spotted-tailed quoll. Monitoring is likely to take the form of both remote (e.g. infra-red cameras) and direct (e.g. spotlighting, trapping) techniques.

6.3 Revegetation Care and Maintenance

Based on the outcomes of the rehabilitation monitoring program as outlined above, a care and maintenance program will be implemented until rehabilitation is shown to meet the acceptable completion criteria. The scope of the care and maintenance program may include weed and feral animal control, fertilising, re-seeding or planting (where required) and erosion and sediment control works. It is envisaged that this program will be continued as required until it can be demonstrated that the rehabilitation area has satisfied the closure criteria.

6.4 Habitat Enhancement Measures

Habitat enhancement will be undertaken in rehabilitation and Bowmans Creek Corridor areas and will focus on the protection and provision of specific habitat features for target threatened species (particularly for woodland-dependent species and the spotted-tailed quoll (*Dasyurus maculatus maculatus*)). The aim of doing so will be to increase the specific habitat features required by the target threatened species, thereby improving the quality of the habitat so it is able to support greater numbers of those species. Specific habitat features are those that can be a limiting factor to population thresholds, and can include for example habitat features such as tree hollows, complex ground strata and specific foraging resources.

6.4.1 Nest Boxes

One of the ecological impacts of the Project will be the removal of tree hollows, which are critical to the survival of several threatened species recorded within the Proposed Modification Area. While only recorded in relatively low numbers within the Proposed Modification Area, the presence of a number of recorded threatened hollow-dependent species in this area highlights the importance of this scare resource in the landscape. The availability of suitable hollows within a landscape is a recognised limiting factor to the survival of hollow-dependent species (DEC 2004). In particular, the loss of suitable hollows is a major factor contributing to the listing of many threatened species under the State and Commonwealth threatened species legislation.

To address the loss of hollows from clearing activities, the following is proposed:

- staged mitigation of hollow loss from the Proposed Modification Areas by placing nest boxes in surrounding secure vegetation; and
- placement of nest boxes within the post-mining rehabilitation areas and corridors.

Nest boxes will be placed in the post-mining Proposed Modification Areas once the rehabilitation reaches suitable maturity. Alternatively, nest boxes can be bolted to poles within rehabilitation areas, to expedite the return of hollow-dependent species to these areas. A range of hollow size classes will be provided, thus increasing the quality of habitat for target threatened species. The number and types of nest boxes to be established in rehabilitation areas will be determined during pre-clearing inspections for the Project. Each tree hollow suitable for use by fauna species will be replaced with a nest box in rehabilitation areas. Nest boxes will be regularly monitored and maintained within rehabilitation areas for the life of the mine to ensure that hollow-dependent species are able to inhabit rehabilitated areas.

6.4.2 Habitat Feature Salvage

Habitat features such as boulders, hollow logs and hollow-bearing trees will be identified during pre-clearing surveys, and salvaged as part of the clearing process, where suitable and feasible to do so. Salvaged features will then be stockpiled for use in rehabilitated areas to increase the value and complexity of rehabilitation areas, thus making them more suitable for native fauna colonisation (particularly that of threatened species).

6.4.3 Tiger Orchid Salvage

One individual of the tiger orchid (*Cymbidium canaliculatum*) was recorded within the Proposed Modification Area. This individual is representative of the endangered population listed under the TSC Act. This record was of a very small individual within a low trunk fissure of a senescing bulloak. This record is located within the Proposed Modification Area, as such will be removed as a result of the Project.

LCO will salvage this individual as part of the clearing process, and translocate it to an area of secure habitat within the LCO holdings. The physical features of this species make it amenable to translocation, and if completed with appropriate planning and expertise, salvage and translocation into an appropriate host tree will ensure the species is able to persist in the LCO holding. Such a translocation plan is currently operating (on a much larger scale) at Mangoola Coal Operations, and considerable research and consultation has gone into the development of a detailed set of procedures, processes and monitoring requirements for this action. These will be reviewed and utilised, where appropriate for the LCO translocation.

6.4.4 Planting of Specific Foraging Resources

To ensure a variety of different fauna species are encouraged to colonise rehabilitation areas, a variety of plant foraging resource species, particularly flowering resources that will attract nectarivorous species, as well as insects that will attract insectivorous species will be planted. Species planted should target those that were removed from the Proposed Modification Area, including (but not limited to):

- bulloak (*Allocasuarina luehmannii*);
- swamp oak (*Casuarina glauca*);
- broom bitter pea (*Daviesia genistifolia*);
- *Acacia falcata*;
- hickory wattle (*Acacia implexa*); and
- cooba (*Acacia salicina*).

6.4.5 Dam Reconstruction

Dams will be constructed in the post-mining landform to facilitate the re-colonisation of woodland fauna communities. Dams generally provide a source of permanent water in the landscape and associated fauna species such as frogs and invertebrates will constitute suitable prey for many additional fauna species such as reptiles. Increasing the habitat complexity and range of micro-habitats occurring in the post-mining landscape will result in the increased utilisation of the rehabilitation by a much wider range of fauna species thereby meeting the objective of the re-establishment of fauna habitats and threatened species habitats in the post-mining land form.

6.4.6 Spotted-tailed Quoll Habitat Enhancement

Given the known presence of a spotted-tailed quoll (*Dasyurus maculatus maculatus*) population, the following habitat enhancement measures will be undertaken that are specific to assisting the persistence of this species in the LCO holdings, and broader local area:

- salvage of hollow-bearing trees (and non-hollow bearing trees if sufficient resources are lacking) felled during construction works and placement as log piles within areas of rehabilitation (particularly along drainage lines). This will increase the amount of potential foraging and denning habitat for this species throughout the post-mining landscape. It is notable that the current breeding den is located in such a log pile;

- salvage and placement of large rocks and boulders into piles as further potential denning habitat.

6.5 Tree Felling Procedure

A robust tree felling procedure will be implemented to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees. The procedure will include:

- detailed pre-clearing surveys by a suitably experienced persons, prior to felling. This will include marking of hollow-bearing trees, as well as any other notable features such as fallen timber, hollow logs or boulders suitable for salvage; active nests, dreys or dens requiring consideration; and seed-bearing trees for salvage;

- removal of non hollow-bearing trees/vegetation as close to the hollow-bearing tree felling date as possible (in order to discourage fauna usage of the area);

- detailed hollow-bearing tree felling procedures, including (but not limited to):

    - the day prior to felling, shaking of hollow-bearing tree (with heavy machinery) for at least 10 seconds to encourage resident fauna to abandon tree before felling the following day;
    - supervision of all hollow-bearing tree felling works by a suitably experienced persons. If an ecological issue is encountered, further advice is to be sought on the most appropriate measures to ensure minimal impact on fauna species, particularly threatened species;
    - visual canopy inspection on the day of the felling of hollow-bearing trees for species and nests that may have become active since pre-clearing surveys;
    - shaking of hollow-bearing tree (with heavy machinery) for at least 10 seconds to encourage resident fauna to abandon tree, prior to felling;
    - lowering of hollow-bearing trees as gently as possible with heavy machinery;
    - inspection of all hollows in felled trees by a suitably experienced and licensed persons;
    - capture of any displaced/injured fauna by a suitably experienced persons or wildlife carer;
    - release of unharmed fauna into nearby secure habitats by a suitably experienced persons;

- injured fauna to be assessed and taken to wildlife carer, if necessary, by a suitably experienced persons;
- felled trees to be rolled so that the number of hollows blocked against the ground are minimised;
- all felled trees are to remain in place overnight to allow any unidentified fauna to escape; and
- salvage of suitable hollows for use as compensatory habitat, where practicable.

All personnel who will capture/handle/house and/or transport native fauna species (injured or uninjured) must be appropriately licensed under the requirements of the NSW Animal Ethics Committee.

7.0 Biodiversity Offset Strategy

This Biodiversity Offset Strategy is proposed to compensate for impacts on those threatened and migratory species, endangered populations, TECs and other significant ecological features that are likely to be, or could potentially be, significantly impacted by the Project. As part of the design and planning phases, LCO has modified the Project to avoid and then minimise ecological impacts, particularly those impacts that relate to the spotted-tailed quoll (*Dasyurus maculatus maculatus*) and Central Hunter Grey Box – Ironbark Woodland TEC.

In addition, a range of impact mitigation strategies have been included in the Project to minimise those impacts that could not be avoided. Biodiversity offsetting is then proposed to address those residual impacts that are unable to be avoided or minimised to an acceptable level.

This section documents the approach that has been taken to develop a comprehensive Biodiversity Offset Strategy for the Project, and provides information on how the Biodiversity Offset Strategy will address significant, or potentially significant, impacts on threatened and migratory species, endangered populations, TECs and other significant ecological features. This section also provides a framework on how the Biodiversity Offset Strategy will be implemented and monitored.

The precautionary principle has been considered in the development of the mitigation and offsetting strategies, due to uncertainty and data deficiencies for some threatened species and TECs with the potential to be significantly impacted by the Project. The precautionary principle assumes the maximum reasonable potential impact is applied to these entities in the impact assessment and therefore ensures appropriately robust mitigation and offsetting outcomes.

7.1 Aims and Objectives

The aim of the proposed Biodiversity Offset Strategy is to compensate for impacts on those threatened and migratory species, endangered populations, TECs and other significant ecological features that are likely to be, or could potentially be, significantly impacted by the Project.

The key objectives for the Biodiversity Offset Strategy are to:

- maintain or improve the biodiversity values of the surrounding region in the medium to long term;
- maintain or improve the viability of threatened species that could be affected by the Project through the securing and/or restoration of habitat in the Hunter Valley or elsewhere within their range; and
- ensure that there are no residual net impacts on key threatened species and ecological communities in the long term as a result of the construction and operation of the Project.

7.2 Biodiversity Offset Strategy Framework

7.2.1 'Traditional Approaches'

Over the course of the last 10 years or more, biodiversity offsets have been used in NSW as an effective measure to compensate for developmental impacts on biodiversity. Biodiversity offsets are often used where there will be a residual impact on biodiversity once impact avoidance, minimisation and mitigation have all been implemented to reduce impacts. While there are no consistent, universally applied guidelines, it has generally been accepted that in principle, biodiversity offsets should be:

- located close to the areas subject to impact, depending on the availability and suitability of such areas;
- appropriately monitored and managed for biodiversity outcomes;
- appropriately protected;
- at least as large as the area impacted; and
- designed to lead to a net gain in biodiversity values in the medium to long term.

Although these principles are not universally employed, it is recognised that they form an appropriate approach around which individual development offsets are assessed, even if it is not always possible to achieve all elements. In the past, biodiversity offsetting has taken the form of:

- developers managing land that is set aside for biodiversity conservation;
- developers donating appropriate land to OEH or other similar bodies for biodiversity conservation; and
- financial contributions to the government to fund land purchases for biodiversity conservation, or to fund biodiversity land enhancement projects, or funding to other organisations to implement threatened species recovery actions, and to undertake research and monitoring.

Increasingly, consideration of competing land uses, ongoing development pressures and maximising benefits of high quality agricultural lands have lead to offsets needing to be sought further afield from impact areas. Where this is necessary, Glencore Coal has prioritised potential offset areas in strategic positions, such as within the Great Eastern Ranges corridor initiatives, or within areas identified in the Upper Hunter Strategic Regional Land Use Plan and recognised for their natural heritage values.

7.2.2 Ecological Considerations and General Approaches to Biodiversity Offsetting

The Biodiversity Offset Strategy was developed in consideration of the EPBC Act Environmental Offsets Policy (**Section 7.4**) and the OEH Principles (**Section 7.3**).

Unless there is a specific driver for species or habitat-based offsetting, or specific features that require offsetting, it is typical that vegetation communities are the main drivers for designing offset sites. It is usual practice to consider vegetation community offsets in terms of an 'offset ratio'. The offset ratio is expressed as a simple comparison of the area of the offset compared to the area of the impact. There are currently no relevant guiding documents

that establish rules for offset ratios. Rather it is usually through consideration of the relative significance of impact on ecological values and variable application of precedents by government agencies that offset ratios have been developed and applied over time. It is a generally supported notion that an offset should be at least as large as the area being impacted, i.e. a 1:1 ratio, however a range of important factors must be considered when assessing the merits of offset ratios, and in some cases where the offset is of substantially more ecological value than the impacted area the offset may be smaller in size.

The application of offset ratios to species and populations of species is much less practical, in that the investigation of compensatory habitat opportunities for species and populations is poorly informed by area-based rules or ratios. Population sizes, demographics, linkages for genetic exchange and species and habitat resilience are more relevant, if less quantifiable, than simple area-based calculations.

The following matters are relevant when developing offsetting targets for species, populations or communities:

- the level of historical loss (overall reduction) of the species, population or vegetation community;
- the range of the species, population or vegetation community, e.g. widespread or short-range endemic;
- current area of occupancy (footprint) of the vegetation community or population sizes and number of populations;
- the condition (or 'health') of the vegetation community, population or species;
- the representativeness of the vegetation community/habitat, i.e. how well the subject area represents the diversity of forms of the vegetation community (all vegetation communities are inherently variable over space and time);
- the degree of fragmentation and size, shape and landscape setting of fragments of the vegetation community or population;
- the range, degree and duration of threats to which the species, population or vegetation community is subject;
- the proportion of the species, population or vegetation community that is protected in conservation reserves;
- the likely resilience over time of the species, population or vegetation community;
- whether or not 'similar', i.e. closely-related (as demonstrated through pattern analyses) vegetation communities are appropriate to use as surrogates for the target community (including consideration of matters such as their floristic and structural similarity, geographical proximity, and faunal similarity); and
- the strategic location of vegetation communities, considering matters such as their position in relation to ecological linkages and conservation areas.

It is not always possible to obtain reliable data for many of the above matters, however it is appropriate that they are at least intuitively considered when developing offset targets.

As the relative impact on the subject species, population or vegetation community increases, that is, as the entity becomes more 'irreplaceable', the proportion of the offset site to impact area typically increases. The degree of 'irreplaceability' is generally recognised by the level of listing under NSW and/or Commonwealth legislation afforded to the subject entity, although this is subject to whether or not the entity has been nominated for listing. In some cases however this is not strictly true, as in certain areas a species, population, community or broad ecological value might be more or less significant or more important than in other parts of its range.

For the Project, the key offset drivers have been threatened species (spotted-tailed quoll and threatened woodland birds) and threatened ecological communities that are likely to, or could potentially, be significantly impacted by the Project. The species, communities and ecological values for which there will be a residual impact once impact avoidance, minimisation and mitigation measures are taken into account are described in **Section 6.0.**

The development of the Biodiversity Offset Strategy has been prepared in consideration of the above matters and recommendations from the priority actions for threatened species set out by OEH as part of the NSW Threatened Species Priorities Action Statement (PAS) (DECC 2007) have been considered in the development of the Strategy, where relevant.

7.3 NSW Offsetting Principles and Policies

7.3.1 Principles for the Use of Biodiversity Offsets in NSW

OEH guidelines Principles for the Use of Biodiversity Offsets in NSW (DECC 2008a) provide a more formal approach through which biodiversity offsetting can be measured, and incorporate some of the principles enshrined in the OEH BioBanking scheme (see **Section 7.3.3**). The OEH (DECC 2008a) principles, updated on 17 June 2011 and as documented on the OEH web page (http://www.environment.nsw.gov.au/biocertification/offsets.htm) state that:

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 – 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 – the impacts and benefits must be reliably estimated;
10. offsets must be targeted;
11. offsets must be located appropriately;
12. offsets must be supplementary; and

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

Section 7.12.1 details how the above OEH (DECC 2008a) biodiversity offsetting principles have been taken into account in the development of the Project Biodiversity Offset Strategy. The Biodiversity Offset Strategy is generally consistent with the principles for the use of biodiversity offsets in NSW.

7.3.2 OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts

On 25 June 2011 OEH released the NSW OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) (OEH 2011a). The interim policy acknowledges that proposals assessed as State Significant Development 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 Developments or Part 3A proposals;
- establishing, for benchmarking purposes, the offsets that would be required if the State Significant Development or Part 3A proposal had been expected to meet the improve or maintain standard; and
- providing 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.

The Policy provides for a range of mechanisms to be used to implement offsets (i.e. not only BioBanking credits) in view of the currently limited supply of biodiversity credits on the market. The Policy describes three possible outcomes that proposals should strive to meet depending on the circumstances. These outcomes are:

- Tier 1 – Improve or maintain with offsets calculated via the BioBanking calculator;
- Tier 2 – No net loss with offsets calculated via the BioBanking calculator; or
- Tier 3 – Mitigated net loss with offsets calculated by the credit calculator but then amended by offset variation criteria to a minimum land offset to clearing ratio of 2:1.

Tier 3 is most applicable to the LCO Project Biodiversity Offset Strategy. In considering whether the mitigated net loss standard is appropriate, consideration is given to:

- whether the credits required by the calculator are available on the market;
- whether alternative offset sites (other than credits) are available on the market; and
- 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:

- suitable offset sites can be found within a reasonable timeframe;
- the costs of offsetting is brought within a reasonable range; and

- an offset to clearing ratio of at least 2:1 vegetated to cleared hectares is achieved.

7.3.3 BioBanking

The NSW Government developed the BioBanking scheme to enable a more consistent approach to biodiversity offsetting. It forms an alternative approach against which developments can be assessed and through which proponents can achieve appropriate biodiversity offsetting without having ongoing management or legal responsibility for the Offset Sites. Although participation in BioBanking is voluntary, the principles underpinning BioBanking were considered in the development of the biodiversity offset strategy.

The BioBanking scheme works though applying a rule-based approach to determining the likely impact a development will have on biodiversity, and through then calculating the number of *biodiversity credits* (comprising *ecosystem credits* and/or *threatened species credits*) that are required to be purchased to offset the development's impact. The credits are purchased from registered BioBanking Sites and the funds generated from the purchase are used by the BioBanking site manager(s) to achieve a set of previously-agreed management actions at that site(s). This process is known as credit retirement, and once the developer has purchased all of the necessary credits, their development has been offset and they have no further responsibility to any biodiversity offsetting requirements. BioBanking sites will be protected, managed and funded in-perpetuity.

Although the Project is not required to adopt the BioBanking scheme, it is recognised that many of the principles established under the BioBanking scheme are relevant to the amelioration of ecological impacts associated with the Project.

7.4 Commonwealth Environmental Offset Policy

In October 2012 the Australian Government released the document titled EPBC Act Environmental Offsets Policy. The Policy relates to all protected matters under the EPBC Act including adversely impacted heritage values, and applies to offsetting requirements in terrestrial and aquatic (including marine) environments.

The Policy has five key aims:

- to ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act;
- to provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act;
- to deliver improved environmental outcomes by consistently applying the Policy;
- to outline the appropriate nature and scale of offsets and how they are determined; and
- to provide guidance on acceptable delivery mechanisms for offsets.

According to the Policy, direct offsets must comprise a minimum of 90 per cent of the total offset requirement. The remaining offset requirement (up to a maximum of 10 per cent) may be made up by 'other compensatory measures' to complete the 100 per cent offset requirement. Deviation from the 90 per cent direct offset requirement will only be considered in limited circumstances.

Direct offsets under the Policy are defined as those actions that provide a measureable conservation gain for an impacted protected matter. Conservation gain is the benefit that a direct offset delivers to the protected matter, which maintains or increases its viability or reduces any threats of damage, destruction or extinction (DSEWPC 2012). 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 (DSEWPC 2012).

Other compensatory measures are those actions that do not directly offset the impacts of the protected matter, but are anticipated to lead to benefits for the impacted protected matter, for example funding for research or educational programs (DSEWPC 2012).

The concept of 'advanced offsets' has also been introduced. These are a supply of offsets for potential future use, transfer or sale, established before any impact is undertaken. While an advanced offset can reduce an overall future offset requirement, it does not influence whether or not an action referred under the EPBC Act will be determined as acceptable.

The Policy requires that the 'conservation gain' for the impacted protected matter, which is delivered by the offset, is to be new or additional to what is already required by a duty of care or to any environmental planning laws at any level of government.

Importantly, the Policy makes use of an impact and offsets calculator which is designed to determine the ecological costs of a development, termed 'impact points', together with the likely ecological benefit of offset sites, termed 'offset points', in order to assess the relative value of proposed offset packages. The Policy also includes the provision that at least 90 per cent of offset points must be earned from direct offsets, while the remainder can be earned through indirect measures. An assessment of the Project biodiversity offset strategy in relation to the principles governing the Policy is provided in **Section 7.13.2**.

7.5 Assessment of Ecological Values to be Offset

A preliminary ecological values assessment and impact assessment was undertaken during project planning to determine the potential impact of the Project on ecological values. The need for a Biodiversity Offset Strategy was identified early in project planning as refinements to the Proposed Modification Area and the implementation of a range of impact mitigation strategies were not considered likely to be sufficient to counterbalance the impacts of the Project on all ecological values. The overall process was used to consider and assess ecological impacts, and the role that impact avoidance, minimisation, mitigation and offsetting have in counterbalancing impacts.

The Project will result in the loss of habitat for Central Hunter Grey Box – Ironbark Woodland EEC, a single tiger orchid (*Cymbidium canaliculatum*) and a range of woodland-dependant bird and micro-bat species. It is likely to result in the removal of foraging habitat for the spotted-tailed quoll (*Dasyurus maculatus maculatus*). Accordingly, the Biodiversity Offset Strategy has been developed to compensate for residual significant or potentially significant impacts of the Project on this community and species. A comparison of ecological values being impacted compared to those offsets proposed is provided in **Section 7.11**.

Following on from the application of impact avoidance, minimisation and mitigation measures (refer to **Section 6.0**), **Table 7.1** shows how each of the threatened species and Central Hunter Grey Box – Ironbark Woodland EEC will be addressed by the Biodiversity Offset Strategy. **Table 7.1** provides a summary of each of these matters and how they will be affected, as well as the habitat they require, and finally the approach taken to compensate for their impacts during the development of the Biodiversity Offset Strategy. The means through which these species are addressed by the Biodiversity Offset Strategy are documented in the remainder of the report with a summary tabulation of the species-specific elements of the strategy in **Table 7.1**.

Table 7.1 – Significant Ecological Features Addressed in the Biodiversity Offset Strategy

Ecological Feature	Area needed to be offset (hectares)	Habitat Requirements	Proposed Offset Approach
Tiger orchid (*Cymbidium canaliculatum*) in the Hunter Catchment	Single individual	This species occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees. It is usually found occurring singly or as a single clump, typically between 2 and 6 metres above the ground.	Other potentially occurring individuals will be identified as part of detailed pre-clearing process. Translocation of recorded individuals to secure offset areas or rehabilitation.
Central Hunter Grey Box – Ironbark Woodland in the Sydney Basin Bioregion	56 hectares	Generally occurs on Permian sediments in the Hunter Valley. This community is typically identified on slopes and undulating hills and forms a woodland or open forest.	Land-based offset. Forestation of corridors on existing Rehabilitation of post-mined land characteristic vegetation community.
Known habitat for the following threatened and migratory woodland species: • brown treecreeper • hooded robin • grey-crowned babbler • speckled warbler • rainbow bee-eater	123 hectares	Utilise general woodland habitats. Preferring those with high degrees of connectivity and little disturbance.	Direct land-based offset of known or potential habitat. Rehabilitation of post-mined land into characteristic habitats.
Known habitat for the threatened eastern grass owl	65 hectares of derived native grassland vegetation	Typically identified in tall grassy habitats which can include grass tussocks, swamp areas, grassy plains or sedges on floodplains.	Direct land-based offset of potential habitat.
Known hollow-dependent micro-bat species: • eastern freetail-bat • greater broad-nosed bat • eastern false pipistrelle • southern myotis	188 hectares of potential foraging (including 65 hectares of grassland). 123 hectares of potential roosting habitat, although hollow densities recorded as low.	Utilise general woodland habitats, particularly those with hollow-bearing trees for roosting and breeding. Forage over a range of habitats, but generally in proximity to water resources.	Direct land-based offset of known or potential habitat. Rehabilitation of post-mined land into characteristic habitats.

Table 7.1 – Significant Ecological Features Addressed in the Biodiversity Offset Strategy (cont.)

Ecological Feature	Area needed to be offset (hectares)	Habitat Requirements	Proposed Offset Approach
Recorded cave-dependent micro-bat species: • eastern cave bat • eastern bentwing-bat	188 hectares of potential foraging (including 65 hectares of grassland).	Forage over a range of habitats, generally in proximity to water resources.	Direct land-based offset of known or potential habitat. Rehabilitation of post-mined land into characteristic habitats.
Spotted-tailed quoll habitat	123 hectares of potential moderate quality foraging habitat, close to known breeding den. 65 hectares of suitable lower quality grassland which could be used for limited foraging and movement between foraging sites.	Occupies a range of forested habitats, most frequently at ecotones between closed and open forests. Requires maternal denning sites for breeding and abundance of food resources in the form of birds and small mammals and relatively intact vegetation in which to forage.	Direct land-based offset of known or potential habitat. Rehabilitation of post-mined land into characteristic habitats. Targeted habitat enhancement program within rehabilitation works. Targeted fox, dog and cat control program.

Note: All values have been rounded up to the nearest whole number. All values subject to minor mapping/GIS-based variation.

7.6 Biodiversity Offset Strategy Components

The degree of potential impact to a number of significant ecological features has identified the need for refinement of the Project Proposed Modification Area to the minimum practicable area; the development of appropriate impact mitigation measures and the development of a Biodiversity Offset Strategy to compensate for those impacts that could not be avoided or minimised. The need for a Biodiversity Offset Strategy was identified early in project planning because the refinement to the Proposed Modification Area and the implementation of a range of impact mitigation strategies were not considered sufficient to counterbalance the impacts of the Project on ecological values sufficiently.

The Biodiversity Offset Strategy consists of a number of components designed to address the identified impacts on TECs and threatened species. These measures include:

- establishment of an effective targeted rehabilitation strategy (**Section 6.2**) to be undertaken on a progressive basis and commenced immediately after cessation of works to reduce impacts of the project at any one time and reduce offsetting requirements;

- immediate establishment and long-term protection of the 166 hectares of land (**Section 7.10**) in the form of the Mountain Block land–based offset area to allow for the conservation of comparable areas of existing vegetation and the protection of threatened woodland birds, likely spotted-tailed quoll habitat, micro-bats and TECs;

- ongoing management and monitoring of the Mountain Block offset area (**Section 7.9.5**) to increase existing biodiversity values, including actions such as weed and feral animal management, fencing, and natural regeneration; and

- the development of an appropriate ecological monitoring program (**Section 7.9.5**) to assess the success of the Biodiversity Offset Strategy in counterbalancing the impacts of the Project on ecological values.

7.7 Contribution of On-site Rehabilitation

It is a standard Glencore Coal requirement that biodiversity considerations be addressed when determining post-closure land use and the rehabilitation or restoration of ecosystems as appropriate. It is also a standard Glencore Coal requirement that all disturbed and contaminated land shall be progressively rehabilitated and that the wastes generated by operations will be effectively managed to a planned post-closure land use.

Consequently, LCO has committed to undertaking a rehabilitation strategy to counterbalance the impacts incurred as a result of the Project. This is comprehensively documented in **Section 6.2**. The nominated end land use for LCO is grazing, with habitat corridors consisting of trees, shrubs and groundcover. The rehabilitation strategy aims to emulate the pre-mining grazing areas, enhance local and regional ecological linkages and provide for sustainable land use options.

Habitat corridors envisaged as part of the finalised rehabilitation works will enable the protection and preservation of natural ecological systems and processes by linking existing areas of vegetation in surrounding areas.

Details on the rehabilitation works are provided in the Liddell Mining Operations Plan (MOP) as well as within the main impact assessment document. However, it is expected that a more detailed Rehabilitation and Environmental Management Plan will be prepared post-approval as required by the *Mining Act 1992*.

It is intended that these areas of rehabilitation will contribute to the required offsetting for the project. In order to do so, rehabilitation works will need to be undertaken in a manner that:

- minimises the potential for long-term environmental impact and liability;
- minimises the potential impacts from closure activities;
- complies with relevant regulatory requirements and attain regulatory consensus on the successful closure and rehabilitation of the site;
- reduces the need for long term monitoring and maintenance;
- completes the closure, decommissioning and rehabilitation works as efficiently as possible whilst achieving the objectives outline above;
- provides for a rehabilitated post-mining landform, including remaining structures which will be physically and chemically stable and present no hazard to public health and safety as a result of failure or physical deterioration;
- provides a sustainable vegetative cover;
- implements appropriate control and remediation strategies in the event that contamination sources are identified, so as to prevent off-site impacts;
- provides for the design periods and factors of safety for all site works to take into account extreme events and other natural process such as erosion; and
- provides for the successful relinquishment of all mining leases and recovery of the security bond held by DRE.

The anticipated outcomes of rehabilitation works have been considered for their contribution towards the offsetting requirements of the Project.

The rehabilitation strategy has been designed to be complementary to the biodiversity offset strategy. This will include the rehabilitation of 731 hectares the post-mined landscape to be consistent with Central Hunter Grey Box Ironbark Woodland and a 1247 hectares of the post-mined landscape to be consistent with derived native grasslands. A further 183 hectares of rehabilitation works and habitat enhancement works will be undertaken along the Bowmans Creek corridor to assist in the recovery of the local spotted-tailed quoll population.

The rehabilitation strategy has been designed in a manner which will assist in recreating linkages and corridors in the landscape, and will importantly create a corridor assisting in the connection of remnant vegetation to both the north and south of LCO.

It is important to note that substantial progress has already been achieved in relation to the rehabilitation strategy for LCO. Considerable effort has already been expended on high-cost rehabilitation tasks on post-mined land such as backfilling, bulk shaping, return and spreading of topsoil and design and reconstruction of surface drainage to ensure a stable, free draining landform. As such, many components of the rehabilitation strategy committed to in **Figure 6.1** are well advanced. Remaining tasks such as augmentation of existing rehabilitation (for increased ecological gain), planting of newly-prepared rehabilitation areas

and habitat augmentation are all thus able to be commenced quickly, thus reducing lag time between impact and ecological gain from the rehabilitation areas.

7.8 Glencore Approach to Offsetting

Recently Glencore has undertaken to maximise the ecological value of its future offsetting requirements through the development of a strategic approach to the location of offset properties. Future biodiversity offset sites will be positioned in regionally significant locations within the landscape and where possible build upon each other, providing an increased ecological value compared to smaller project by project offset areas.

Two general areas are the focus of this Glencore strategic offset approach, being the Manobalai Offset Cluster and Mount Owen Offset Cluster. Of key importance is the location of these offset clusters in relation to key landscape features such as adjoining vegetation remnants, National Parks, Crown Land, Government Initiatives (such as the Great Eastern Ranges Initiative), and other offset areas.

Given its location, the Mount Owen Offset Cluster is of relevance to this Project. The cluster already includes a number of approved Glencore offset areas (see **Figure 2.1**) and the offsetting proposed for this Project (refer to **Section 7.9** below) will serve to strengthen this cluster. It is Glencore's intention to establish offset areas for its other projects on adjacent or nearby properties, increasing the area of offset land in this Mount Owen Offset Cluster.

In addition to addressing its offset requirements for projects, Glencore also recognises it has a social and regional responsibility to the ongoing management of land for agriculture. Glencore is committed to the ongoing management of productive agricultural land on properties acquired for ecological offsets where suitable productive agricultural land occurs and the management of such land does not compromise the integrity or quality of ecological offset areas.

7.9 Mountain Block Offset Area

The Mountain Block Offset Area (**Figure 7.1**) is a 166 hectare property located to the immediate northwest of LCO. The majority of the property falls within the Sydney Basin Bioregion, however the northern part falls within the NSW North Coast Bioregion. It lies within the Hunter-Central Rivers Catchment. It is located approximately 30 kilometres north-west of Singleton.

Approximately 61 per cent of the Mountain Block Offset Area has been historically cleared and used for agricultural purposes. The remainder of the property is well vegetated and contains an array of rocky areas. The property also contains a number of gullies ranging from gradual to steep slopes. These gullies contain drainage lines which generally remain dry, however contain dry rainforest communities. There are also a small number of farm dams scattered on the lower slopes and upper plateaux of the property, generally in areas cleared for livestock grazing.

The alluvial flats and lower slopes of the property trend from open grassland, to grassland with scattered trees to woodland areas, representing several different vegetation community types.

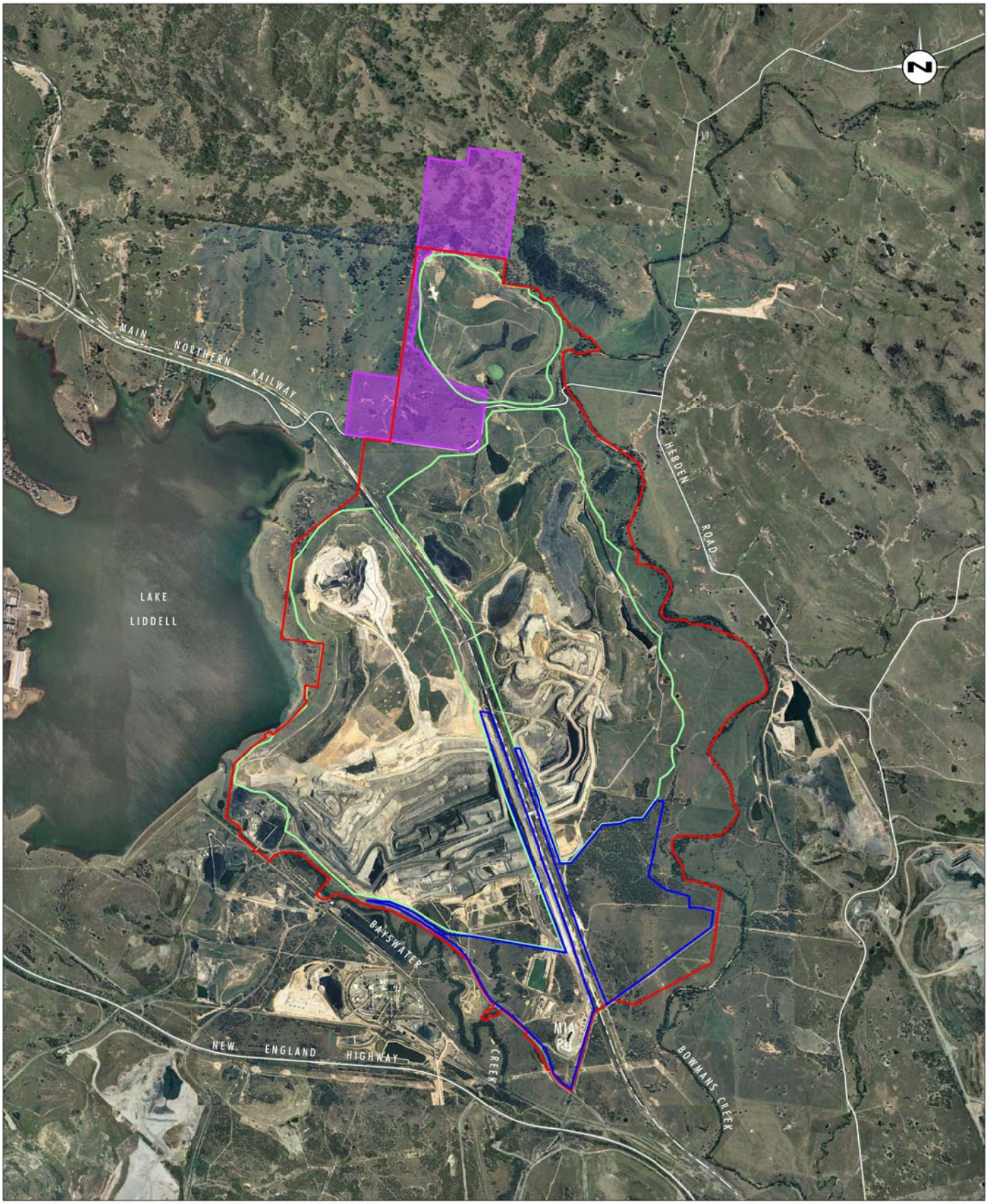

Image Source: Xstrata (2013), Google Earth (2008)
Data Source: Xstrata (2013)

0 0.5 1.0 2.0km
1:50 000

Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Mining Footprint
- Proposed Modification Area
- Mountain Block Offset Site

FIGURE 7.1

Location of Mountain Block Offset Site

7.9.1 Great Eastern Ranges Initiative

The Great Eastern Ranges Initiative (GERI) aims to maintain and improve the 'corridor' connectivity of mountain ecosystems running the length of eastern Australia. The focal area of the Initiative includes the Great Dividing Range and the Great Escarpment of Eastern Australia which extend along the majority of Australia's east coast. The corridor includes un-fragmented natural ecosystems along extensive sections of these two major geomorphic structures. The current area of focus for this initiative is the 1200 kilometre section of the Great Eastern Ranges that falls within NSW.

The Initiative aims to strengthen the resilience of natural ecosystems, of native plant and animal species, to help protect water supplies for over 93 per cent of eastern Australia's population and to support the regions significant nature-based tourism assets. The Initiative focuses on bringing together the various stakeholders including the government, non-government groups, industry and the community to achieve its purposes.

The Hunter Valley has been identified as one of the five priority areas along the ranges and is considered to be the most diverse and complex in regards to its biodiversity and connectivity and its social and economic factors. The Hunter Valley represents a significant east-west linkage of natural vegetation in the Great Eastern Ranges, with the potential for north-south 'stepping stones' of vegetation to allow species movement.

While the Mountain Block Offset Area is not located in an identified priority area for this Initiative, it does fall on the southern footslopes of the Mount Royal/Barrington Tops National Parks. This offset area lies with a cluster of other Glencore offset areas established for the Ravensworth and Mount Owen Operations. This cluster of offset areas currently serves to protect existing vegetation in the highly cleared Lake Liddell area, and will assist in securing existing 'stepping-stone' habitat in this area that leads from the valley floor north into secure conservation areas. In addition to protecting existing vegetation, the management commitments for these areas will promote active and natural regeneration of native vegetation communities to further enhance this habitat connectivity.

7.9.2 Ecological Surveys Completed on Mountain Block Offset Area

Eco Logical Australia (ELA) was commissioned by LCO to identify and map vegetation and condition of the Mountain Block Offset Area to assess its potential offsetting value. Field surveys for this work were undertaken on 17 and 18 July 2012, and results were presented in a brief letter report dated 2 August 2013.

While Umwelt was later engaged to complete the potential offset site assessment, these initial surveys and resulting data from ELA are highly relevant and were used as a foundation for the vegetation mapping of the Mountain block property and the fauna data has been incorporated into the fauna species list for the site (**Appendix 9**).

A detailed survey methodology was undertaken across the Mountain Block Offset Area to determine the ecological attributes of the site, with a particular focus on vegetation community mapping and habitat assessment. Field surveys were completed by Umwelt on 6 and 7 June 2013 and added to information already collected as part of the ELA 2012 survey effort. Flora survey of the Mountain Block Offset Area comprised systematic plots, rapid assessments and general reconnaissance. Fauna survey comprised targeted spotted-tailed quoll (*Dasyurus maculatus maculatus*) surveys (remote camera trapping, diurnal surveys for signs of presence, nocturnal spotlighting), diurnal bird surveys, habitat assessments and opportunistic observations. **Table 7.2** summarises the survey methods and survey effort undertaken across the Mountain Block Offset Area, and this is detailed further in **Appendix 6**.

Table 7.2 – Mountain Block Offset Area Survey Methodology and Survey Effort

Method	Effort	
	Umwelt (2013)	ELA (2012)
Flora		
Systematic plot based survey	6 plots	-
Rapid vegetation assessments	11 sites	-
Field reconnaissance		2 days of reconnaissance surveys
Fauna		
Walking spotlighting	2 person hours	-
Diurnal Bird searches	6 person hours	-
Signs of presence searches/Opportunistic records	Carried out during all aspects of survey	Carried out over 2 surveys days
Habitat Assessment	4 sites	-
Targeted Diurnal Quoll Searches	2 days of walking searches	-
Baited Remote Camera Surveys	41 full days over 4 cameras	-

Figure 7.2 shows the location of the flora and fauna survey techniques undertaken across the Mountain Block Offset Area.

7.9.3 Mountain Block Offset Area Flora Survey Results

This section describes the flora survey results from the surveys undertaken across the Mountain Block Offset Area by Umwelt during 2013. A detailed description of the survey results can be found in **Appendix 7**.

7.9.3.1 Threatened Ecological Communities

Two TECs were recorded in the Mountain Block Offset Area, as shown in **Table 7.3**. **Figure 7.3** shows the location of these TECs within the Mountain Block Offset Area.

Table 7.3 – TECs recorded in the Mountain Block Offset Area

Vegetation Community Name	HRVP[1]	GHVPC[2]	Legal Status		Area (ha)[3]
			TSC Act	EPBC Act	
Narrow-leaved Ironbark – Spotted Gum Woodland	MU 27	MU086	EEC - Central Hunter Ironbark – Spotted Gum – Grey Box Forest	-	35
Narrow-leaved Ironbark – Bulloak Open Forest	MU 10	MU173	EEC - Central Hunter Grey Box – Ironbark Woodland	-	22
TOTAL					**57**

Notes

[1] = Vegetation map unit described in Hunter Remnant Vegetation Project (Peake 2006).

[2] = Vegetation map unit described in Greater Hunter Vegetation Mapping Classification Unit (Sivertsen, 2012).

[3] = Rounding of totals applied (numbers less than 1 – 2 decimal places, numbers between 1 and 10 – 1 decimal place, and greater than 10 no decimal places).

TSC Act = *Threatened Species Conservation Act 1995*

EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

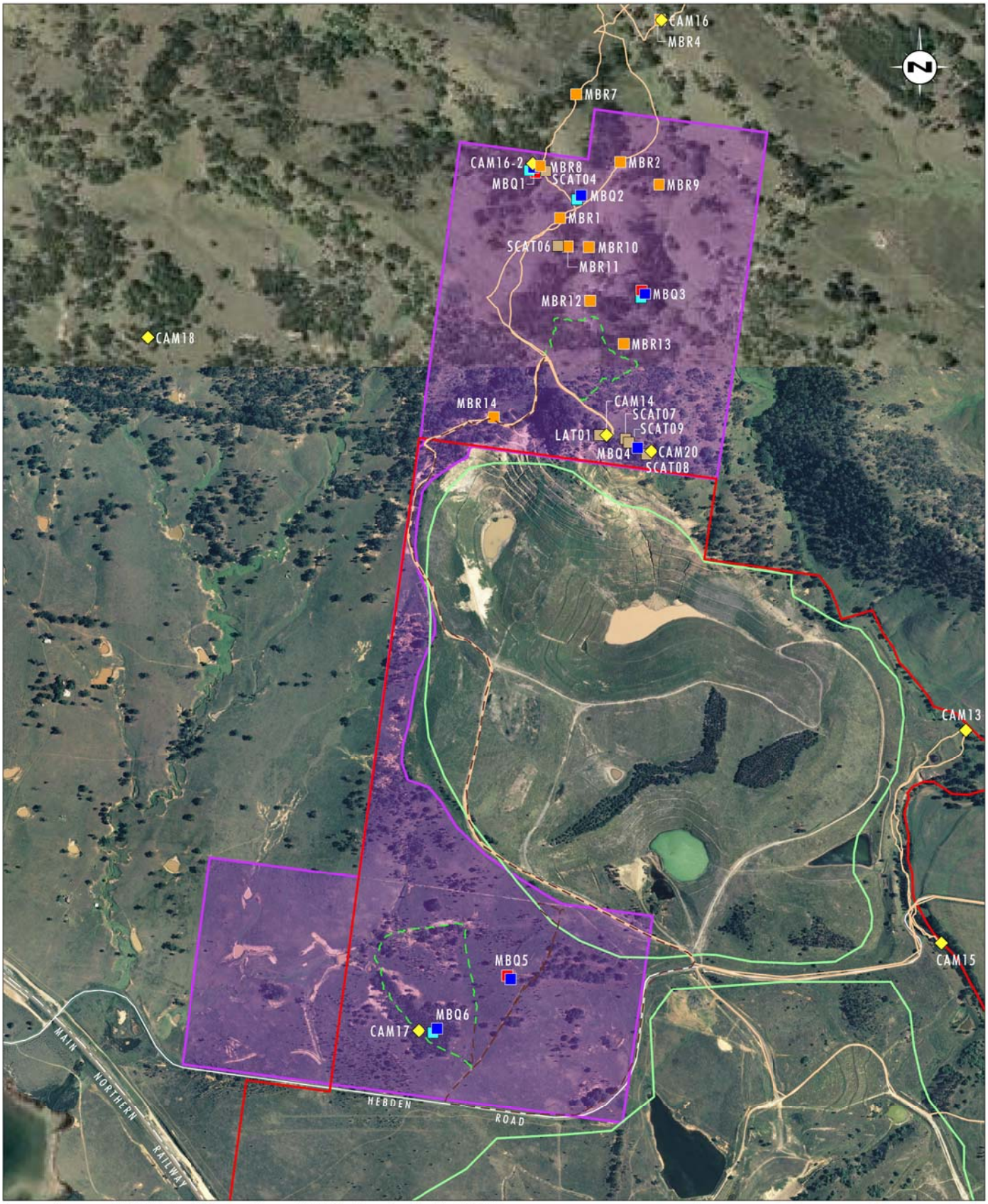

Image Source: Liddell Coal Operations (2013), Google Earth (2008)
Data Source: Liddell Coal Operations (2012), Umwelt (2013)

0 250 500 750m
1:15 000

Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Mining Footprint
- Mountain Block Offset Site
- Baited Camera Stations
- Rapid Vegetation Assessment Poitns
- Tracks occuring within Mountain Block Site??
- Habitat Assessment Location
- Systematic Plot Points
- Spotlighting Transect
- Driving Spotlighting Transect
- Bird Survey
- Scat Collections

FIGURE 7.2

Mountain Block Survey Effort

File Name (A4): R02/3122_067.dgn
20120801 15.53

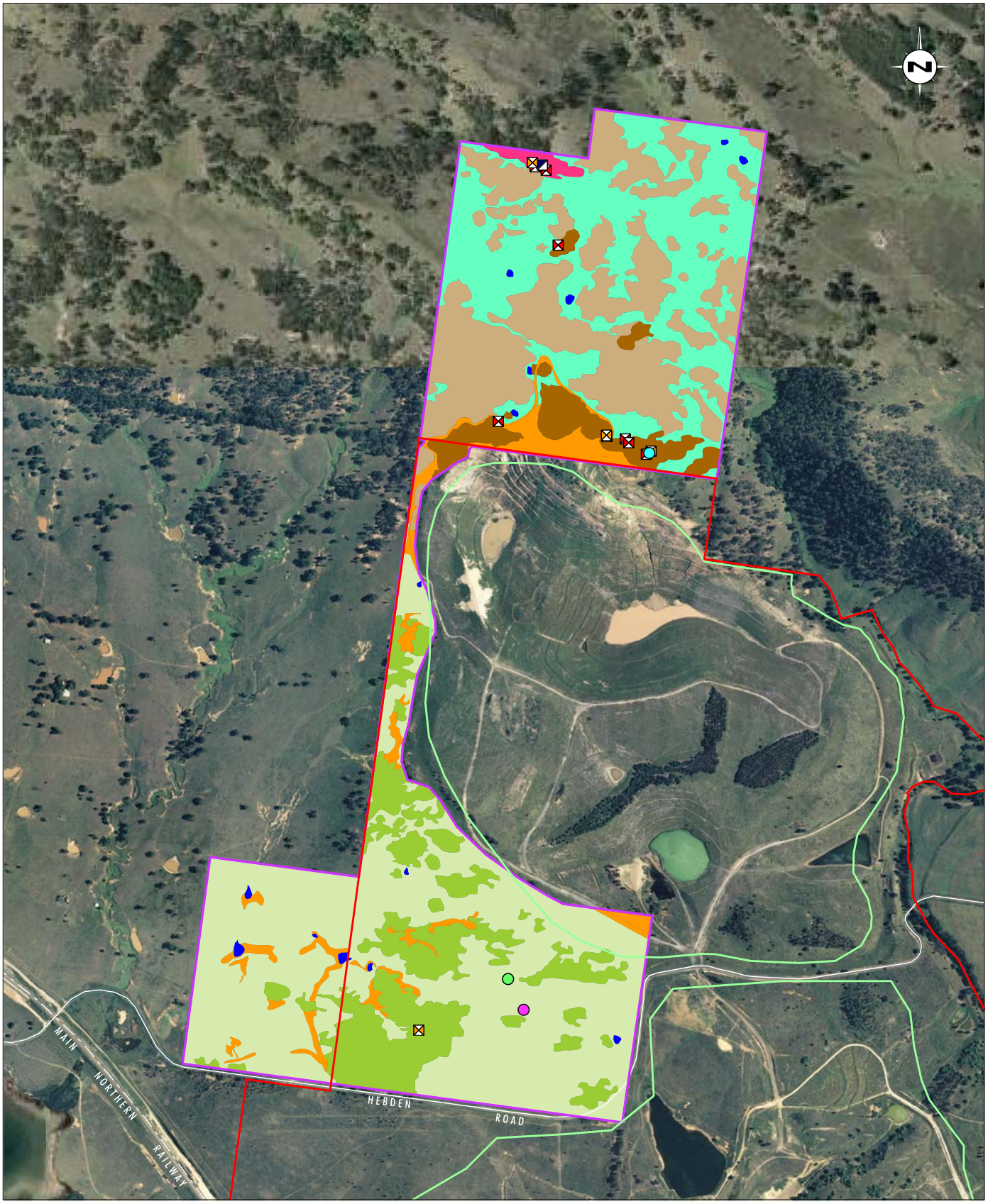

Image Source: Liddell Coal Operations (2013), Google Earth (2008)
Data Source: Liddell Coal Operations (2012), Umwelt (2013), ELA (2012)

0 250 500 750m
1:15 000

Legend

- Liddell Coal Operations Approved DA Boundary
- Approved Mining Footprint
- Mountain Block Offset Site
- Dam
- Disturbed Land
- Grey Myrtle - Kangaroo Vine Dry Rainforest
- Narrow-leaved Ironbark - Bulloak Open Forest
- Narrow-leaved Ironbark - Bulloak Open Forest DNG
- Narrow-leaved Ironbark - Spotted Gum Woodland
- Narrow-leaved Ironbark - Spotted Gum Woodland DNG
- Rusty Fig Dry Rainforest
- *Cymbidium canaliculatum*
- Speckled Warbler
- Spotted-tailed Quoll Den
- Spotted-tailed Quoll Scats
- Spotted-tailed Quoll Sightings
- Spotted harrier

FIGURE 7.3

Vegetation Communities, Threatened Species and Endangered Populations in the Mountain Block Offset Site

File Name (A4): R02/3122_068.dgn
20130829 15.25

7.9.3.2 Non-threatened Ecological Communities

Four vegetation communities were recorded in the Mountain Block Offset Area that were not considered to conform to TECs listed on the TSC Act or EPBC Act. A number of farm dams were also mapped as a separate unit, as was Disturbed Land. **Table 7.4** lists the four non-threatened ecological communities and the area of each recorded within the Mountain Block Offset Area. **Figure 7.3** shows the location of each of these non-threatened ecological communities within the Mountain Block Offset Area. Descriptions of each of the non-threatened vegetation communities are detailed in **Appendix 7**.

Table 7.4 – Non-threatened Vegetation Communities recorded in the Mountain Block Offset Area

Vegetation Community Name	HRVP[1]	GHVPC[2]	Legal Status		Area (ha)[3]
			TSC Act	EPBC Act	
Narrow-leaved Ironbark – Spotted Gum Woodland DNG	MU 27	MU086	-	-	33
Grey Myrtle – Kangaroo Vine Dry Rainforest	MU 3	MU025	-	-	1.1
Rusty Fig Dry Rainforest	MU 3	MU025	-	-	6.9
Narrow-leaved Ironbark – Bulloak Open Forest DNG	MU 10	MU173	-	-	60
Disturbed Land	-	-	-	-	7.7
Dam	-	-	-	-	0.58
TOTAL					**109.28**

Notes
[1] = Vegetation map unit described in Hunter Remnant Vegetation Project (Peake 2006).
[2] = Vegetation map unit described in Greater Hunter Vegetation Mapping Classification Unit (Sivertsen, 2012).
[3] = Rounding of totals applied (numbers less than 1 – 2 decimal places, numbers between 1 and 10 – 1 decimal place, and greater than 10 no decimal places).

7.9.3.3 Threatened Flora Species

No threatened flora species were recorded within the Mountain Block Offset Area.

7.9.3.4 Endangered Flora Populations

One endangered flora population was recorded on the Mountain Block Offset Area during the survey, being *Cymbidium canaliculatum* population in the Hunter Catchment. One record was made in the south of the Mountain Block Offset Area (refer to **Figure 7.3**). This flora population is listed as Endangered under the TSC Act.

7.9.3.5 Regionally Significant Flora Species

A total of nine regionally significant flora species (Peake *et al*. 2003) were identified across the Mountain Block Offset Area. The presence of these regionally significant flora species adds to the ecological value of the vegetation of the Mountain Block Offset Area. The nine regionally significant flora species are listed in **Appendix 8**.

7.9.3.6 Non-threatened Flora Species

A total of 84 plant species were identified in the Mountain Block Offset Area during surveys. Plants were recorded from two major vascular plant classes and from 43 plant families. A total of 22 introduced flora species were recorded (26 per cent) across the Mountain Block Offset Area. A list of all flora species recorded can be found in **Appendix 8**.

7.9.4 Mountain Block Offset Area Fauna Survey Results

Following is a summary of the results of the fauna surveys undertaken across the Mountain Block Offset Area. A detailed description of the survey results can be found in **Appendix 7**.

7.9.4.1 Threatened Fauna Species

A total of three threatened fauna species were identified in the Mountain Block Offset Area during field surveys (refer to **Figure 7.3**). **Table 7.5** lists the three species and the likely frequency of occurrence of each species.

Table 7.5 – Threatened Fauna Species Recorded in the Mountain Block Offset Area

Common Name	Scientific Name	TSC Act	EPBC Act	Likely Frequency of Occurrence
Birds				
Speckled warbler	*Chthonicola sagittata*	V	-	Recorded. Likely resident population present. [1]
Spotted harrier	*Circus assimilis*	V	-	Recorded. Likely to be using site as foraging habitat as part of larger range. Potential to breed onsite, however not recorded.
Mammals				
Spotted-tailed quoll	*Dasyurus maculatus maculatus*	V	E	Recorded. Known male den site recorded. Numerous individuals identified from remote camera surveys. Numerous active latrine sites indicate area of high social activity for this species. Likely to be resident onsite.

CE Critically Endangered
E Endangered
V Vulnerable
Mig Migratory Species
1 These species typically have home ranges smaller than the Mountain Block Offset Area and their presence likely represents resident individuals, pairs or groups.
2 Due to the potential occurrence of suitable breeding and roosting sites, each of these species may be present as resident populations.

In addition to providing habitat for threatened fauna species recorded in the Mountain Block Offset Area, potential habitat for a further 35 threatened fauna species is also present (see **Appendix 7**).

7.9.4.2 Endangered Fauna Populations

No endangered fauna populations were recorded or are considered likely to occur within the Mountain Block Offset Area.

7.9.4.3 Migratory Species

Four migratory species listed on the EPBC Act were recorded in the Mountain Block Offset Area (**Table 7.6**).

Table 7.6 – Migratory Species recorded in the Mountain Block Offset Area

Common Name	Scientific Name	TSC Act	EPBC Act
brown goshawk	*Accipiter fasciatus*		Mig
silvereye	*Zosterops lateralis*		Mig
welcome swallow	*Hirundo neoxena*		Mig
tree martin	*Hirundo nigricans*		Mig

Mig Migratory Species

7.9.4.4 Non-threatened Fauna Species

A total of 49 vertebrate fauna species have been recorded in the Mountain Block Offset Area, comprising two amphibians, no reptiles, 36 birds and three mammals. A full list of all the vertebrate fauna species recorded across the Mountain Block Offset Area can be found in **Appendix 9**.

7.9.5 Offset Management and Improvements for Mountain Block Offset Area

This section describes the improvements and management actions to be undertaken across the Mountain Block Offset Area. A Biodiversity Offset Management Plan for the Mountain Block Offset Area is to be prepared to detail the planned improvements to the Mountain Block Offset Area and ongoing management for ecological value. This Plan may form part of a broader Management Plan for the Mountain Block Offset Area.

The Mountain Block Offset Area will be managed to conserve ecological values, with a focus on weed and pest control, fencing and regeneration of derived native grassland (DNG) areas. A monitoring program will be established to assess the progress and determine the success of ongoing management actions.

Preliminary on-ground works will likely involve:

- weed and pest control programs;
- fencing of Biodiversity Offset Areas to exclude stock access; and
- undertaking ecological monitoring across the Mountain Block Offset Area to monitor the success of the recovery of DNG areas.

Following the completion of the Biodiversity Offset Management Plan it will be submitted to DP&I for approval. The Biodiversity Offset Management Plan will include a concise and auditable strategy for the implementation of the offsets.

7.9.5.1 Access Management and Exclusion of Stock

Domestic stock will be strategically managed across the Mountain Block Offset Area, to help achieve desired ecological outcomes and manage key risks such as weeds and bushfire. Areas of retained vegetation and rehabilitated vegetation within the Mountain Block Offset Area will be fenced to help manage livestock, unauthorised access and disturbance. All fences will be suitably signposted to identify the value of these areas.

Any new fencing used within, or on the boundary of, the Mountain Block Offset Area will use no barbed wire on the upper strands, and as little barbed wire generally as possible, to ensure minimal impact on native fauna species. As part of the ongoing monitoring program, if a restricted level of barbed wire on fencing is shown to fail to exclude stock, additional measures that pose minimal impact to native fauna will be investigated and implemented.

Appropriate signage will be used throughout the Mountain Block Offset Area to identify areas of high ecological significance, such as areas of regeneration and fenced areas containing threatened species, endangered populations or TECs.

7.9.5.2 Weed Management

Of the 84 flora species recorded, 22 (26 per cent) were introduced species. Introduced species recorded that are considered environmental weeds include cobbler's pegs (*Bidens pilosa*), galenia (*Galenia pubescens*), narrow-leaved cotton bush (*Gomphocarpus fruticosus*), African boxthorn (*Lycium ferocissimum*), African olive (*Olea europaea* subsp. *cuspidata*), creeping pear (*Opuntia humifusa*), common prickly pear (*Opuntia stricta* var. *stricta*), blackberry complex (*Rubus fruticosus*) and pepper tree (*Schinus areira*). Four species recorded (5 per cent of the flora of the Mountain Block Offset Area) are declared noxious in the Upper Hunter County Council control area. Declared noxious weeds recorded in the Mountain Block property are listed in **Table 7.7**.

Table 7.7 - Noxious Weeds Recorded on the Mountain Block Property

Family	Botanical name	Common name	Noxious weed control objective
Cactaceae	* *Opuntia humifusa*	creeping pear	4
Cactaceae	* *Opuntia stricta* var. *stricta*	common prickly pear	4
Rosaceae	* *Rubus fruticosus*	blackberry complex	4
Solanaceae	**Lycium ferocissimum*	African boxthorn	4

Notes: Control objectives:

4 Minimise the negative impact of those plants on the economy, community or environment of NSW.

* Denotes introduced – not native to Australia.

There are no legal requirements to control these species, however the success of the BOS will depend in part on their appropriate management if present in areas of ecological significance. A weed control program will be implemented to limit the spread and colonisation of noxious and environmental weeds within the Mountain Block Offset Area, and this will include:

- an annual weed control program across the Mountain Block Offset Area targeting noxious weeds;
- the implementation of weed management measures including hand removal, mechanical removal and application of approved herbicides in authorised areas when favourable conditions prevail;
- control of noxious weeds in accordance with the relevant legislation;
- monitoring and inspections of areas to assess the effectiveness of the weed control program and to ascertain the requirement for further work; and
- ongoing consultation with the relevant authorities regarding weed listings, weed occurrence and management technologies.

7.9.5.3 Pest Management

A Land Management Plan will be prepared for the Mountain Block Offset Area and will provide for the control and management of feral fauna species. The only confirmed feral fauna species within the Mountain Block Offset Area is the pig (*Sus scrofa*), it is highly likely that others such as rabbits, foxes and wild dogs occur in this area also. These species may impact on the native fauna species through predation and competition for resources such as food, shelter, and breeding sites. Feral animals can also have a detrimental effect on regenerating areas as well as soil stability.

Monitoring will include surveys for the presence of significant populations of feral fauna species. Records of significant populations of such species may trigger appropriate control strategies to reduce and control numbers.

7.9.6 Key Ecological Values of the Mountain Block Offset Area

The Mountain Block Offset Area has many ecological values that make it beneficial as a Biodiversity Offset Site for the Proposed Modification Area; these include known values, likely predicted values and its location relative to the central Hunter Valley. The values provided by the Mountain Block Offset Area are provided below.

7.9.6.1 Known Ecological Values of the Mountain Block Offset Area

From the ecological assessments and surveys completed within the Mountain Block Offset Area to date, a number of key ecological features have been identified. Of these, those with legislative status have been summarised below:

- 35 hectares of Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions EEC;
- 22 hectares of Central Hunter Grey Box – Ironbark Woodland in the Sydney Basin Bioregion EEC;
- one individual of the endangered flora population *Cymbidium canaliculatum* in the Hunter Catchment;
- speckled warbler (*Chthonicola sagittata*) (V TSC Act);
- spotted harrier (*Circus assimilis*);
- spotted-tailed quoll (*Dasyurus maculatus maculatus*); and
- three migratory species listed under the EPBC Act..

7.9.6.2 Likely Ecological Values of the Mountain Block Offset Area

Based on the identified ecological features of the broader area, the Mountain Block Offset Area has potential to contain habitat for:

- threatened flora species lobed bluegrass (*Bothriochloa biloba*), painted diuris (*Diuris tricolor*) and austral toadflax (*Thesium australe*);
- habitat areas for the non-threatened vegetation communities listed in **Table 7.4** above. Non-threatened vegetation communities provide habitat for a wide range of flora and fauna species; and

- threatened fauna species that have not been recorded but which may occur. Threatened species may not have been recorded due to the amount and type of surveys completed, temporal and spatial variation of species distribution across the Mountain Block Offset Area or due to the cryptic nature of some species. A total of 35 threatened fauna species have been identified as potentially occurring within the Mountain Block Offset Area due to the presence of suitable habitat areas.

7.9.6.3 Strategic Location

Glencore Coal is committed to the development of a consolidated offset approach to the offsetting requirements of its future projects. Glencore Coal is seeking to provide consolidated offset areas for the Liddell, Ravensworth and Mount Owen Operations, in a strategic position within the landscape. The potential future addition of other offset properties adjacent or in the nearby areas would increase the conservation value of the Mountain Block Offset Area through an increase in the amount of land under conservation in the area and a subsequent reduction in the level of fragmentation and isolation of conservation areas.

7.10 Contribution of Vegetation Types to Offsetting requirements – Use of Substitution Ratios

Where possible, vegetation communities to be impacted have been offset with the same vegetation communities, commonly referred to as using like-for-like communities. However like-for-like communities did not always exist in the Mountain Block Offset Area or did not exist at the scale required for offsetting. This is a typical occurrence in offsetting in the Hunter Valley as suitable land based offsets are not always available that contain the same vegetation communities that will be impacted by a development.

Where like-for-like communities were not available on the Mountain Block Offset Area, vegetation communities with similar structural and floristic characteristics were used at a range of substitution ratios to build the offset package for each impacted vegetation community. This approach is valid where there is some ecological relationship/similarity between the target community and that with which it is offset. Similarity can be measured through floristic, habitat or geographic relationship. In addition, where the threat status of the 'related' community is higher there is a conservation argument to suggest that including it in an offset package for a less threatened community is appropriate, within reason. It is important to note that the use of related vegetation communities is only included where there is a robust ecological and conservation argument for the use of those communities, at a reduced ratio, in the offset package.

Individual substitution ratios were assigned to each vegetation community which had similar floristic and structural characteristics as an impacted community. Substitution ratios comprise a de-valuing of a vegetation community's contribution to the offset package, where that community is not the same or very similar to the target community. Hence at best a community can have a 1.0 substitution ratio (where it is the same or very similar) or 0.125 (where the similarity is less relevant).

Substitution ratios were assigned on a hierarchical scale based on the similarity between the vegetation community to be impacted and the vegetation community to be used as an offset. The following attributes were taken into consideration:

- level of regional clearing (as determined by the BioBanking Vegetation Types Database);
- vegetation formation type (as determined by the BioBanking Vegetation Types Database);

- condition of vegetation types;
- fauna habitat similarity and fauna species records; and
- floristic and structural similarity of the vegetation types.

Substitution ratios were also applied to DNG communities that would be managed to regenerate to woodland communities.

As a result of the use of substitution ratios a much larger area of land is required to offset an area of impact. For example if a substitution ratio of 0.25 is used, the area of the community used to offset the impacted vegetation community will be four times the area of the impact, to achieve a 1 to 1 offset ratio. The increase in the area of offset due to the use of substitution ratios has a significant indirect benefit for fauna and flora species that occur in the offset communities, increasing the area of conservation well above that achieved using like-for-like offsets.

7.11 Long Term Security of Offset

It is a general condition of approval of most offsets that the landholder provides for appropriate long-term security of the offset to the satisfaction of the Director-General. The mechanism for securing this conservation will be determined in consultation with DP&I, OEH, and DSEWPC.

7.12 Comparison of Ecological Values between the Proposed Modification Area, Proposed On-Site Rehabilitation and Mountain Block Offset Area

The Biodiversity Offset Strategy was identified as needing to compensate for impacts on the following ecological values (as presented in **Section 7.5** and **Table 7.1**):

- known presence of tiger orchid (*Cymbidium canaliculatum*) in the Hunter Catchment;
- 56 hectares of Central Hunter Grey Box Ironbark Woodland EEC (TSC Act);
- 123 hectares of known habitat for threatened and migratory woodland birds;
- potential roosting habitat and known foraging habitat for hollow-dwelling micro-bat species;
- 65 hectares of derived native grassland habitat for the eastern grass owl (*Tyto longimembris*);
- known foraging habitat for cave-dwelling micro-bat species;
- 123 hectares of potential moderate quality foraging habitat for the spotted-tailed quoll, located close to a known breeding den; and
- 65 hectares of suitable lower quality grassland for the spotted-tailed quoll which could be used for limited foraging and movement between foraging sites.

Table 7.8 summarises the ecological values identified in the Proposed Modification Area that were identified as requiring offsetting (as presented in **Section 7.5** and **Table 7.1**) and those identified during targeted surveys of the Mountain Block Offset Area.

Table 7.8 – Offset Suitability Compared to Values of the Proposed Modification Area

Biodiversity Asset Known from Site	Proposed Modification Area	Recorded in LCO	Mountain Block Offset Area	On-Site Rehabilitation	Bowmans Creek Riparian Corridor
Area of Site	**255 hectares**	**2108 hectares**	**166 hectares**	**1978 hectares**	**183 hectares**
Key Threatened Fauna Species					
Regent honeyeater (*Anthochaera phrygia*) (CE TSC Act, E & MIG EPBC Act)	Not recorded but potential to occur	Not recorded but potential to occur	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Blue-billed duck (*Oxyura australis*) (V TSC Act)	Potential to occur	√	-	Dams within rehabilitation Existing conservation measures	-
Australian painted snipe (*Rostratula benghalensis australis*) (E TSC Act, E & MIG EPBC Act)	Potential to occur	√	-	-	Will provide additional riparian vegetation in future
Speckled warbler (*Chthonicola sagittata*) (V TSC Act)	√	√	√	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) (V TSC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Spotted harrier (*Circus assimilis*) (V TSC Act)	Potential to occur	√	√	Will provide up to 1978 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Little eagle (*Hieraaetus morphnoides*) (V TSC Act)	Potential to occur	√	Not recorded but potential to occur	Will provide up to 1978 hectares of habitat in future	Will provide up to 183hectares of habitat in future

Table 7.8 – Offset Suitability Compared to Values of the Proposed Modification Area (cont.)

Biodiversity Asset Known from Site	Proposed Modification Area	Recorded in LCO	Mountain Block Offset Area	On-Site Rehabilitation	Bowmans Creek Riparian Corridor
Area of Site	**255 hectares**	**2108 hectares**	**166 hectares**	**1978 hectares**	**183 hectares**
Eastern grass owl (*Tyto longimembris*) (V TSC Act)	√	Potential to occur	Not recorded but potential to occur	Will provide up to 1978 hectares of habitat in future	-
Grey-crowned babbler (*Pomatostomus temporalis temporalis*) (V TSC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*) (V TSC Act)	Potential to occur	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183hectares of habitat in future
Varied sittella (*Daphoenositta chrysoptera*) (V TSC Act)	Potential to occur	Potential to occur	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Spotted-tailed quoll (*Dasyurus maculatus maculatus*) (V TSC Act & E EPBC Act)	188 hectares (123 hectares moderate quality and 65 hectares lower quality)	√	√	Will provide up to 1978 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Squirrel glider (*Petaurus norfolcensis*) (V TSC Act)	Potential to occur	Potential to occur	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Southern myotis (*Myotis macropus*) (V TSC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183hectares of habitat in future
Eastern freetail-bat (*Mormopterus norfolkensis*) (V TSC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183hectares of habitat in future
Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) (V TSC Act)	Potential to occur	Potential to occur	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future

Table 7.8 – Offset Suitability Compared to Values of the Proposed Modification Area (cont.)

Biodiversity Asset Known from Site	Proposed Modification Area	Recorded in LCO	Mountain Block Offset Area	On-Site Rehabilitation	Bowmans Creek Riparian Corridor
Area of Site	**255 hectares**	**2108 hectares**	**166 hectares**	**1978 hectares**	**183 hectares**
Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) (V TSC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Eastern false pipistrelle (*Falsistrellus tasmaniensis*) (V TSC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Eastern cave bat (*Vespadelus troughtoni*) (V TSC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Large-eared pied bat (*Chalinolobus dwyeri*) (V TSC Act and EPBC Act)	Potential to occur	Potential to occur	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Greater broad-nosed bat (*Scoteanax rueppellii*) (V TSC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Rainbow bee-eater (*Merops ornatus*) (MIG EPBC Act)	√	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Great egret (*Ardea alba*) (MIG EPBC Act)	Potential to occur	√	Not recorded but potential to occur	Will provide habitat in future	Will provide up to 183 hectares of habitat in future
Cattle egret (*Ardea ibis*) (MIG EPBC Act)	Potential to occur	√	Not recorded but potential to occur	Will provide up to 1978 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
White-bellied sea-eagle (*Haliaeetus leucogaster*) (MIG EPBC Act)	Potential to occur	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future

Table 7.8 – Offset Suitability Compared to Values of the Proposed Modification Area (cont.)

Biodiversity Asset Known from Site	Proposed Modification Area	Recorded in LCO	Mountain Block Offset Area	On-Site Rehabilitation	Bowmans Creek Riparian Corridor
Area of Site	**255 hectares**	**2108 hectares**	**166 hectares**	**1978 hectares**	**183 hectares**
White-throated needletail (*Hirundapus caudacutus*) (MIG EPBC Act)	Potential to occur	√	Not recorded but potential to occur	Will provide up to 1978 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Clamorous reed warbler (*Acrocephalus stentoreus*) (MIG EPBC Act)	Potential to occur	√	Not recorded but potential to occur	Will provide habitat in future	Will provide habitat in future
Satin flycatcher (*Myiagra cyanoleuca*) (MIG EPBC Act)	Potential to occur	√	Not recorded but potential to occur	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Appropriate threatened woodland bird habitat	123 hectares	√	65 hectares	Will provide up to 731 hectares of habitat in future	Will provide up to 183 hectares of habitat in future
Threatened Flora Species					
Lobed blue grass (*Bothriochloa biloba*) (V TSC Act)	Potential to occur	Potential to occur	Not recorded but potential to occur	-	-
Tiger orchid (*Cymbidium canaliculatum*)	√	√	√	-	-
TECS					
Central Hunter Grey Box – Ironbark Woodland EEC	56 hectares	√	√ 22 hectares	Will be major focus of rehabilitation strategy	Will be focus of rehabilitation strategy
Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC	-	-	√ 33 hectares	-	-
Other Non-Threatened Native Vegetation Communities					
Central Hunter Box – Ironbark Derived Native Grassland	65	√	-	-	-
Central Hunter Swamp Oak Forest	5	√	-	-	-

Table 7.8 – Offset Suitability Compared to Values of the Proposed Modification Area (cont.)

Biodiversity Asset Known from Site	Proposed Modification Area	Recorded in LCO	Mountain Block Offset Area	On-Site Rehabilitation	Bowmans Creek Riparian Corridor
Area of Site	**255 hectares**	**2108 hectares**	**166 hectares**	**1978 hectares**	**183 hectares**
Central Hunter Bulloak Forest	62	√	-	-	-
Narrow-leaved Ironbark – Spotted Gum Woodland DNG		√	33	-	-
Grey Myrtle – Kangaroo Vine Dry Rainforest	-	-	1.1	-	-
Rusty Fig Dry Rainforest	-	-	6.9	-	-
Narrow-leaved Ironbark – Bulloak Open Forest DNG	-	-	60	-	#8.59
Derived Native Grassland	-	-	-	-	#64.34
Hunter Valley River Oak Forest	-	-	-	-	#20.09
Narrow-leaved Ironbark - Bulloak Open Forest	-	-	-	-	#6.35
Narrow-leaved Ironbark – Spotted Gum Woodland	-	-	-	-	#0.18

Note: All values have been rounded up to the nearest whole number. All values subject to minor mapping/GIS-based variation.
CEEC Critically Endangered Ecological Community
EEC Endangered Ecological Community
Vegetation composition of Bowmans Creek Riparian Corridor may change as a result of rehabilitation works subject to a Rehabilitation/Revegetation Plan.

7.13 Assessment of the Biodiversity Offset Strategy against State and Commonwealth Offsetting Guidelines

The following section documents the Biodiversity Offset Strategy against the state and Commonwealth guidelines for biodiversity offsetting.

7.13.1 Assessment of the Biodiversity Offset Strategy against the Principles for Biodiversity Offsetting (DECC 2008)

Section 7.3 documents the DECC (2008) Principles for Biodiversity Offsetting. The following provides an assessment of the Project Biodiversity Offset Strategy against these principles.

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

The Project has been designed in a manner that aims to avoid disturbance to the ecological features of the Proposed Modification Area where possible, whilst maintaining the economic feasibility and practicality of all components of the Project.

The area to be disturbed for the Project largely consists of cleared areas and grassland. Where impacts on ecological features were deemed unavoidable, an impact mitigation strategy was prepared that addresses the mitigation of these impacts in the long term.

LCO has sought to avoid and minimise potential impacts on the ecological values of the Proposed Modification Area throughout the project planning process.

Section 6.0 of the report documents the range of mitigation measures that will be undertaken or considered for the Project.

2. All regulatory requirements must be met.

The Biodiversity Offset Strategy for this Project (including all of its components) has been developed in accordance with the necessary offsetting regulatory requirements, particularly the requirements of the Director-General of DP&I (which includes consideration of all other relevant regulatory authorities).

3. Offsets must never reward ongoing poor performance.

Glencore Coal has a long history of sound environmental management within the Hunter Region and have an industry-leading sustainable development framework.

Glencore Coal has also funded research and monitoring for numerous biodiversity initiatives such as the Great Eastern Ranges initiative.

Liddell has developed and implemented an Environmental Management System generally in accordance with ISO14001. The principle focus of this Environmental Management Strategy (LCO 2012) is on continual environmental improvement. It includes management plans and system procedures to manage activities on site and hence minimises the risk of impacts to the environment.

4. Offsets will complement other government programs.

The proposed Biodiversity Offset Strategy has been designed to complement government programs, where possible, and includes some key initiatives that add significant value to existing government programs and reserves. Further, the Strategy does not contradict any government programs relevant to the local area, nor does it negatively impact on national parks, nature reserves, state conservation areas, Ramsar sites or state forests in the area. Specific examples of the complementary value of the proposed Biodiversity Offset Strategy are provided below:

- This offset area lies with a cluster of other Glencore offset areas established for the Ravensworth and Mount Owen Operations. This cluster of offset areas currently serves to protect existing vegetation in the highly cleared Lake Liddell area, and will assist in securing existing 'stepping-stone' habitat in this area that leads from the valley floor north into secure conservation areas. In addition to protecting existing vegetation, the management commitments for these areas will promote active and natural regeneration of native vegetation communities to further enhance this habitat connectivity.

5. Offsets must be underpinned by sound ecological principles.

The proposed Biodiversity Offset Strategy has been developed with the aim to compensate for impacts on threatened and migratory species, endangered populations, TECS and other significant ecological features that are likely to be, or could potentially be significantly impacted by the Project. To achieve this, a variety of actions/strategies will be employed to address specific impacts of the Project. Such actions and strategies are commonly employed in projects of this type and magnitude, and are well tested and accepted in relation to their ability to address impacts.

The land-based Mountain Block Offset Area has been selected because of the significant ecological features it contains and the potential for habitat restoration. It is also contiguous with LCO and other land secured by Glencore Coal for biodiversity offsetting, and it would be managed in a complementary and holistic fashion. The land is also wholly owned by Glencore Coal.

The proposed offset property would offer an important strategic addition to the area of conservation lands (national parks, nature reserves, offsets, etc) in the region.

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

The proposed Biodiversity Offset Strategy for the Project has been developed with the aim to compensate for impacts on threatened and migratory species, endangered populations, TECS and other significant ecological features that are likely to be, or could potentially be significantly impacted by the Project. With the various impact mitigation and offset strategies to be employed as part of the Project, it is likely that such an improvement will occur.

The Mountain Block Offset Area will contribute towards a net improvement in biodiversity over time through the restoration and protection of areas of EEC, the protection of areas of threatened and migratory species habitat, and through long-term ecological management and monitoring of these areas.

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

The proposed Biodiversity Offset Strategy commitments for the Project will occur over the long-term, until such time that the commitments have been achieved, completion criteria have been met and sign-off has occurred.

The Mountain Block Offset Area will be secured for long-term conservation. The mechanism for securing this conservation will be determined in consultation with DP&I, OEH, and DSEWPC.

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

The proposed Impact Mitigation Strategy contained within this Ecological Assessment represents the suite of actions that will be employed in order to reduce (mitigate) the impact of the Project on ecological features. The Liddell Coal Landscape Management Plan (Umwelt 2013) will be updated post-approval to capture the specific ecological impact mitigation and management strategies that have been determined as part of the Project. The update to this document will also further define the commitments within this document, detail the proposed ecological management of the site, and address any additional issues that arise as part of the review and approvals process. This updated Landscape Management Plan will be submitted to the relevant authorities for approval.

The Biodiversity Offset Strategy allows for the up-front protection and proactive conservation management of the Mountain Block Offset Area, to provide immediate compensation for loss of habitat from the Proposed Modification Area. A management plan will be prepared for the site and submitted to the relevant authorities for review and approval. It is envisaged that this plan will form part of the Biodiversity Offset Management Plan.

It is anticipated the offset will be agreed prior to the impact occurring.

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

The Biodiversity Offset Strategy has been developed through detailed consideration of known impacts on known of records of threatened and migratory species and TECs (including their habitats), which have been identified and discussed in **Section 5.0**. The selection of the Mountain Block Offset Area took into account such identified impacts, and identified preferences based on the ability of such available areas to appropriately address such impacts. The potential for restoration and recreation of substantial areas of threatened species habitat was also prioritised in the selection of the site.

The area of impact has been derived from detailed GIS mapping of project boundaries and impact areas, and the ecological survey, mapping and impact assessments have been completed by qualified ecologists with considerable experience in the region.

All relevant ecological features of the Mountain Block Offset Area are quantifiable and, where the information is available, are presented in such a manner in this report. The quantification is documented in **Table 7.1** of the report.

10. Offsets must be targeted.

The development of the Biodiversity Offset Strategy for the Project has been based on addressing the identified ecological impacts of the Project (**Section 5.0**). These impacts have been identified via a thorough survey and assessment process, which has been described in detail within this document. Following this identification of impact, the Biodiversity Offset Strategy has been designed to provide mitigation actions targeted at each of the major impacts. **Table 7.1** clearly documents the key ecological species, communities and features that occur or have potential to occur in the Proposed Modification Area and were hence targeted during the development of the offset strategy.

11. Offsets must be located appropriately.

The Mountain Block Offset Area is located in an area that contains the relevant ecological features required for offsetting the impacts of the Project. The habitats represented within this site are representative of the habitats that will be lost within the Proposed Modification Area. Additionally, the Mountain Block Offset Area is located within the Hunter Valley on the border between the Sydney Basin and NSW North Coast Bioregions, is nearby or adjacent to other existing offset areas and supports habitat relevant to a range of target species for the Project.

12. Offsets must be supplementary.

The land-based offset proposed as part of the Project does not overlap with any other government funded protection or habitat restoration program on that site. It is located on currently non-reserved land and will add an important strategic area into a cluster of existing Glencore offset areas.

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

As the Impact Mitigation Strategy and Biodiversity Offset Strategy are being proposed as integral components of the Project, it is expected that the commitments in these strategies will be included within the project approval conditions, and any other relevant legally binding consents.

7.13.2 Assessment of the Biodiversity Offset Strategy against the Commonwealth Environmental Offsets Policy 2012

As documented in **Section 7.4**, the Commonwealth Government's position on offsetting contains was formalised in October 2012, as outlined in the Environmental Offset Policy (DSEWPC 2012). This section provides an assessment of the Biodiversity Offset Strategy proposed as part of the Project against the Environmental Offset Policy.

1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter.

The Biodiversity Offset Strategy for the Project has been developed with the aim to maintain or improve the biodiversity values of the surrounding region in the medium to long term. With the impact mitigation and offset strategies to be employed as part of the Project, it is likely that such an improvement will occur as woodland and derived native grassland (DNG) areas are managed for conservation and DNG areas are encouraged to return to woodland condition.

The Mountain Block Offset Area will be secured for long-term conservation. The mechanism for securing this conservation will be determined in consultation with DP&I, OEH, and DSEWPC (as relevant).

2. Suitable offsets must be built around direct offsets but may include other compensatory measures.

The Biodiversity Offset Strategy is based on the use of an off-site land-based offset that occurs within the Sydney Basin Bioregion and NSW North Coast Bioregion.

Rehabilitation of approximately 731 hectares of woodland across the Proposed Modification Area will not only contribute significantly to the reduction in the residual impacts of the Project but will provide a large area of woodland habitat providing connectivity between the Proposed Modification Area and surrounding habitat areas, including future habitat areas following rehabilitation of Mount Owen and existing established Glencore Coal offsets which adjoins the Proposed Modification Area to the east and north. Rehabilitation works will focus on strengthening the existing narrow vegetated corridor along Bowmans Creek, thus increasing the amount of habitat in a key area of known spotted-tailed quoll activity. This will also link the known habitats of Bowmans Creek in a northerly direction to other areas of known spotted-tailed quoll habitats, such as the Hillcrest Offset Area. Rehabilitation will include habitat augmentation to increase structural complexity of these communities, thereby increasing their value as fauna habitat. Salvage of felled timber and boulders from the Proposed Modification Area will provide the ability to construct log and boulder piles within the rehabilitated areas, thereby providing habitat for prey species for the spotted-tailed quoll.

183 hectares of rehabilitation works and habitat enhancement works will be undertaken along Bowmans Creek to assist in the recovery of the local spotted-tailed quoll population. Within the Spotted-tailed Quoll Corridor, the proportion of non-mined areas versus previously-mined areas is 91 hectares to 92 hectares, respectively. The rehabilitation strategy has been designed in a manner which assists in recreating linkages and corridors in the landscape, and will importantly create a corridor assisting in the connection of remnant vegetation to both the north and south of LCO.

3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.

The level of statutory protection that applies to the impacted Matters of National Environmental Significance (MNES) was considered during project planning to ensure that adequate offsets were obtained, commensurate with the status of the threatened or migratory species. The result is a suitable biodiversity offset for impacted species, as detailed in **Table 7.8**.

4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter.

Section 7.0 and **Table 7.8** concisely document the area of impact on MNES, together with the relevant ecological features within the offset that is proposed for each MNES. These show that the Biodiversity Offset Strategy is comprehensive and targeted towards the MNES affected, or likely to be affected, by the Project. The Biodiversity Offset Strategy is complemented by the on-site mitigation, including the substantial rehabilitation strategy, which will target habitat reinstatement for the spotted-tailed quoll.

5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding.

The Biodiversity Offset Strategy is based on the use of direct land-based offsets that occur within the Sydney Basin Bioregion and NSW North Coast Bioregion. Project consent conditions and subsequent auditing processes will ensure that the offsets are established removing the risk of the offset site not becoming established. The Mountain Block Offset Area contains existing woodland vegetation and areas of DNG. Once established and managed as an offset site, the risk of the offset not succeeding is related to the management of threats such as weeds and pests. Glencore Coal has a proven record of best practice rehabilitation and regeneration of mining sites in the Hunter Valley (e.g. University of Newcastle 2012) and the risk of regeneration areas failing is low. Glencore Coal also has a good record of pest and weed management and

current management strategies will be extended across all offset sites and habitat management areas.

6. Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs.

The land-based offset proposed as part of the Project does not overlap with any other government funded protection or habitat restoration program on that site. It is located on currently non-reserved land and will add an important strategic area of conserved land to the region.

7. Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable.

The Biodiversity Offset Strategy allows for the up-front protection and pro-active conservation management of the Mountain Block Offset Area to provide immediate compensation for loss of habitat from the Proposed Modification Area. The offset component of the Biodiversity Offset Strategy will be secured by Glencore Coal as an offset site prior to the approval of the Project.

The area of impact has been derived from detailed GIS mapping of project boundaries and impact areas, and the ecological survey, mapping, impact assessments and design of the Biodiversity Offset Strategy have been completed by qualified ecologists with considerable experience in the region ensuring that the Strategy is scientifically robust, transparent and reasonable.

This report clearly documents the survey methods undertaken (refer to **Section 3.0**), the results of all surveys (refer to **Section 4.0** and appendices), the assessment of the level of impacts (refer to **Section 5.0** and appendices), the mitigation and management measures to be undertaken (refer to **Section 6.0**) and the development of and justification for the offset strategy (refer to **Section 7.0**) to compensate for the residual impacts of the Project.

8. Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced

As the Impact Mitigation Strategy and Biodiversity Offset Strategy are integral components of the Project, it is expected that the commitments in these strategies will be included within the Project development consent conditions, and any other legally binding consents. It is anticipated that regular auditing of offset site will be undertaken. A revision of the existing on-site monitoring program will be undertaken including the addition of several techniques to provide data on the status and/or recovery of communities and species impacted by the Project.

8.0 Conclusion

The Project will impact on 188 hectares of vegetation, including 22 hectares of woodland, 33 hectares of regrowth woodland, 67 hectares of forest and 65 hectares of grassland. Of this, 56 hectares consists of Central Hunter Grey Box – Ironbark Woodland EEC (listed under the TSC Act). No threatened flora species were recorded in the Proposed Modification Area or considered likely to be impacted by the Project and one endangered population, being a single individual of the tiger orchid (*Cymbidium canaliculatum*), was recorded. Surveys undertaken in the Proposed Modification Area identified the following threatened fauna species:

- brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- speckled warbler (*Chthonicola sagittata*);
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*);
- eastern grass owl (*Tyto longimembris*);
- eastern freetail-bat (*Mormopterus norfolkensis*);
- southern myotis (*Myotis macropus*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*); and
- greater broad-nosed bat (*Scoteanax rueppellii*).

In addition, the spotted-tailed quoll (*Dasyurus maculatus maculatus*) has been recorded along Bowmans Creek, including at a den site, through previous ecological monitoring and as part of studies undertaken for this Project. Although not recorded in the Proposed Modification Area, it is likely that the species forages within the Proposed Modification Area.

Impact assessment (excluding mitigation and offsetting strategies and undertaking the precautionary approach), identified potential significant impacts on the spotted-tailed quoll (*Dasyurus maculatus maculatus*), brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), speckled warbler (*Chthonicola sagittata*), grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) and hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*).

A comprehensive mitigation strategy is proposed to reduce the level of impacts. This includes a robust tree felling procedure designed to target threatened and arboreal fauna. The rehabilitation strategy has been integrated with the existing rehabilitation strategy and commitments at LCO, and these will result in the establishment of 839 hectares of woodland both in post-mined areas and also a strengthened riparian corridor along Bowmans Creek (183 hectares). The rehabilitation strategy has been designed in a manner which will assist in recreating linkages and corridors in the landscape, and will importantly create a corridor assisting in the connection of remnant vegetation to both the north and south of LCO. This will particularly aim to provide interconnected foraging (and potentially denning) habitat for the spotted-tailed quoll.

The impact assessment (**Section 5.0**) identified the need for a Biodiversity Offset Strategy to compensate for the likely residual significant impacts of the Project that could not be adequately avoided or mitigated. This is centred on the establishment of a 166 hectare off-site biodiversity offset site, the Mountain Block Offset Area. The Mountain Block Offset Area is located strategically within the region and will be subject to long-term protection.

The biodiversity offset strategy described in this document has outlined the proposed offsetting components that have demonstrated an appropriate and valuable offsetting outcome in achieving the aim of this offset being to compensate for impacts on threatened and migratory species, endangered populations, TECS and other significant ecological features that are likely to be, or could potentially be, significantly impacted by the Project.

In addition, the Mountain Block Offset Area allows for the conservation of significant ecological values that are not being impacted by the Project such as the Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC.

Together, the rehabilitation of the Proposed Modification Area, the Mountain Block Offset Area, Bowmans Creek Riparian Corridor and the proposed mitigation measures ensure that the residual ecological impacts of the Project are adequately mitigated, offset and counterbalanced.

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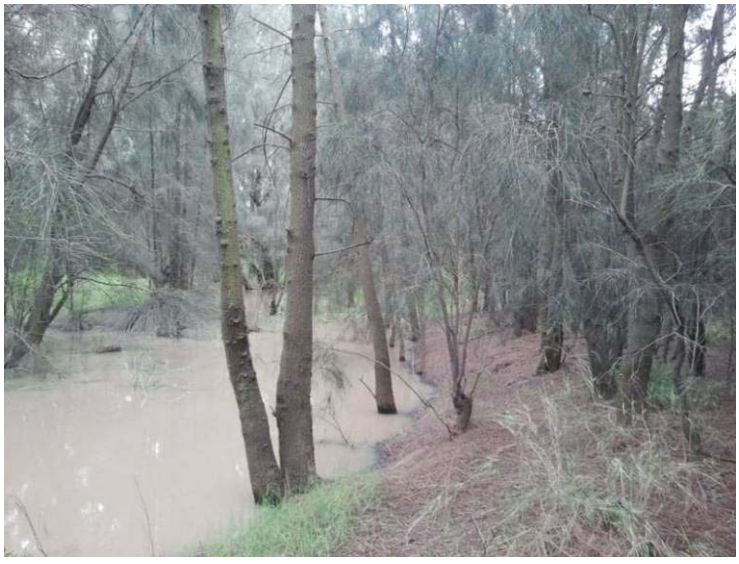
APPENDIX 1

Liddell Coal Operations Extension Project
– Fauna Survey Report
(Eco Logical Australia 2013)

LIDDELL COAL OPERATIONS EXTENSION PROJECT
Fauna survey
Final Report

Prepared for
Liddell Coal Operations

15 February 2013



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Abbreviations

ABBREVIATION	DESCRIPTION
BOM	Bureau of Meteorology
CMA	Catchment Management Authority
DEC	NSW Department of Environment and Conservation (now OEH)
DECC	NSW Department of Environment and Climate Change (now OEH)
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
DPI	Department of Planning and Infrastructure
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LCO	Liddell Coal Operations
LGA	Local Government Area
MMA	Mitsui Matsushima Australia Pty Limited
OEH	Office of Environment and Heritage
SEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (formerly DEWHA)
TSC Act	NSW *Threatened Species Conservation Act 1995*

1 Introduction

Eco Logical Australia (ELA) was commissioned by Liddell Coal Operations Pty Ltd to describe the fauna habitat values of the site proposed for the expansion of Liddell Coal Operations (LCO) (the project).

LCO is an open cut and underground coal mine located approximately 25 kilometres northwest of Singleton, NSW and is located on the boundary of the Muswellbrook and Singleton Local Government Areas (LGAs). The project is located in the Hunter Central Rivers Catchment Management Authority (CMA) area.

LCO is operated by Liddell Coal Operations Pty Ltd on behalf of a Joint Venture between Xstrata Coal Pty Limited (Xstrata) (67.5%) and Mitsui Matsushima Australia Pty Limited (MMA) (32.5%).

The project primarily involves a southern extension of the South Pit and the Entrance Pit and is referred to as modification 5. The project involves the clearing and modification of all land contained within the blue dashed line (the subject site) as shown in Figure 1.

REPORT STRUCTURE

The report is structured in the following chapters:

1. **Introduction** – outlines the Project and provides detail on all project components and their likely impact areas
2. **Existing environment** – provides context for the landscape in which the study area is located
3. **Methods** – outlines the methods used for database, literature review and field survey
4. **Results** – outlines the findings of the database, literature review and field survey

KEY TERMS

For the purposes of this report the following terminology has been used.

The project includes all works associated with the proposed expansion of LCO.

The proposal is used interchangeably with 'the project'.

The subject site represents the proposed development footprint for the project or the area directly affected by the proposal and is approximately 229 ha (Figure 1).

The study area includes the subject site and additional land that has the potential to be affected by the proposal, either directly or indirectly. The total area of the study area is approximately 564 ha.

The survey area includes the subject site and a large area of predominantly cleared grazing land to the north of the subject site adjoining Bowmans Creek. This area was included in the study area in previous iterations of the proposal but has since been removed.

The locality is the broader location of the project and includes a 10 km radius from the subject site. The locality is used to investigate threatened species, populations and communities that could potentially utilise the study area.

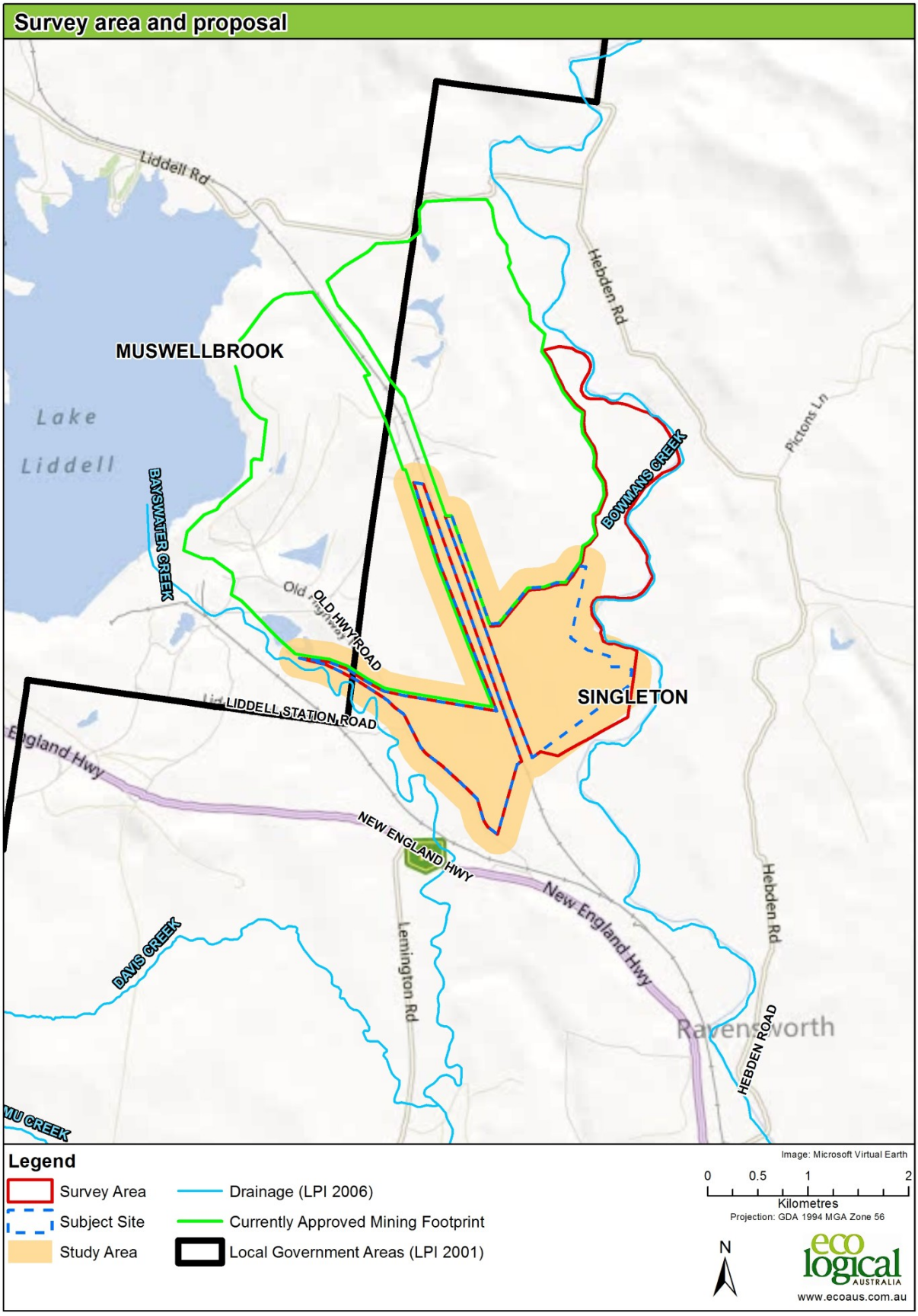


Figure 1: Study area and proposal

1.1 PROJECT DESCRIPTION

The Life of Mine planning process at LCO has identified the opportunity to maximise the recovery of coal resources within the existing development consent boundary and mining lease via the extension of open cut mining activities. In addition, LCO currently has approval to conduct mining operations until the end of 2023; however, open cut mining activities will reach this approved boundary by 2015.

LCO are therefore seeking approval to modify the existing development consent, DA 305-11-01, to allow for this extension of mining activities. The key components of the Project, include the following:

- Extension of existing open cut mining activities in the South Pit to the south east, beyond the currently approved mining and dump footprint
- Extension of existing open cut mining activities in the Entrance Pit to the south east, beyond the currently approved mining and dump footprint
- Associated extension of the life of mining operations at LCO from 2023 to approximately 2028
- Development of a tailings emplacement area within the final void in the South Pit following completion of mining in this pit to dispose of the additional tailings associated with the extension of open cut mining activities
- Temporary tailings evaporation cells will also be trialled within the overburden dumps of the South Pit to improve dewatering of the tailings for rehandle and final co-disposal within the overburden dumps
- Mining of coal resources under the Mine Infrastructure Area (MIA) following completion of mining in the Entrance and South Pits
- Auxiliary surface disturbance and infrastructure to support the new mining areas, including but not limited to, powerlines, pipelines and haul roads

No further changes to the operations at LCO are proposed. No changes are proposed to the mining method, mining equipment, annual ROM production rates, or operating hours. These aspects will not be altered and will remain as approved by development consent DA 305-11-01, as modified.

2 Existing environment

2.1 LANDSCAPE CONTEXT

The study area is situated to the east of Lake Liddell, north of the New England Highway, northwest of Ravensworth and west of Bowmans Creek (Figure 1). The remaining natural section of Chain of Ponds Creek traverses the south western portion of the subject site and drains to Bayswater Creek in the south west of the study area. Both Bowmans Creek and Bayswater Creek are tributaries of the Hunter River. The study area is located on the boundary of the Muswellbrook and Singleton Local Government Areas (LGAs) and is within the Hunter subregion of the Hunter-Central Rivers CMA.

The locality is characterised by cleared agricultural land with several large open cut mines including Ravensworth East/Mt Owen to the east, Drayton Coal to the west and Ravensworth North to the south. Bayswater and Liddell Power Stations are located to the west of the study area.

The climate of the study area is mild, with a mean minimum temperature of 17.6^{o} and a mean maximum of 30.6^{o} (BOM 2011). Mean annual rainfall totals 720 mm with the highest rainfall recorded in January (94.3 mm) and the lowest rainfall recorded in July (28.2 mm) (BOM 2011).

The study area comprises a range of man-made, natural and semi-natural characteristics, including LCO and associated infrastructure, large areas of improved pasture, rehabilitated areas, remnant and regrowth woodland, riparian forest and riparian woodland. .

The nearest conservation reserves to the study area include Mount Royal National Park (approximately 25 km to the north east) and Wollemi National Park (approximately 17 km to the south west). Ravensworth State Forest is located approximately 5 km to the east of the study area.

2.2 MITCHELL LANDSCAPES

Mitchell Landscapes are a system of ecosystem classification mapped at the 1:250,000 scale, based on a combination of soils, topography and vegetation (DECC 2008). Mitchell Landscapes are used in regional conservation planning in NSW and form a component of Biobanking. The study area consists of three Mitchell Landscapes as outlined in Table 1 and Figure 2.

Table 1: Mitchell Landscapes in the study area

MITCHELL LANDSCAPE	LANDSCAPE DESCRIPTION	LOCATION
Central Hunter Foothills	Undulating lowlands, rounded to steep hills with rock outcrop on ridges on Permian lithic sandstone, conglomerate, shale and coal, general elevation 40 to 300m with a few higher peaks, local relief 30 to120m. Red-brown to yellow brown harsh texture-contrast soils on slopes, dark coloured clays in valleys and limited accumulations of sand and gravel in streams. Woodlands to open forest of *Corymbia maculata* (Spotted Gum), *Eucalyptus tereticornis* (Forest Red Gum), *E. crebra* (Narrow-leaved Ironbark), *E. sideroxylon (*Mugga Ironbark), *E. albens (*White Box), *E. dawsonii* (Slaty Gum), *Angophora floribunda* (Rough-barked Apple) with *Themeda australis* (Kangaroo Grass) and *Austrodanthonia* spp. (Wallaby Grass).	Central portion of study area

MITCHELL LANDSCAPE	LANDSCAPE DESCRIPTION	LOCATION
Central Hunter Alluvial Plains	Channel, floodplain and terraces of the Hunter River on Quaternary alluvium, general elevation 20 to 40m, local relief 15m. Harsh brown texture-contrast soils on the third terrace, gradational sandy loam on the second terrace and loamy sand on the low terrace and floodplain. Limited areas of source bordering sand dune with grey to yellow-brown sand. Open grassland with scattered *E. melliodora* (Yellow Box), *E. tereticornis*, *Angophora floribunda* and patches of *Casuarina glauca* (Swamp Oak) on brackish and saline flats, *C. cunninghamiana* (River Oak) along the streams.	Bowmans Creek in the east and Bayswater Creek in the south west.

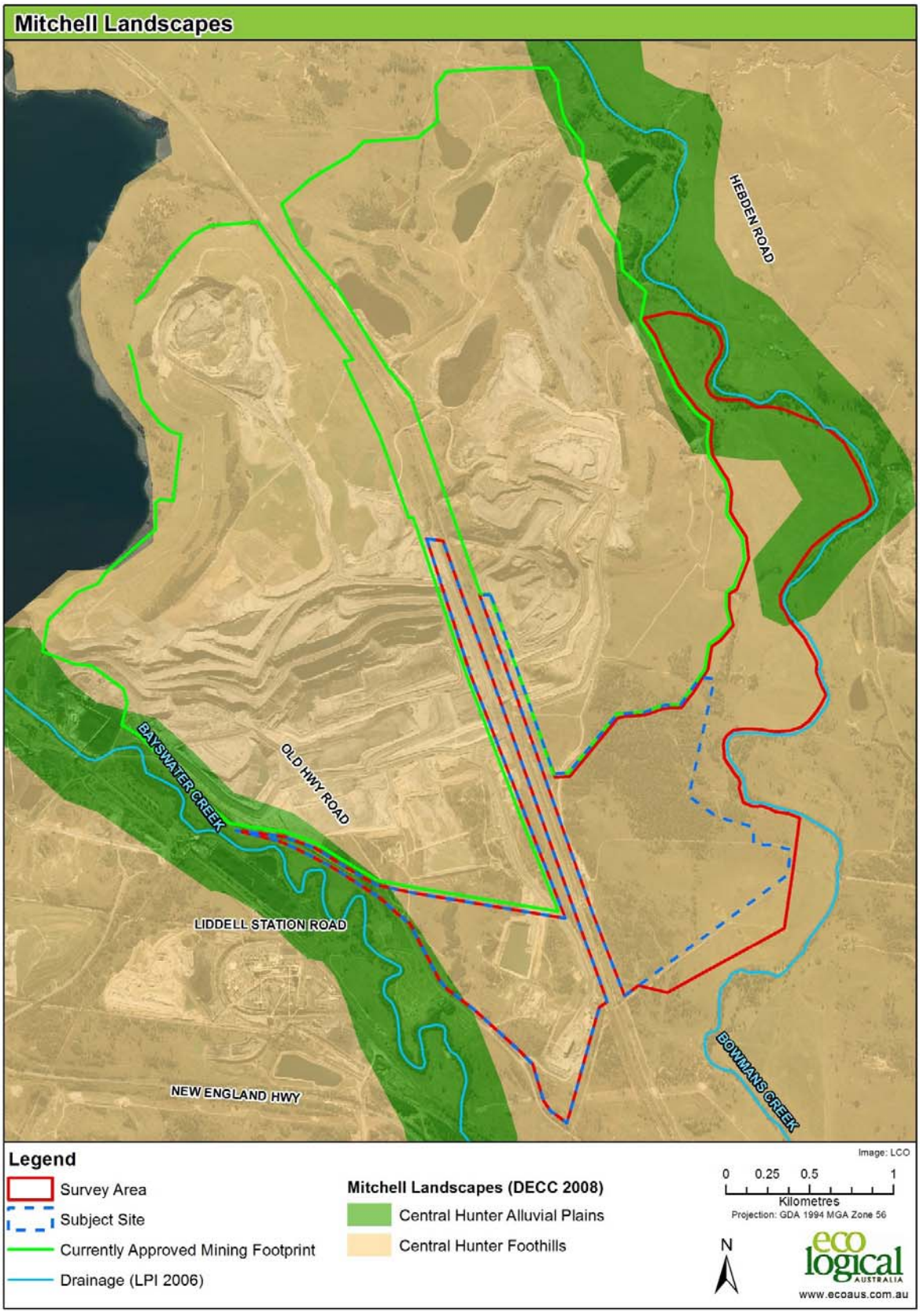


Figure 2: Mitchell Landscapes

3 Methods

3.1 DATA AND LITERATURE REVIEW

3.1.1 Data review

The data review was based on analysis of environmental databases including the Atlas of NSW Wildlife (OEH 2011a) and the EPBC Protected Matters Search Tool (SEWPaC 2011). Searches included a 10 km radius around the subject site to determine the potential occurrence of threatened fauna in accordance with state and federal statutory requirements. These searches were carried out in April 2011.

High resolution aerial photographs were also used to investigate the extent of vegetation cover, landscape features and disturbance patterns in the study area.

3.1.2 Literature review

A number of additional ecological impact assessments, and flora and fauna surveys conducted in general around the existing LCO were reviewed for records of threatened vegetation communities and flora and fauna species occurring in the study area. They include:

- Umwelt (2001) undertook investigations for threatened species, populations, ecological communities and native vegetation as part of a Continued Operations Environmental Impact Statement for LCO
- HLA (2005) established permanent vegetation plots, nest boxes and threatened species searches as part an annual monitoring program for LCO
- Umwelt (2006) undertook investigations for threatened species, populations, ecological communities and native vegetation as part of an impact assessment on proposed modifications to the LCO operation area
- Umwelt (2008; 2010; 2011) continued the annual monitoring program in accordance with the Xstrata Biodiversity and Land Management Standard and Liddell Coal Flora and Fauna Management Plan

3.2 FIELD SURVEY METHODOLOGY

Given the survey effort that has previously been implemented as part of previous studies, the survey methods for this project have been designed to supplement the previous surveys and results. Survey effort was guided by the draft *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities* (DEC 2004); OEH field survey guidelines (OEH 2011b); Threatened species survey and assessment guidelines field survey methods for fauna – Amphibians (DECC 2009); and the EPBC Act survey guidelines for Nationally Threatened Species (DEWHA 2010).

Field survey and reporting was undertaken by staff from Eco Logical Australia (Appendix E). Five habitat types (Figure 3) were identified on site and used as the basis for survey stratification. Habitat types were:

- Woodland (68 ha)
- Regrowth (35 ha)
- Riparian Forest (5.2 ha)
- Riparian woodland (3.5 ha)
- Grassland (145.3 ha)

3.2.1 Fauna surveys

Given the detailed surveys that have previously been undertaken (Umwelt 2001; 2006; 2008 and 2010 and HLA (2005) (refer to section 3.1.2); fauna surveys were designed as a gap analysis to cover habitat or fauna groups within the study area that required more information. Four habitat types were surveyed. These were 68 ha of remnant woodland, 35 ha of regrowth, 5.2 ha of riparian forest and 3.5 ha of riparian woodland. Grasslands were not included in all fauna survey distributions due to the lack of habitat features present and hence the unlikely occurrence of targeted fauna. The adopted survey methods are outlined below.

Field work for fauna surveys was undertaken in three survey periods; 5 – 7 July 2011, 24 – 28 October 2011 and 13 – 15 December 2011 by five ELA ecologists Antony von Chrismar, Enhua Lee, Andrea Sabella, Danielle Bennett and Daniel McKenzie. Fauna surveys were staggered to enable the identification of specific fauna assemblages (e.g. winter migrating birds in July). Weather during the July survey period (winter migrating birds only) was dominated by gusty winds and temperatures ranging from 9ºC to 15ºC during surveys with no rainfall recorded (BOM 2011). Weather during the October survey period was windy at times with temperatures ranging from 9ºC to 30ºC with over 20 mm of rain recorded midweek (BOM 2011). Weather during the December survey period was influenced by a heavy rainfall event prior to the survey although no rainfall was recorded during the survey (BOM 2011). Temperatures were mild to warm ranging from 15ºC to 24ºC with wind also being mild (BOM 2011).

3.2.2 Terrestrial and arboreal mammal surveys

A range of active and passive survey techniques including cage traps, hair tubes, spotlighting and call playback were utilised to survey terrestrial and arboreal mammal diversity (Figure 4). Hair tubes were baited with a mixture of rolled oats, peanut butter and honey. Additionally, the tree trunks on which the arboreal tubes were positioned were sprayed with a mixture of water and honey. Cage traps were baited with sardines.

The locations of the traps and hairtubes were chosen based on the presence of potential habitat and the trap night requirement for each vegetation type (Figure 4).

Terrestrial hairtubing

Terrestrial hairtubing required distributing 10 large and 10 small hair tubes in pairs over four days and nights per 50 ha of stratification unit (vegetation type). The number of trap nights was increased for this study to 49 for all vegetation types to accommodate for adverse weather conditions during the initial survey.

The terrestrial hairtubes were set between 24 October 2011 and 12 December 2011. Both *Faunatech* hair funnels and 90 mm PVC tubes with a bait capsule were used. All samples were sent to Hans Brunner, a hair identification specialist, to determine the species encountered.

Arboreal hairtubing

Arboreal hairtubing required distributing three tubes in each of 10 habitat trees over four days and nights. The number of trap nights was increased for this study to 49 for all vegetation types to accommodate for adverse weather conditions during the initial survey.

The arboreal hairtubes were set between 24 October 2011 and 12 December 2011. All hair tubes were baited with a mixture of rolled oats, peanut butter and honey and the tree trunks were sprayed with a mixture of water and honey. Both 65 mm *Faunatech* hair funnels and 90 mm PVC tubes with an internal bait capsule were used with double-sided adhesive tape at each entrance. The tubes were nailed to a tree approximately two metres above the ground. All samples were sent to Hans Brunner, a hair identification specialist, to determine the species encountered.

Wire cage trapping and remote camera surveying

Wire cage trapping required 24 trap nights over three to four consecutive nights per 50 ha of stratification unit (habitat type). This equated to six traps per night over four nights per 50 ha of stratification unit. This requirement was followed for riparian woodland. Due to adverse weather conditions, only 18 trap nights over three consecutive nights was achieved for regrowth and the riparian forest habitat types. Forty-two trap nights over three consecutive nights was achieved for the woodland habitat type to accommodate for the greater distribution of this vegetation type. The wire cages were set between 24 October 2011 and 28 October 2011. All traps were baited with sardines, targeting the Spotted-tailed Quoll.

A remote camera was also installed at each cage trap location. Each camera was pointed towards the baited cage and programmed to trigger from a combination of movement and infrared, taking three still photographs each time it was triggered. The cameras were active from 25 October 2011 to 28 October 2011.

Spotlighting

Spotlighting required walking a 1 km transect over one person hour and repeating this on two separate nights. This requirement was followed for the woodland, regrowth, and riparian forest habitat types. This survey method has already been completed in some of the riparian woodland within the study area (Umwelt 2008a) and was not repeated.

3.2.3 Microchiropteran bat surveys

Microchiropteran bats were surveyed using both Anabat recording and harp trapping to increase the bat diversity recorded.

Anabat recording

Anabat recording was used to survey Microchiropteran bat diversity. This method required two Anabats at each site repeated over two nights. This requirement was followed for riparian forest and regrowth habitat types. However, only one night was possible for the woodland habitat type. This survey method has already been completed in some areas of riparian woodland within the study area (Umwelt 2008a) and was not repeated.

Two Anabats were positioned at each site, near an area of open water and a clearing or flyway within woodland habitat if possible to increase the possibility of recording bat calls (Figure 4). Data was analysed by Peter Knock, a trained ELA consultant.

Harp trapping

Harp trapping was used to survey Microchiropteran bat diversity. This method required four trap nights over two consecutive nights for all of the four vegetation types. This equated to two harp traps at each site over two consecutive nights. Due to adverse weather conditions, this requirement was achieved for riparian forest and regrowth habitat types but only two trap nights were achieved for woodland and riparian woodland habitats.

Harp traps were allocated to areas of potential bat flight paths including areas adjacent to open water and trails within woodland habitat (Figure 4). Traps were checked each morning at dawn with captures released that night at dusk.

3.2.4 Bird surveys

Diurnal birds were surveyed in both winter and spring to increase the chance of detecting migratory and resident bird species. Call playback was also used to target threatened nocturnal species.

Diurnal bird census (winter and spring)

Diurnal bird censuses required a 20 minute dawn and dusk census repeated over two days. During the spring survey, this method was required for all of the habitat types. During the winter survey, four sites with habitat containing winter flowering species such as *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus tereticornis* (Forest Red Gum) were surveyed to target winter migratory species (Figure 4).

Call playback

Call playback was used to target large forest owls, specifically *Ninox strenua* (Powerful Owl), *Ninox connivens* (Barking Owl) and *Tyto novaehollandiae* (Masked Owl). To make each call playback event independent, regrowth and riparian forest habitats were combined into one site and woodland and riparian woodland habitats were combined into one site. Call playback was repeated twice for both sites.

At each site (Figure 4), an initial listening period of 10 minutes was undertaken. Each call was then played intermittently for five minutes, followed by a five minute listening period between each call. To conclude, a 10 minute spotlighting and listening survey was conducted.

3.2.5 Herpetofauna surveys

Diurnal census

A survey for reptiles and amphibians required a 30 minute habitat search repeated on two separate days. This requirement was followed for regrowth, woodland, riparian forest and riparian woodland habitat types (Figure 4).

Spotlighting

Spotlighting required walking a 1 km transect over one person hour and repeating this on two separate nights. This requirement was followed for regrowth, woodland and riparian forest habitat types. This survey method has already been completed in riparian woodland habitat (Umwelt 2008a) and was not repeated.

3.3 SURVEY LIMITATIONS

The list of species recorded from this study should not be considered comprehensive. Rather it is an indication of the species present at the time of the survey. A period of several seasons or years is often

needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year (e.g. frogs), and/or may require specific weather and seasonal conditions for optimum detection (e.g. migratory birds).

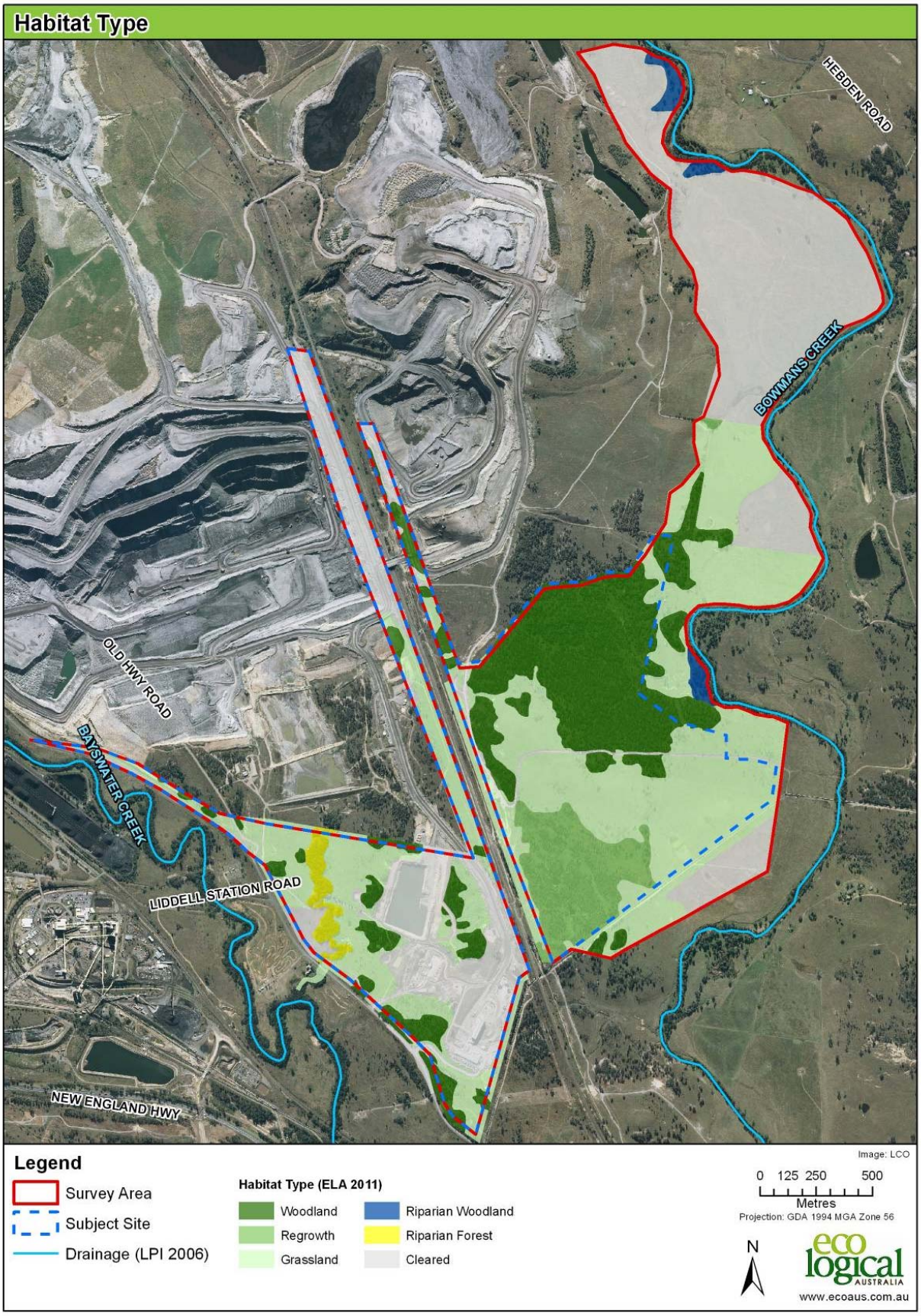


Figure 3: Habitat Type

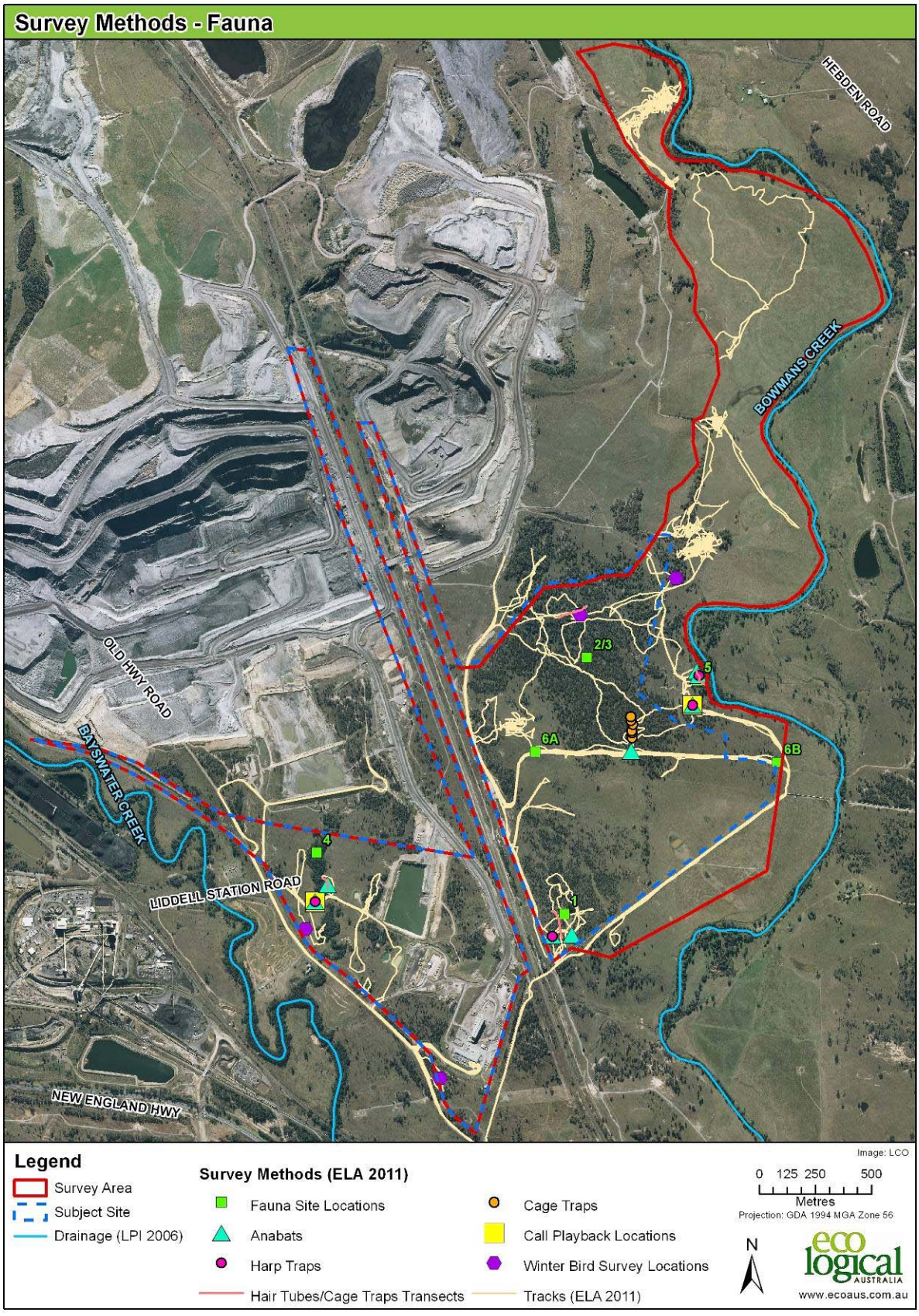


Figure 4: Fauna Survey Methods

4 Results

4.1 LITERATURE REVIEW

Umwelt (2001) Liddell Colliery Continued Operations Environmental Impact Statement

This Environmental Impact Statement (EIS) was prepared for LCO for a development application covering an area of approximately 1,400ha. Habitat types comprised pastoral grassland, woodland, riparian woodland/forest and aquatic vegetation. Exotic species were common in all communities.

Fauna diversity was highest in the woodland areas, with threatened species recorded including *Miniopterus shreibersii oceanensis* (Common Bent-wing Bat), *Myotis adversus* (Large-footed Myotis), *Scoteanax ruepellii* (Greater Broad-nosed Bat) and *Mormopterus norfolkensis* (East Coast Freetail Bat).

HLA (2005) Liddell Coal Flora and Fauna Monitoring

HLA (2005) conducted the first annual monitoring program of the LCO. Fauna surveys included nest boxes, microbat echolocation call recording at two sites, spotlighting, microhabitat searches for reptiles and amphibians and diurnal bird surveys.

Threatened fauna species recorded included *Oxyura australis* (Blue billed Duck) and *Pomatostomus temporalis temporalis* (Grey-crowned Babbler).

Umwelt (2008; 2010; 2011) Liddell Coal Flora and Fauna Monitoring

Umwelt have completed several annual fauna monitoring surveys within the Liddell Coal area since the original monitoring was completed by HLA in 2005. Fauna monitoring has been undertaken in accordance with the Xstrata Biodiversity and Land Management Standard (Xstrata 2004) and Liddell Coal Flora and Fauna Management Plan (Umwelt 2003). One fauna monitoring site (site 5) occurs within the study area and four fauna monitoring sites (1, 2, 8 and Dam 13) occur adjacent to the study area.

Numerous threatened fauna species were identified within the study area.

Umwelt (2006) Ecological Assessment for proposed modifications to the Liddell mine operation area

Umwelt were commissioned to prepare an ecological assessment of a portion of the study area for a proposed modification. In relation to the current project study area, the Umwelt investigation was concentrated on the Barrier Pit extension, the South Pit Dam 13 extension, the South Pit Southern extension, the relocated office and workshop complex and the realigned access road and service corridor. Field surveys were conducted in July 2006 and involved walk-over surveys, with supplementary vehicle traverses completed in October 2006.

Umwelt (2006) reported that the site was heavily modified and fragmented by agricultural and mining activities. Two fauna habitat types were recorded within the study area, grassland and regrowth.

Umwelt (2006) recorded several threatened fauna species within the Liddell area, including Grey-crowned Babbler and Blue-billed Duck. Other species recorded in the general area during the 2006 annual survey (Umwelt 2008a; Umwelt 2010) included *Pyrrholaemus sagittata* (Speckled Warbler) and the Eastern Bent-wing Bat.

The survey effort conducted to date within the study area, compliance with guidelines and additional survey required for this study is outlined in Table 2.

Table 2: Survey methods and effort conducted to date.

SURVEY METHOD	SURVEY REFERENCE	DATE	EFFORT	ADDITIONAL SURVEY REQUIRED FOR THIS STUDY?
Hair tubes (terrestrial)	Umwelt (2010)	August – September 2009	280 trap nights at 4 sites (1 in study area) (total trap nights 1120) over 14 days	No additional survey is required, however targeted survey was undertaken to obtain better site coverage.
	Umwelt (2011)	November – December 2010	280 trap nights at 4 sites (none in study area) (total trap nights 1120) over 14 days	No additional survey is required, however targeted survey was undertaken to obtain better site coverage
Spotlighting, and call playback	Umwelt (2008)	March 2008	2 person hours over 2 nights at 1 site within the study area	No additional survey is required, however targeted survey was undertaken to obtain better site coverage
Anabat II bat call recorder	Umwelt (2008)	March 2008	2 recording nights at 1 site in study area (Bowmans Creek)	No additional survey is required, however targeted survey was undertaken to obtain better site coverage
	Umwelt (2010)	August – September 2009	2 nights at each of 4 sites (1 in study area) (total 8 Anabat recording nights).	Additional survey in more appropriate seasonal conditions (October-March) is required.
	Umwelt (2011)	November – December 2010	2 nights at each of 4 sites (none in study area) (total 8 Anabat recording nights).	No additional survey is required, however targeted survey was undertaken to obtain better site coverage
Habitat Assessment	Umwelt (2006)	October 2006	General observations on presence of habitat and resources.	Mapping of hollow bearing trees and water bodies is recommended.
	Umwelt (2008)	March 2008	Habitat features within 1 site in study area was recorded	No
	Umwelt (2010)	August – September 2009	Habitat features within 1 site within study area and 3 adjacent sites were recorded	No

SURVEY METHOD	SURVEY REFERENCE	DATE	EFFORT	ADDITIONAL SURVEY REQUIRED FOR THIS STUDY?
	Umwelt (2011)	November – December 2010	Habitat features within 3 adjacent sites were recorded	No
Diurnal bird survey	Umwelt (2008)	March 2008	Two person hours over 2 days at 1 site in the current study area (Bowmans Creek)	Additional survey effort considered necessary for adequate site coverage Winter bird census also required
	Umwelt (2010)	August – September 2009	Two person hours over 2 days at 1 site in the study area and 3 sites adjacent to the study area (1,2,5,8)	Additional survey effort considered necessary for adequate site coverage Winter bird census also required
	Umwelt (2011)	November – December 2010	Two person hours over 2 days at 3 sites adjacent to the study area (1,2,8)	Additional survey effort considered necessary for adequate site coverage Winter bird census also required
Targeted waterbird survey	Umwelt (2006)	9&10August 2006 19&20 October 2006	Surveys of dams and part of Lake Liddell – all water birds were recorded. Person hours not provided.	1hr dawn/dusk census per wetland is required.
	Umwelt (2008)	March 2008	Two person hours over 2 days at each dam. Surveys undertaken for 5 dams outside of the study area	No
	Umwelt (2008)	March 2008	One person hour targeted Blue-billed Duck survey at 7 locations around Lake Liddell	No
	Umwelt (2010)	August – September 2009	Targeted Blue-billed Duck surveys at 1 dam (Dam 13) – 2 x 30min census's on 2 days.	Additional survey effort considered necessary for adequate site coverage

SURVEY METHOD	SURVEY REFERENCE	DATE	EFFORT	ADDITIONAL SURVEY REQUIRED FOR THIS STUDY?
	Umwelt (2011)	November – December 2010	Targeted Blue-billed Duck surveys at 3 dams (Dam 13 is adjacent to study area) – 2 x 20min census's on 2 days.	Additional survey effort considered necessary for adequate site coverage
Amphibian survey	Umwelt (2008)	March 2008	4 person hours over 2 days (2 diurnal and 2 nocturnal hours) at 1 site within the study area (Bowmans Creek)	No
	Umwelt (2010)	August – September 2009	2 person hours over 2 days (diurnal only) at 1 site within the study area (Bowmans Creek)	Nocturnal survey required
	Umwelt (2011)	November – December 2010	Two person hours over 2 days at 3 sites adjacent to the study area (1,2,8)	Nocturnal survey required
Reptile survey	Umwelt (2008)	March 2008	4 person hours over 2 days at 1 site within the study area (Bowmans Creek)	Additional coverage in the study area is required.
	Umwelt (2010)	August – September 2009	Two person hours over 2 days at 1 site in the study area and 3 adjacent sites (1, 2, 5 and 8)	Additional coverage in the study area is required.
	Umwelt (2011)	November – December 2010	Two person hours over 2 days at 1 site in the study area and 3 adjacent sites (1, 2, 5 and 8)	Additional coverage in the study area is required.
Opportunistic surveys	Umwelt (2006)	October 2006	All opportunistic observations of fauna were recorded	No
	Umwelt (2008)	March 2008	All opportunistic observations of fauna were recorded	No

SURVEY METHOD	SURVEY REFERENCE	DATE	EFFORT	ADDITIONAL SURVEY REQUIRED FOR THIS STUDY?
	Umwelt (2010)	August – September 2009	All opportunistic observations of fauna were recorded	No
	Umwelt (2011)	November – December 2010	All opportunistic observations of fauna were recorded	No

4.2 FIELD SURVEY

A total of 111 fauna species were recorded, including seven amphibians, sixty-six avian species, thirty-two mammal species and six reptile species (Appendix A). Table 3 and Figure 5 provides a summary of all the threatened and migratory species listed under the EPBC Act and TSC Act that have been recorded at the subject site and adjoining areas (including previous studies).

Table 3: List of threatened and migratory species recorded within the study area

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	STUDY REFERENCE
Climacteris picumnus victoriae	Brown Treecreeper	V	-	This survey
Dasyurus maculatus *Dasyurus maculatus maculatus*	Spotted-tailed Quoll Spotted-tailed Quoll (SE Mainland Population)	V —	— E	Recorded by Umwelt (2008; 2010)
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	—	This survey , Umwelt (2010)
Melanodryas cucullata *Melanodryas cucullata cucullata*	Hooded Robin Hooded Robin (southeastern subspecies)	V	—	This survey, recorded by Umwelt (2010)
Merops ornatus	Rainbow Bee-eater	—	M	This survey , recorded by Umwelt (2010)
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	—	This survey , Umwelt (2001; 2006; 2008; 2010)
Mormopterus norfolkensis	East Coast Freetail Bat	V	—	This survey, Umwelt (2001; 2008; 2010)
Myotis adversus	Large-footed Myotis	V	—	This survey , Umwelt (2001; 2006; 2008; 2010)

SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	STUDY REFERENCE
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	—	This survey, HLA (2001) Umwelt (2001; 2006; 2008; 2010)
Pyrrholaemus sagittatus	Speckled Warbler	V	—	This survey , Umwelt (2006; 2010)
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	This survey , Umwelt (2001)
Vespadelus troughtoni	Eastern Cave Bat	V	—	This survey , Recorded by Umwelt (2010)

4.2.1 Fauna habitats

The survey area was classified into five habitat types: woodland (68 ha), regrowth (35 ha), riparian forest (5.2 ha), riparian woodland (3.5 ha) and grassland (143.3 ha). A brief description of each habitat type is presented below. In addition to these habitat types a number of small farm dams were also present.

Woodland

The woodland habitat type is generally dominated by *Eucalyptus crebra* (Narrow-leaved Ironbark) in the upper stratum and *Allocasuarina luehmannii* (Bull Oak) and *Acacia salicina* (Cooba) in the mid stratum (Plate 1); however some areas have a canopy dominated by Bull Oak and others by Narrow-leaved Ironbark. The shrub layer is sparse but the ground cover is dense with native forbs, sedges, ferns and grasses including *Dichondra repens* (Kidney Weed), *Chrysocephalum apiculatum* (Common Everlasting), *Lomandra filiformis* (Wattle Mat-rush), *Cheilanthes sieberi* (Poison Rock Fern), *Cymbopogon refractus* (Barbed Wire Grass), *Aristida ramosa* (Purple Wiregrass), *Eragrostis brownii* (Brown's Lovegrass) and *Cynodon dactylon* (Couch). The weed species *Opuntia humifusa* (Creeping Pear) and *Senecio madagascariensis* (Fireweed) were prevalent.

There was a general paucity of hollow resources (recorded at a low rate of 2 per hectare) and fallen logs within this habitat type, however sheltering resources are provided by dense Bulloak. The woodland type provides habitat (foraging, roosting and breeding) for a range of threatened fauna species, particularly woodland birds and microchiropteran bats.

Plate 1: Woodland

Regrowth

The regrowth type is dominated by regrowth *Allocasuarina luehmannii* over a diverse groundlayer similar to that present in the woodland habitat type (Plate 2).

The regrowth type provides reduced fauna habitat compared to that available within the adjacent woodland, however resources for foraging and roosting for a number of threatened fauna species, particularly woodland birds and microchiropteran bats still exist.

Plate 2: Regrowth

Riparian Forest

This habitat type is present as a low to tall forest dominated by *Casuarina glauca* (Swamp Oak) and occasionally also *Eucalyptus tereticornis* (Forest Red Gum) in the upper stratum (Plate 3). The mid layer is sparse but the ground cover is dense with native low lying shrubs, forbs and grasses including *Maireana microphylla* (Small-leaf Bluebush), *Einadia nutans* (Climbing Saltbush), *Oxalis perennans, Pratia purpurascens* (Whiteroot), *Austrostipa verticillata* (Slender Bamboo Grass), *Cynodon dactylon, Microlaena stipoides* (Weeping Grass) and *Panicum* sp.. The native mistletoe *Amyema cambagei* was commonly observed and weed species were also prevalent including *Aster subulatus* (Wild Aster), *Bryophyllum daigremontianum*, *Ehrharta erecta* (Panic Veldtgrass), *Galenia pubescens* (Galenia), *Juncus acutus* (Spike Rush), *Senecio madagascariensis, Sida rhombifolia* (Paddy's Lucerne) and *Solanum nigrum* (Black-berry Nightshade).

The riparian forest habitat type provides habitat (foraging, roosting and breeding) for a range of threatened fauna species, particularly woodland birds and microchiropteran bats Hollow resources (recorded at a rate of 7 per hectare) were more abundant within this habitat type compared with the adjoining woodland. This habitat type also provides connectivity across the landscape.

Plate 3: Riparian Forest

Riparian Woodland

This habitat type is present as a tall woodland dominated by *Casuarina cunninghamiana* (River Oak) in the upper stratum (Plate 4). The mid layer is sparse but the ground cover is dense, dominated by native grasses including *Austrostipa verticillata, Chloris ventricosa* (Plump Windmill Grass) and *Sporobolus creber* (Western Rat-tail Grass) and weed species including *Bidens subalternans* (Greater Beggar's Ticks), *Conyza bonariensis* (Flaxleaf Fleabane), *Galenia pubescens, Lepidium africanum, Opuntia aurantiaca, Pennisetum clandestinum* (Kikuyu), *Senecio madagascariensis, Setaria parviflora* and *Sida rhombifolia.*

The riparian woodland type provides similar habitat values to the riparian forest type with greater connectivity across the landscape, however hollow resources (recorded at a rate of 5 per hectare) were slightly lower than the riparian forest habitat type.

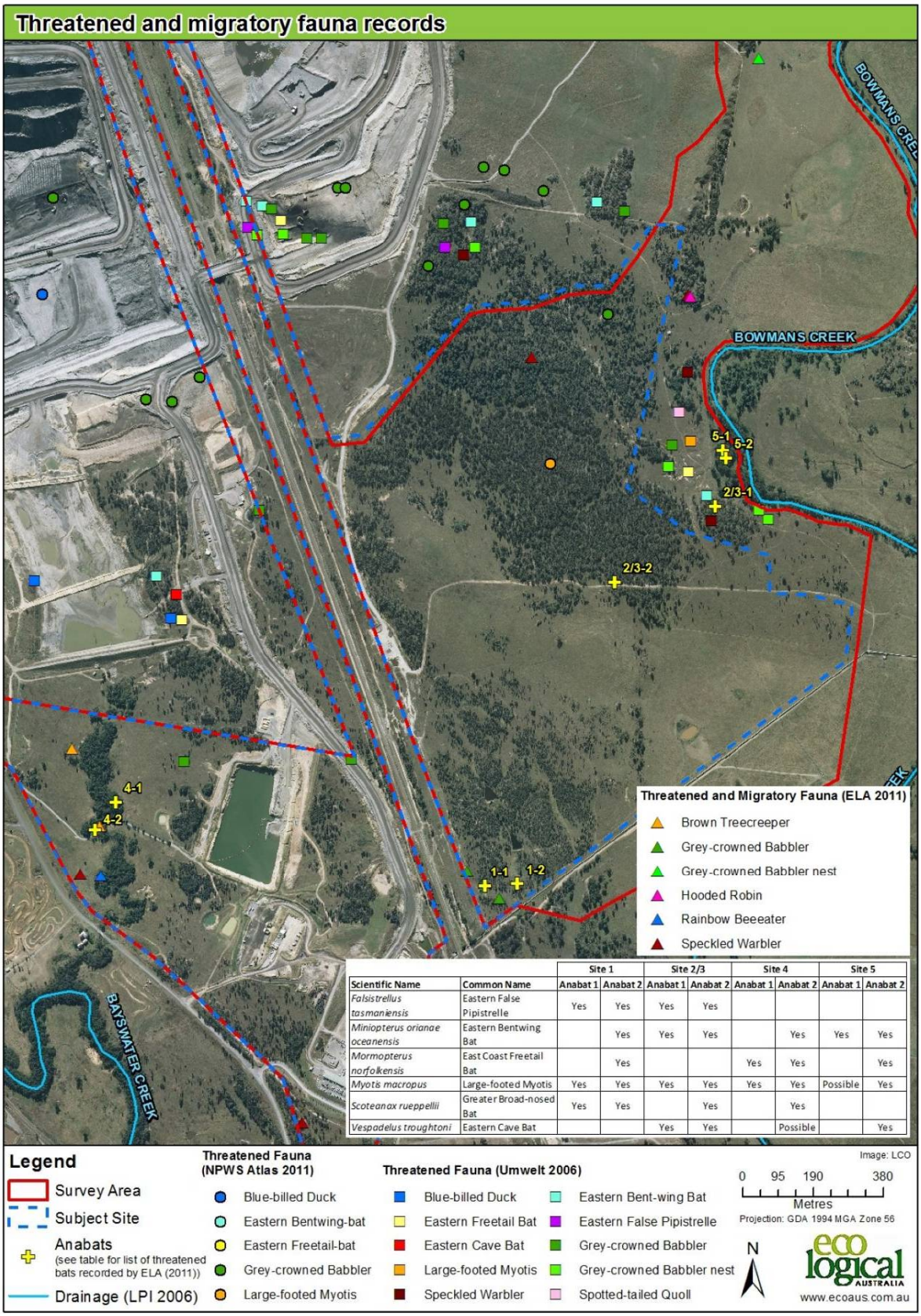
Plate 4: Riparian Woodland

Grassland

The grassland habitat generally lacks any shrub or canopy strata but has a diverse groundlayer similar to that present in the woodland habitat type.

The grassland type provides reduced fauna habitat to that available within the adjacent woodland and regrowth, however resources for foraging for a number of threatened fauna species, particularly woodland birds and microchiropteran bats still exist.

Plate 5: Grassland



Scientific Name	Common Name	Site 1		Site 2/3		Site 4		Site 5	
		Anabat 1	Anabat 2	Anabat 1	Anabat 2	Anabat 1	Anabat 2	Anabat 1	Anabat 2
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Yes	Yes	Yes	Yes				
Miniopterus orianae oceanensis	Eastern Bentwing Bat		Yes	Yes	Yes		Yes	Yes	Yes
Mormopterus norfolkensis	East Coast Freetail Bat		Yes			Yes	Yes		Yes
Myotis macropus	Large-footed Myotis	Yes	Yes	Yes	Yes	Yes	Yes	Possible	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	Yes	Yes		Yes		Yes		
Vespadelus troughtoni	Eastern Cave Bat			Yes	Yes		Possible		Yes

Figure 5: Threatened and migratory fauna records from this survey, Umwelt 2006 and NPWS Atlas 2011

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Appendix A: Fauna species recorded

CLASS NAME	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	WINTER BC1*	WINTER BC2*	WINTER BC3*	WINTER BC4*	FAUNA 1*	FAUNA 2/3*	FAUNA 4*	FAUNA 5*	FAUNA 6A*	FAUNA 6B*	OPPORTUNISTIC*
Amphibia	Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog							S	O				W	I
Amphibia	Hylidae	*Litoria latopalmata*	Broad-palmed Frog							S	I				W	
Amphibia	Hylidae	*Litoria peronii*	Peron's Tree Frog							S					W	I
Amphibia	Myobatrachidae	*Crinia signifera*	Common Eastern Froglet			O			O			W	W			I
Amphibia	Myobatrachidae	*Limnodynastes peronii*	Brown-striped Frog												W	
Amphibia	Myobatrachidae	*Limnodynastes tasmaniensis*	Spotted Grass Frog							S					O	I
Amphibia	Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet							S		S				
Aves	Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill			O, W	O				O				O	I
Aves	Acanthizidae	*Acanthiza nana*	Yellow Thornbill			O	O		O							
Aves	Acanthizidae	*Acanthiza pusilla*	Brown Thornbill							I					O	
Aves	Acanthizidae	*Acanthiza reguloides*	Buff-rumped Thornbill													I
Aves	Acanthizidae	*Acanthiza sp.*	Unidentified Thornbill							O						
Aves	Acanthizidae	*Malurus cyaneus*	Superb Fairy-wren			O		O, W	O, W	O	O	O	O		O, W	I
Aves	Acanthizidae	*Pyrrholaemus saggitatus*	Speckled Warbler	V		O	O, W	O	O, W	I						
Aves	Acanthizidae	*Smicrornis brevirostris*	Weebill			O	O		O							I
Aves	Accipitridae	*Aquila audax*	Wedge-tailed Eagle											O		I
Aves	Accipitridae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike												O	
Aves	Alcedinidae	*Cracticus torquatus*	Grey Butcherbird			O	O	O	O							
Aves	Anatidae	*Anas castanea*	Chestnut Teal					W								

CLASS NAME	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	WINTER BC1*	WINTER BC2*	WINTER BC3*	WINTER BC4*	FAUNA 1*	FAUNA 2/3*	FAUNA 4*	FAUNA 5*	FAUNA 6A*	FAUNA 6B*	OPPORTUNISTIC*
Aves	Anatidae	*Colluricincla harmonica*	Grey Shrike-thrush			O	O	O								
Aves	Apodidae	*Dacelo novaeguineae*	Laughing Kookaburra													I
Aves	Ardeidae	*Ardea pacifica*	White-necked Heron							O						
Aves	Ardeidae	*Cisticola exilis*	Golden-headed Cisticola													I
Aves	Artamidae	*Strepera graculina*	Pied Currawong					O, W		O	O, S	O	O			I
Aves	Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo												O, W	I
Aves	Cacatuidae	*Cacatua sp.*	Corella													I
Aves	Cacatuidae	*Cracticus nigrogularis*	Pied Butcherbird			O				O						I
Aves	Cacatuidae	*Eolophus roseicapillus*	Galah					O			O	O		W	O, W	I
Aves	Campephagidae	*Hirundo neoxena*	Welcome Swallow					O				O				I
Aves	Cisticolidae	*Manorina melanocephala*	Noisy Miner						O, W	O	O	O	O	O, W		I
Aves	Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern sub-species)	V				O, W								I
Aves	Columbidae	*Acridotheres tristis*	Common Myna													I
Aves	Columbidae	*Phaps chalcoptera*	Common Bronzewing				O					O				I
Aves	Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough				O, W			O, RC	O		O			I
Aves	Corvidae	*Corvus coronoides*	Australian Raven			O		O, W	O	O		O	O	W		I
Aves	Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo									O				
Aves	Cuculidae	*Egretta novaehollandiae*	White-faced Heron					O								I
Aves	Cuculidae	*Elanus axillaris*	Black-shouldered Kite							O			O(?)	O		I
Aves	Dicruridae	*Grallina cyanoleuca*	Magpie-lark			O				O, I			O		W	I
Aves	Dicruridae	*Rhipidura albiscapa*	Grey Fantail			O	O, W	O	O				O			I
Aves	Estrildidae	*Neochmia temporalis*	Red-browed Finch					O, W				O				

CLASS NAME	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	WINTER BC1*	WINTER BC2*	WINTER BC3*	WINTER BC4*	FAUNA 1*	FAUNA 2/3*	FAUNA 4*	FAUNA 5*	FAUNA 6A*	FAUNA 6B*	OPPORTUNISTIC*
Aves	Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch			O										I
Aves	Falconidae	*Falco berigora*	Brown Falcon			O										
Aves	Falconidae	*Falco cenchroides*	Nankeen Kestrel												O	I
Aves	Falconidae	*Falco longipennis*	Australian Hobby			O										I
Aves	Falconidae	*Falco sp.*	Unidentified Falcon										O			
Aves	Hirundinidae	*Gerygone mouki*	Brown Gerygone													I
Aves	Hirundinidae	*Petrochelidon nigricans*	Tree Martin									O				
Aves	Meliphagidae	*Anthochaera sp.*	Unidentified Wattlebird													I
Aves	Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater													I
Aves	Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater			O	O	O				O				
Aves	Meliphagidae	*Philemon corniculatus*	Noisy Friarbird											W		
Aves	Meliphagidae	*Plectorhyncha lanceolata*	Striped Honeyeater			O		O, W	W			O				
Aves	Meropidae	*Merops ornatus*	Rainbow Bee-eater		M							O				
Aves	Motacillidae	*Anthus australis*	Australian Pipit (Richard's - novaeseelandiae)												O	I
Aves	Oriolidae	*Rhipidura leucophrys*	Willie Wagtail			O		O		O, I	O	O		O, W	O, W	I
Aves	Pachycephalidae	*Gymnorhina tibicen*	Australian Magpie			O, W	O	O			O	O		O		I
Aves	Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler			O										
Aves	Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler			O									O, W	I(?)
Aves	Pardalotidae	*Vanellus miles*	Masked Lapwing					W		O						I
Aves	Petroicidae	*Melanodryas cucullata*	Hooded Robin	V		O										
Aves	Petroicidae	*Petroica goodenovii*	Red-capped Robin			O, W	O		O							I
Aves	Phasianidae	*Coturnix sp.*	Unidentified Quail							O						

CLASS NAME	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	WINTER BC1*	WINTER BC2*	WINTER BC3*	WINTER BC4*	FAUNA 1*	FAUNA 2/3*	FAUNA 4*	FAUNA 5*	FAUNA 6A*	FAUNA 6B*	OPPORTUNISTIC*
Aves	Phasianidae	*Coturnix ypsilophora*	Brown Quail											O		I
Aves	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe							S						
Aves	Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler	V						I						I
Aves	Psittacidae	*Parrot Hybrid*	Crimson Rosella/Red-rumped Parrot													I
Aves	Psittacidae	*Parrot Hybrid*	King/Red-winged Parrot													I
Aves	Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella			O	O	W	O	O			O		O, W	
Aves	Psittacidae	*Platycercus elegans elegans* x *adscitus eximius*	Crimson/Eastern Rosella													I
Aves	Rallidae	*Anas superciliosa*	Pacific Black Duck												O	
Aves	Sturnidae	*Sturnus vulgaris*	Common Starling						O							I
Aves	Sylviidae	*Cincloramphus mathewsi*	Rufous Songlark							O					O	I
Mammalia	Bovidae	*Bos taurus*	European cattle													I
Mammalia	Bovidae	*Capra hircus*	Goat													I
Mammalia	Canidae	*Canis lupus familiaris*	Dog													I
Mammalia	Canidae	*Vulpes vulpes*	Fox							TH	TH					I
Mammalia	Leporidae	*Lepus capensis*	Brown Hare													
Mammalia	Leporidae	*Lepus capensis*	Brown Hare													I
Mammalia	Leporidae	*Oryctolagus cuniculus*	Rabbit													I
Mammalia	Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo							S, RC						I
Mammalia	Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby							S						
Mammalia	Macropodidae	*Wallabia bicolor*	Swamp Wallaby													I

CLASS NAME	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	WINTER BC1*	WINTER BC2*	WINTER BC3*	WINTER BC4*	FAUNA 1*	FAUNA 2/3*	FAUNA 4*	FAUNA 5*	FAUNA 6A*	FAUNA 6B*	OPPORTUNISTIC*
Mammalia	Molossidae	*Austronomus australis*								A	A		A			
Mammalia	Molossidae	*Mormopterus* "Species 4"								A	A	A	A			
Mammalia	Molossidae	*Mormopterus norfolkensis*	Eastern Freetail-bat	V						A		A	A			
Mammalia	Molossidae	*Tadarida australis*	White-striped Freetail-bat								W					
Mammalia	Muridae	*Rattus rattus*	Black Rat								TH	AH				
Mammalia	Muridae	*Rattus* sp.	Rat									AH				
Mammalia	Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum							AH(?)	TH, AH, RC	TH, AH, RC, S	TH(?), AH			
Mammalia	Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum													I
Mammalia	Suidae	*Sus scrofa*	Pig													I
Mammalia	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat								A	A	A			
Mammalia	Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat							A	A	A	A			
Mammalia	Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V						A	A					
Mammalia	Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V						A	A	A	A			
Mammalia	Vespertilionidae	*Myotis adversus*	Large-footed Myotis	V							A					
Mammalia	Vespertilionidae	*Myotis macropus*	Southern Myotis							A		A	A			
Mammalia	Vespertilionidae	*Nyctophilus sp.*	long-eared bat							A	A	A	A			
Mammalia	Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V						A	A	A	A			
Mammalia	Vespertilionidae	*Scotorepens balstoni*	Inland Broad-nosed Bat								A		A			
Mammalia	Vespertilionidae	*Vespadelus pumilus*	Eastern Forest Bat								A	A	A			
Mammalia	Vespertilionidae	*Vespadelus troughtoni*	Eastern Cave Bat	V							A	A(??)	A			
Mammalia	Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat								A, HT		A			

CLASS NAME	FAMILY NAME	SCIENTIFIC NAME	COMMON NAME	TSC ACT	EPBC ACT	WINTER BC1*	WINTER BC2*	WINTER BC3*	WINTER BC4*	FAUNA 1*	FAUNA 2/3*	FAUNA 4*	FAUNA 5*	FAUNA 6A*	FAUNA 6B*	OPPORTUNISTIC*
Mammalia	Vombatidae	*Vombatus ursinus*	Common Wombat													I(?)
Reptilia	Agamidae	*Physignathus lesueurii*	Eastern Water Dragon								O					
Reptilia	Agamidae	*Pogona barbata*	Bearded Dragon										O			
Reptilia	Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle							O						
Reptilia	Scincidae	*Carlia tetradactyla*	Southern Rainbow-skink								O					
Reptilia	Scincidae	*Lampropholis sp.*	unidentified grass skink							O						
Reptilia	Varanidae	*Varanus varius*	Lace Monitor								O					I

Appendix B: Staff qualifications

STAFF MEMBER	ROLE	QUALIFICATIONS
Martin Sullivan	Senior Botanist	Bachelor of Science (Biodiversity and Conservation), Macquarie University, Sydney Accredited Biobanking Assessor under the TSC Act
Antony von Chrismar	Ecologist	Bachelor of Applied Science Environmental Resource Management Southern Cross University Accredited Biobanking Assessor under the TSC Act Certificate II in Bushland Regeneration TAFE NSW
Dr Enhua Lee	Ecologist	PhD in Ecology and Wildlife Management. The Ecological Effects of Sealed Roads in Australia's Arid Zone Bachelor of Advanced Science (First Class Honours). Mitochondrial Adjustments in the Muscles of the Fat-tailed Dunnart, Sminthopsis crassicaudata, During Cold Acclimation
Andrea Sabella	Ecologist	Bachelor of Environmental Science (Hons) Biology, University of New South Wales

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APPENDIX 2

Threatened Species Assessment

Appendix 2 – Threatened Species Assessment

Threatened species, endangered populations (EPs) and threatened ecological communities (TECs) listed under the *Threatened Species Conservation Act 1995* (TSC Act) and/or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) recorded or considered likely to occur within 10 kilometres of Liddell Coal Operations have been identified based on the results of database searches as well as the results of the literature review described in the Ecological Assessment.

From this, **Tables 1** and **2** identify the threatened flora and fauna species, EPs, TECs and migratory species that have potential to occur within a 10 kilometre radius of the centre of the Proposed Modification Area. This information was obtained from searches undertaken of the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (2013), the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Protected Matters Database (2013), the NSW OEH Threatened Species website (search for the Hunter CMA subregion), the Department of Primary Industries (DPI) – Fishing and Agriculture Threatened and Protected Species Records Viewer (2013) and literature reviews undertaken by Umwelt and ELA.

These tables contain information including habitat requirements, known range and reservation within conservation reserves in the region, as well as an assessment as to whether the entity is likely to occur in the LCO holdings and whether there is the potential for the entity to be impacted by the Project.

It should be noted that some species are listed in both tables as they are listed under both threatened species legislation and international migratory conventions. In these cases the information presented is identical, except for the legal listing (which is relevant to the table under which they are listed).

An assessment of significance was prepared in accordance with the requirements of the TSC and EPBC Acts for each threatened and migratory species, EP or TEC recorded or for which there is the potential for impact as a result of the Project. These assessments of significance are provided in Appendices 5 and 6.

Table 1 – Threatened Flora Species, Endangered Populations and Threatened Ecological Communities recorded or with Potential to Occur in the Proposed Modification Area

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
THREATENED FLORA SPECIES						
Lobed blue-grass *Bothriochloa biloba*	V (EPBC)	Grows in woodlands and grasslands on poorer soils.	Regionally recorded across much of the central and upper Hunter Valley with fewer records in the lower Hunter but as far east as Maitland.	This species is not known from any conservation reserves in the region.	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Leafless tongue-orchid *Cryptostylis hunteriana*	V (TSC) V (EPBC) 3VC (ROTAP)	This species appears to favour moist soils on the flat coastal plains. Occupies swamp heath, but also in sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing *Eucalyptus haemastoma, E. capitellata* and *Corymbia gummifera*.	This species is known to occur in the Karuah Manning and Wyong CMA sub-regions in the Hunter Central Rivers region.	This species is not known to occur in any conservation reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded in the Proposed Modification Area despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Finger panic grass *Digitaria porrecta*	E (TSC) E (EPBC) 3E (ROTAP)	Native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire.	Found in NSW and Queensland. In NSW, occurs on the North-west Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded in the Proposed Modification Area despite numerous surveys. There is no potential for a significant impact on this species.	No
Painted diuris *Diuris tricolor*	V (TSC) 3K (ROTAP)	Sclerophyll forest among grass, often with *Callitris* spp. Usually on sandy soils, either on flats or small rises. In the Hunter valley it mostly occurs in native grassland in areas not subject to intensive grazing.	Muswellbrook LGA is the eastern limit of the known range and the only recorded occurrence in the Sydney basin Bioregion. The distribution of the species is defined by Warialda to the north, Cobar to the west and Tumut to the south.	This species is not known to occur in reserves in the region.	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Slaty red gum *Eucalyptus glaucina*	V (TSC) V (EPBC) 3VCa (ROTAP)	This species grows in grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils.	Found in the Hunter Valley and North Coast from near Cessnock to Taree. There are records extending west to near Denman, Dungog and Gloucester. There is an outlying record near Gosford on the Central Coast. A separate population of the species also occurs from south of Grafton north to the Queensland border.	Belford NP Singleton Military Training Area	The Proposed Modification Area does provide potential habitat for this species, although it has not been recorded in this area despite numerous surveys. A single specimen (since removed) of this species was recorded from nearby Mt Owen in 1998. There is no potential for a significant impact on this species.	No
Euphrasia arguta	X (TSC) PD CE (TSC) CE (EPBC) 3X (ROTAP)	This species grows in grassy areas near rivers (Botanic Gardens Trust 2013).	This species is presumed to be extinct. When present, it was recorded from as far south as Bathurst and as far north as Walcha. It was believed to occur in the botanical subdivisions of the North Coast, Northern Tablelands, Central Tablelands, North Western Slopes and Central Western Slopes (Botanic Gardens Trust 2013).	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded in the Proposed Modification Area despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Ozothamnus tesselatus	V (TSC) V (EPBC) 2VC- (ROTAP)	Dry sclerophyll forest and woodlands.	Restricted to a few locations north of Rylstone. Unconfirmed recording exists near Mt Owen. .	Goulburn River NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. It has been recorded nearby in Ravensworth State Forest within Mt Owen. If present, this species would be potentially sensitive to the Project.	Yes
Leek orchid *Prasophyllum* sp. Wybong (C.Phelps ORG 5269)	CE (EPBC)	This species generally occurs in grassy and scrubby habitats in open eucalypt woodland and grasslands.	This species is endemic to NSW, from which there are only seven known populations from near NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. It is not known to occur outside the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes bioregions. Its area of occupancy is estimated at 1500 m^2.	This species is not known from any conservation reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded in the Proposed Modification Area despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Illawarra greenhood *Pterostylis gibbosa*	E (TSC) E (EPBC) 2E (ROTAP)	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. At Milbrodale, the only known population in the Hunter, it occurs on soils derived from Triassic sandstone. It is found in association with narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*E. moluccana*), black cypress pine (*Callitris endlicheri*) and a dense shrub layer.	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra).	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded in the Proposed Modification Area despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Siahs backbone *Streblus pendulinus*	E (EPBC)	This species occurs in warmer rainforest, mostly along watercourses, north from Milton. Listing advice for this species indicates that the species is endangered on Norfolk Island and taxonomic revisions may have unintentionally included mainland occurrences of the species. For the purposes of this assessment it is assumed that the listing relates only to the Norfolk Island population of the species.	There are a number of known records of this species occurring in the Muswellbrook and Singleton areas. The closest records occur approximately 15 kilometres north-east of the Proposed Modification Area.	Barrington Tops NP Yengo NP	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded in the Proposed Modification Area despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Austral toadflax *Thesium australe*	V (TSC) V (EPBC) 3VCi+ (ROTAP)	This species occurs in grassland or grassy woodland and is often found in damp sites in association with kangaroo grass (*Themeda australis*). This species is a root parasite that takes water and some nutrients from other plants, especially kangaroo grass.	This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania, Queensland and in eastern Asia. Occurs also at Mangoola, west of Muswellbrook, NSW.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded in the Proposed Modification Area despite numerous surveys. There is no potential for a significant impact on this species.	No
THREATENED FLORA POPULATIONS						
Weeping myall *Acacia pendula* in the Hunter Catchment	EP (TSC)	Grows on major river floodplains on heavy clay soils, sometimes as the dominant species and forming low open woodlands. Within the Hunter catchment it typically occurs on heavy soils, sometimes at the margins of small floodplains, but also in more undulating locations remote from floodplains, such as at Jerrys Plains.	There are at least 30 naturally occurring remnants of the *A. pendula* population in the Hunter catchment. These range as far east as Bulga, and as far west as Kerrabee, west of Sandy Hollow. *Acacia pendula* is not known to occur naturally further north than the Muswellbrook-Wybong area. Eight planted *A. pendula* populations (not naturally occurring) have been recorded in the Hunter, and it is likely that numerous more planted populations occur.	This population is not known to occur in any reserves in the region.	The Proposed Modification Area does provide suitable habitat for this endangered population, however it has not been recorded in the Proposed Modification Area despite numerous surveys. There is no potential for a significant impact on this endangered population.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Tiger orchid *Cymbidium canaliculatum* in the Hunter Catchment	EP (TSC)	This species occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees. It is usually found occurring singly or as a single clump, typically 2-6 m above the ground.	The population of *Cymbidium canaliculatum* in the Hunter Catchment is at the south-eastern limit of the geographic range for this species.	Goulburn River NP	This endangered population has been recorded within the Proposed Modification Area on a single occasion. This endangered population is potentially sensitive to the Project.	Yes
Diuris tricolor (*Diuris tricolor* Fitz., the pine donkey orchid, in the Muswellbrook LGA)	EP (TSC)	The Muswellbrook LGA population of *Diuris tricolor* comprises the large-flowered form of the species (which also occurs at several other locations). Occurs in sclerophyll vegetation on flats or small rises, on a range of substrates including sandy or loamy soils derived from granite, porphyry, laterite or alluvium.	The population of *Diuris tricolor* in the Muswellbrook LGA is at the eastern limit of the geographic range of the species. All other populations of the species are located west of the Great Dividing Range. The distance of the Muswellbrook LGA population to the nearest population of the species to the west is approximately 100 km. Therefore the population in the Muswellbrook LGA is disjunct and at the limits of its geographic range.	This population is not known to occur in any reserves in the region.	The Proposed Modification Area provides suitable habitat for this endangered population, although it has not been recorded there during numerous surveys. If present, this endangered population would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
River red gum *Eucalyptus camaldulensis* in the Hunter Catchment	EP (TSC)	River red gums are located on the banks and floodplains of watercourses on alluvial soils. This endangered population may occur with forest red gum (*Eucalyptus tereticornis*), yellow box (*Eucalyptus melliodora*), river sheoak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) and rough-barked apple (*Angophora floribunda*).	The Hunter population occurs as far east as Hinton, east of Maitland, west to Bylong, and north to near Scone. Currently only 28 populations are known in the Hunter Valley, covering an area of only 83 hectares and constituting about 1840 trees, and occurring over a range of at least 2000 km^2.	This population is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this endangered population, and it has not been recorded, despite numerous surveys. There is no potential for a significant impact on this endangered population.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
THREATENED ECOLOGICAL COMMUNITIES						
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC (TSC)	This community generally occurs on Permian sediments in the Hunter Valley. This community is typically identified on slopes and undulating hills and forms a woodland or open forest. Typical canopy layer species are inclusive of narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*Eucalyptus moluccana*).	Located in the NSW North Coast and Sydney Basin Bioregions.	There are no known occurrences of this TEC within the conservation reserves of the region.	This TEC has been recorded within the Proposed Modification Area. This TEC is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions	EEC (TSC)	This community typically occurs in the form of an open forest or woodland and occurs upon Permian sediments of the Hunter Valley. The canopy layer is dominated by grey box (*Eucalyptus moluccana*), broad-leaved ironbark (*Eucalyptus fibrosa*), slaty red gum (*Eucalyptus glaucina*), forest red gum (*Eucalyptus tereticornis*) and narrow-leaved ironbark (*Eucalyptus crebra*).	Located in the NSW North Coast and Sydney Basin Bioregions.	Belford NP	The Proposed Modification Area provides potential habitat for this TEC however, it has not been recorded in the Proposed Modification Area. There is no potential for a significant impact on this TEC.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC (TSC)	This ecological community generally occurs at the interface of Narrabeen Sandstone and Permian sediments in the Hunter Valley and typically forms a low to mid-high woodland. The community is characterised by an overstorey of slaty gum (*Eucalyptus dawsonii*) and/or grey box (*E. moluccana*) with a moderately dense to dense shrub stratum. The ground layer is generally sparse to very sparse and generally species poor.	Located in the Sydney Basin Bioregion.	Wollemi NP Goulburn River NP	The Proposed Modification Area does not provide suitable habitat for this community and it has not been recorded at the site. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Hunter Lowland Redgum Forest	EEC (TSC)	Occurs on gentle slopes arising from depressions and drainage flats on Permian sediments of the Hunter Valley floor.	Recorded from Maitland, Cessnock and Port Stephens LGAs (in the Sydney Basin Bioregion) and Muswellbrook and Singleton LGAs (in the NSW North Coast Bioregion) but may occur elsewhere in these bioregions. The Proposed Modification Area is within the known distribution of this EEC.	Werakata NP Werakata SCA Singleton Military Training Area	The Proposed Modification Area provides potential habitat for this TEC however, it has not been recorded in the Proposed Modification Area. There is no potential for a significant impact on this TEC.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Lowland Rainforest of Subtropical Australia	CEEC (EPBC)	This community occurs on basalt soils, alluvial soils, floodplain alluvia and occasionally on enriched rhyolitic soils and basaltically enriched metasediments. It is mostly found in areas below 300 m above sea level with annual rainfall >1300 mm. Canopy vegetation is usually dominated by bangalow palm (*Archontophoenix cunninghamiana*), cabbage palm (*Livistona australis*), *Syzygium floribundum* and weeping lilly pilly (*Waterhousea floribunda*). Remnants are generally less than 10 hectares in size.	This CEEC primarily occurs from Maryborough in Queensland to the Clarence River (near Grafton) in NSW. It also occurs in isolated stands between the Clarence River and Hunter River, including the Bellinger Valley. It is known to occur in the Hunter-Central Rivers and Northern Rivers Catchment Management Areas.	This CEEC is not known to occur in conservation reserves in the Region	The Proposed Modification Area does not provide suitable habitat for this community and it has not been recorded at the site. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
White Box – Yellow Box – Blakely's Red Gum Woodland and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	EEC (TSC) CEEC (EPBC)	This ecological community occurs in areas where rainfall is between 400 and 1200 mm per annum, on moderate to highly fertile soils at altitudes of 170 m to 1200 m.	This EEC occurs in an arc along the western slopes and tablelands of the Great Dividing Range from Southern Queensland through NSW to central Victoria. It occurs in the Brigalow Belt South, Nandewar, New England Tableland, South Eastern Queensland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes, Victorian Midlands and Riverina Bioregions.	There are no known occurrences of this CEEC within the conservation reserves of the region.	Field surveys have targeted the presence of this community and no evidence of its presence has been identified. The community is not considered likely to occur.	No
Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion	EEC (TSC)	Weeping Myall Woodlands occur in a range from open woodlands to woodlands, generally 4-12 m high, in which weeping myall (*Acacia pendula*) trees are the sole or dominant overstorey species.	The EEC occurs in a small stand on heavy, brown clay soil at Jerrys Plains in the Hunter Valley, in the South Hunter Province of the Sydney Basin Bioregion.	This EEC is not known from any conservation reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this community and it has not been recorded at the site. There is no potential for a significant impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to the Proposed Modification Area	Reservation Within the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Weeping Myall – Coobah – Scrub Wilga Shrubland	CEEC (EPBC)	This CEEC consists of a woodland of weeping myall (*Acacia pendula*) with coobah (*Acacia salicina*) and scrub wilga (*Geijera salicifolia*). yarran (*Acacia omalophylla*) and stiff canthium (*Canthium buxifolium*) are also present in the small tree/shrub layer. The ground stratum is dense and primarily grassy. Grasses include kangaroo grass (*Themeda triandra/australis*), wallaby grass (*Austrodanthonia* sp.), snow grass (*Poa sieberiana*) and barbed wire grass (*Cymbopogon refractus*). Some exotic grasses have also invaded the site.	The CEEC occurs in a small stand on heavy, brown clay soil at Jerrys Plains in the Hunter Valley, in the South Hunter Province of the Sydney Basin Bioregion.	There are no known occurrences of this EEC within the conservation reserves of the region.	The Proposed Modification Area does not provide suitable habitat for this community and it has not been recorded at the site. There is no potential for a significant impact on this community.	No

Notes:
CE: Critically endangered
CEEC: Critically endangered ecological community
E: Endangered
EEC: Endangered ecological community
EP: Endangered population
EPBC: Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LGA: Local Government Area
NP: National Park

PD:	preliminary determination
ROTAP:	Rare or Threatened Australian Plants
TSC:	NSW *Threatened Species Conservation Act 1995*
V:	Vulnerable
X:	Extinct
1:	The following conservation area were searched for record at each species, population or community: Belford NP, Goulburn River NP, Manobalai NR, Singleton Military Area, Towarri NP, Watagans NP, Werakata NP, Werakata SCA, Wingen Maid NR, Wollemi NP, Yengo NP

ROTAP Codes:

a:	Adequately reserved
C:	In a conservation reserve
E:	Endangered
i:	Inadequately reserved
K:	Poorly known
R:	Rare
V:	Vulnerable
X:	Extinct
2:	Found over < 100 kilometres
3:	Found over > 100 kilometres
-:	Species recorded from a reserve but population size unknown
+:	Taxon has a natural occurrence overseas

Table 2 -Threatened Fauna Species, Threatened Fauna Populations and Marine and Migratory Species Known or Predicted to Occur in the Proposed Modification Area

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
THREATENED FAUNA SPECIES						
AMPHIBIANS						
Stuttering frog *Mixophyes balbus*	E (TSC) V (EPBC)	Occurs in naturally vegetated streams typically in hilly or mountainous country, between elevations of 20 m and 1420 m, in a wide range of vegetation types, including: subtropical, warm and cool temperate rainforest, and wet and dry sclerophyll forest.	Occurs in eastern-flowing streams of the Great Dividing Range, between the Cann River Catchment in Gippsland, Victoria, and the Clarence River catchment in north-eastern NSW, in the NSW North Coast, New England Tableland, Sydney Basin, and South Eastern Highlands.	Barrington Tops NP	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No
Giant barred frog *Mixophyes iteratus*	E (TSC) E (EPBC)	This species forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams.	Coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is a stronghold.	This species is not known to occur in conservation reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Green and golden bell frog *Litoria aurea*	E (TSC) V (EPBC)	Occurs amongst emergent aquatic or riparian vegetation and amongst vegetation, fallen timber, including grassland, cropland and modified pastures. Breeds in still or slow flowing waterbodies with some vegetation such as *Typha* spp. and *Eleocharis* spp.	NSW North Coast near Brunswick Heads, southwards along the NSW Coast to Victoria where this species extends into east Gippsland. The Proposed Modification Area is close to the inland limit of this species' known distribution.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does provide suitable habitat for this species, although it has not been recorded there despite numerous surveys. This species has been recorded at nearby Mt Owen. If present, this species would be potentially sensitive to the Project.	Yes
Booroolong frog *Litoria booroolongensis*	E (TSC) E (EPBC)	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge.	The Booroolong frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. It has disappeared from the Northern Tablelands and is now rare throughout most of the remainder of its range. Most recent records are from the south-west slopes of NSW.	Mt Royal NP	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
REPTILES						
Broad-headed snake *Hoplocephalus bungaroides*	E (TSC) V (EPBC)	The broad-headed snake is nocturnal, and shelters 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.	The broad-headed snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney.	Wollemi NP Yengo NP	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No
BIRDS						
Australasian bittern *Botaurus poiciloptilus*	E (TSC) E (EPBC)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.).	This species may be found over most of NSW except for the far north-west.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Malleefowl *Leipoa ocellata*	E (TSC) V (EPBC) MIG (EPBC)	The malleefowl is typically found in semi-arid and arid areas of temperate Australia, in shrubland and low woodlands dominated by dense but discontinuous mallee vegetation. They are usually on loamy or sandy soils with an annual average rainfall between 200 and 450 mm. The malleefowl has been known to forage in open grassland and farmland areas; and breeds in areas with plentiful leaf litter.	The malleefowl is distributed across southern Australia. Typically found west of the Great Dividing Range, from the Pilliga south-west through to the Griffith and Wentworth districts. A small number of records have been identified from east of the Great Dividing Range in the Goulburn River NP.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Blue-billed duck *Oxyura australis*	V (TSC)	This species prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover.	Widespread in NSW, but most common in the southern Murray-Darling Basin area.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area is not considered to provide suitable habitat for this species and it has not been recorded within the Proposed Modification Area. This species has, however been recorded within the LCO, within 500 m of the Proposed Modification Area. This species is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Freckled duck *Stictonetta naevosa*	V (TSC)	This species prefers permanent freshwater swamps and creeks with heavy growth of cumbungi, lignum or tea-tree. During drier times it moves from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. This species generally rests in dense cover during the day, usually in deep water. Nesting usually occurs between October and December but can take place at other times when conditions are favourable. The nests are usually located in dense vegetation at or near water level.	The freckled duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. This species may also occur as far as coastal NSW and Victoria during such times.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area is not considered to provide suitable habitat for this species and it has not been recorded within the Proposed Modification Area. However, given the records of the blue-billed duck within the LCO, there is potential this similar species could periodically use similar habitats. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Australian painted snipe, painted snipe *Rostratula benghalensis australis*	E (TSC) E (EPBC) MAR (EPBC) MIG (EPBC)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowal, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area is not considered to provide suitable habitat for this species and it has not been recorded within the Proposed Modification Area. It has, however been recorded recently along Bowmans Creek within 2 km of the Proposed Modification Area. This species is potentially sensitive to the Project.	Yes
Black-necked stork *Ephippiorhynchus asiaticus*	E (TSC)	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.	This species is widespread across coastal northern and eastern Australia, becoming uncommon further south into NSW, and rarely found south of Sydney.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Spotted harrier *Circus assimilis*	V (TSC)	Open grassy woodland, grassland, inland riparian woodland and shrub steppe. Although mostly associated with native grasslands this species has also been identified in agricultural farmland.	This species can be found throughout mainland Australia except for areas of dense forest on the coast, escarpments and ranges and rarely in Tasmania.	Wollemi NP	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes
Red goshawk *Erythrotriorchis radiatus*	CE (TSC) V (EPBC)	In NSW, this species is mainly found along or near watercourses, in swamp forest and woodlands on the coastal plain. This species favours patches of dense forest interspersed with open woodland or cleared land and often frequents forest edges.	This species is found across northern Australian south through eastern Queensland to far north-east NSW. This species is very rare in NSW. Most records are from the Clarence River Catchment, with a few about the lower Richmond and Tweed Rivers.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Little eagle *Heiraaetus morphnoides*	V (TSC)	This species is typically identified in open eucalypt forests, woodlands and open woodlands.	The little eagle is distributed throughout mainland Australia except for the most densely forested parts of the Great Dividing Range escarpment.	Mt Royal NP Ravensworth SF	The Proposed Modification Area provides suitable habitat for this species. And it has been recorded within the LCO landholdings. However, this record was prior to it being listed as a threatened species and the location of this sighting was not recorded. This species is potentially sensitive to the Project.	Yes
Eastern grass owl *Tyto longimembris*	V (TSC)	Found in areas of tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.	The grass owl has been recorded in all mainland states of Australia, although it is most common in north and north east Australia. In NSW this species is most likely to be found in the north-east of the state in coastal areas from the Queensland-NSW border through to Sydney; and with several outlying records from inland areas, some as far west as Broken Hill.	This species is not known to occur in any reserves in the region.	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Glossy black-cockatoo *Calyptorhynchus lathami*	V (TSC)	Habitat for this species includes forests on low-nutrient soils, specifically those containing key *Allocasuarina* feed species. This species will feed on seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as insect larvae. Breeding occurs in autumn and winter, with large hollows required.	The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith.	Wollemi NP Yengo NP Mount Royal NP Manobalai NR Barrington Tops NP	Although it has not been recorded, there is potential habitat in the Proposed Modification Area for this species to occur. There is a potential for a significant impact on this species.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Swift parrot *Lathamus discolor*	E (TSC) E (EPBC) MAR (EPBC)	This species often visits box-ironbark forests, feeding on nectar and lerps. In NSW, typical tree species in which this species forages include mugga ironbark (*Eucalyptus sideroxylon*), grey box (*E. moluccana*), swamp mahogany (*E. robusta*), spotted gum (*Corymbia maculata*), red bloodwood (*C. gummifera*), narrow-leaved red ironbark (*E. crebra*), forest red gum (*E. tereticornis*) and yellow box (*E. melliodora*). This species is a migratory species that breeds in Tasmania during the spring and summer, and migrates to the mainland during the cooler months of the year.	In NSW this species has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW. The Proposed Modification Area is within the known distribution of this species.	Wollemi NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. This species has been recorded at nearby Mt Owen. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Little lorikeet *Glossopsitta pusilla*	V (TSC)	This species can be found in dry-open eucalypt forests and woodlands, and have been identified in remnant vegetation, old growth vegetation, logged forests, and roadside vegetation. The little lorikeet usually forages in small flocks, not always with birds of their own species. They nest in hollows, mostly in living smooth-barked apples.	This species is distributed from just north of Cairns, around the east coast of Australia down to Adelaide. In NSW this species is found from the coast to the western slopes of the Great Dividing Range, extending as far west as Albury, Dubbo, Parkes and Narrabri.	Manobalai NR Wollemi NP Yengo NP Mount Royal NP Ravensworth SF	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Powerful owl *Ninox strenua*	V (TSC)	This species inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It generally 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. This species roosts by day in dense vegetation.	This species occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south western Victoria to Bowen in Queensland.	Wollemi NP Yengo NP Mt Royal NP Belford NP Manobalai NR Barrington Tops NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Masked owl *Tyto novaehollandiae*	V (TSC)	This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land.	This species occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea.	Wollemi NP Yengo NP Mt Royal NP Manobalai NR Barrington Tops NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Brown treecreeper (eastern sub-species) *Climacteris picumnus victoriae*	V (TSC)	Typical habitat for this species includes; drier forests, woodlands and scrubs with fallen branches; river red gums on watercourses and around lake-shores; paddocks with standing dead timber; and margins of denser wooded areas. This species prefers areas without a dense understorey.	This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys.	Wollemi NP Yengo NP Manobalai NR	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes
Speckled warbler *Chthonicola sagittata*	V (TSC)	This species occurs in eucalypt-dominated communities that have a grassy understorey, leaf litter and shrub cover, often on rocky ridges or in gullies.	This species has a patchy distribution throughout south-eastern Queensland, eastern half of NSW and into Victoria, as far west as the Grampians.	Wollemi NP Yengo NP Belford NP Manobalai NR	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Regent honeyeater *Anthochaera phrygia*	CE (TSC) E (EPBC) MIG (EPBC)	This species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine *Casuarina* woodlands. An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills.	Once recorded between Adelaide and the central coast of Queensland, this species range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland.	Wollemi NP Yengo NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Black-chinned honeyeater (eastern sub-species) *Melithreptus gularis gularis*	V (TSC)	This sub-species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially mugga ironbark (*Eucalyptus sideroxylon*), white box (*E. albens*), grey box (*E. moluccana*), yellow box (*E. melliodora*) and forest red gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	This sub-species is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. This sub-species is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. This sub-species has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.	Yengo NP Wollemi NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Hooded robin (south-eastern form) *Melanodryas cucullata cucullata*	V (TSC)	This species is found in lightly timbered woodland, mainly dominated by acacia and/or eucalypts.	This species is found all over mainland Australia, except Cape York and eastern Gulf of Carpentaria or inland around the Simpson Desert, on the Nullarbor Plain or south of the Kimberley Ranges. This species is commonly found in south-eastern Australia from Adelaide to Brisbane.	Wollemi NP Ravensworth SF	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Scarlet robin *Petroica boodang*	V (TSC)	This species can be found in woodlands and open forests from the coast through to inland slopes. This species can sometimes be found on the eastern fringe of the inland plains in the colder months of the year. Woody debris and logs are both important structural elements of this species' habitat. This species forages from low perches on invertebrates either on the ground or in woody debris or tree trunks.	This species can be found in south-eastern Australia, from Tasmania to the southern end of Queensland, to western Victoria and southern SA. In NSW this species is found throughout the eastern areas of the state, no further than 500 km from the coast.	Wollemi NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Flame robin *Petroica phoenicea*	V (TSC) MAR (EPBC)	This species is known to breed in moist eucalypt forests and woodlands. This species can usually be seen on ridges and slopes in areas where there is an open understorey layer. This species migrates during the winter to lowland areas such as grasslands where there are scattered trees, as well as open woodland on the inland slopes and plains.	This species is found in south-eastern Australia from the Queensland border to Tasmania and extends through Victoria to south-east SA. In NSW this species has been recorded from the coast to as far west as the NSW-Victoria border at Mildura.	Wollemi NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Grey-crowned babbler (eastern sub-species) *Pomatostomus temporalis temporalis*	V (TSC)	This species is found in open box-gum woodlands on the slopes; box-cypress-pine and open box woodlands on alluvial plains; and acacia shrubland and adjoining areas.	This species occurs throughout northern and south-eastern Australia. In NSW, this species occurs on the western slopes of the Great Dividing Range and on the western plains reaching as far west as Louth and Hay. This species also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW.	Belford NP Wollemi NP Yengo NP Ravensworth SF	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region[1] (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Varied sittella *Daphoenositta chrysoptera*	V (TSC)	This species can typically be found in eucalypt forests and woodlands, especially of rough-barked species and mature smooth-barked gums with dead branches.	This species is a sedentary species that inhabits the majority of mainland Australia with the exception of the treeless deserts and open grasslands. This species is found all throughout NSW.	Manobalai NR Wollemi NP Yengo NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Diamond firetail *Stagonopleura guttata*	V (TSC)	This species is found in a range of eucalypt dominated communities with a grassy understorey, including woodland, forest and mallee. It appears that populations are unable to persist in areas where vegetated remnants are less than 200 hectares.	This species occurs through central and eastern NSW, north into southern and central Queensland and south through Victoria to SA. In NSW this species mainly occurs west of the Great Dividing Range, although populations are known from drier coastal areas such as the Cumberland Plain and the Hunter, Clarence, Richmond and Snowy River valleys.	Wollemi NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
MAMMALS						
Spotted-tailed quoll (SE mainland population) *Dasyurus maculatus maculatus*	V (TSC) E (EPBC)	Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops. Suitable den sites include hollow logs, tree hollows, rocky outcrops and caves.	In NSW this species occurs on both sides of the Great Dividing Range, with the highest densities occurring in the north east of the state. This species occurs from the coast to the snowline and inland to the Murray River.	Wollemi NP Yengo NP Mt Royal NP Belford NP Barrington Tops NP	There is potential habitat for this species within the Proposed Modification Area, however it has not been recorded there despite numerous surveys. This species has been recorded regularly from LCO and nearby Mt Owen. The nearest records to the Proposed Modification Area are within 200 m along Bowmans Creek and a breeding den within 2 km along Bowmans Creek. This species is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Koala *Phascolarctos cinereus*	V (TSC) V (EPBC)	This species inhabits eucalypt forests and woodlands. The species is known to feed on a large number of eucalypt species; however it tends to specialise on a small number in different areas. *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis, E. microcorys, E. robusta, E. albens, E. camaldulensis* and *E. populnea* are some preferred species.	This species has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west. This species is known to occur along inland rivers on the western side of the Great Dividing Range.	Wollemi NP Yengo NP Mt Royal NP Manobalai NR Barrington Tops NP	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. This species has been recorded from possible scats from nearby Mt Owen in 1994, but not since then. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Squirrel glider *Petaurus norfolcensis*	V (TSC)	This species inhabits a variety of mature or old growth habitats, including box, box-ironbark woodlands, river red gum forests, and blackbutt-bloodwood forests with a heath understorey. This species prefers mixed species stands with a shrub or acacia mid-storey, and requires abundant tree hollows for refuge and nest sites.	The species is distributed from northern Queensland to western Victoria. In NSW it can be found from the coast, to no further than 400 km west of the coast.	Wollemi NP Yengo NP Mt Royal NP Belford NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Brush-tailed rock-wallaby *Petrogale penicillata*	E (TSC) V (EPBC)	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. This species browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. This species shelters or basks during the day in rock crevices, caves and overhangs and is most active at night.	The brush-tailed rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia. This species distribution roughly followed the Great Dividing Range for 2500 kilometres from the Grampians in West Victoria to Nanango in south-east Queensland, with outlying populations in coastal valleys and ranges to the east of the divide, and the slopes and plains as far west as Cobar in NSW and Injune (500 km NW of Brisbane) in Queensland.	Wollemi NP Yengo NP Manobalai NR Barrington Tops NP Watagans NP	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Grey-headed flying-fox *Pteropus poliocephalus*	V (TSC) V (EPBC)	This species occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	This species is found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.	Yengo NP Wollemi NP Barrington Tops NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Yellow-bellied sheathtail bat *Saccolaimus flaviventris*	V (TSC)	This species forages for insects, flies high and fast over the forest canopy, but lower in more open country. This species forages in most habitats across its wide range, with and without trees; and appears to defend an aerial territory. This species roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to use mammal burrows.	This species is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent SA - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North-west Slopes.	Wollemi NP Manobalai NR	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Eastern freetail-bat *Mormopterus norfolkensis*	V (TSC)	This species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. This species roosts mainly in tree hollows but will also roost under bark or in man-made structures.	This species is found along the east coast from south Queensland to southern NSW.	Wollemi NP Yengo NP Manobalai NR Belford NP Barrington Tops NP	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Little bentwing-bat *Miniopterus australis*	V (TSC)	This species prefers moist eucalypt forest, rainforest or dense coastal banksia scrub. This species roosts in caves, tunnels and sometimes tree hollows during the day, and at night forages for small insects beneath the canopy of densely vegetated habitats.	This species occurs in coastal north-eastern NSW and eastern Queensland. In NSW this species mostly occurs along the coast from the Queensland border to Sydney at its south-most, and Ulan at its western-most.	Wollemi NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Eastern bentwing-bat *Miniopterus schreibersii oceanensis*	V (TSC)	This species hunts in forested areas and uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. This species forms discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	This species occur along the east and north-west coasts of Australia. In NSW this species is found both east and west of the Great Dividing Range, but typically no further than 300 km from the coast. .	Yengo NP Wollemi NP Mount Royal NP Belford NP Manobalai NR Barrington Tops NP	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Eastern long-eared bat (SE form) , greater long-eared bat *Nyctophilus timoriensis*	V (TSC) V (EPBC)	This species inhabits a variety of vegetation types, including mallee, bulloak (*Allocasuarina luehmanni*) and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. This species roosts in tree hollows, crevices, and under loose bark.	The distribution of the south eastern form of this species coincides approximately with the Murray Darling Basin with the Pilliga Scrub region a distinct stronghold for this species. This species has been recorded throughout NSW with the exception of the extreme north-west of the state, and most areas east of the Great Dividing Range (with the exception of the areas around Sydney).	Manobalai NR Wollemi NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Large-eared pied bat *Chalinolobus dwyeri*	V (TSC) V (EPBC)	This species is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands however, it probably tolerates a wide range of habitats. This species tends to roost in the twilight zones of mines and caves, generally in colonies or common groups.	This species has a distribution from south western Queensland to NSW from the coast to the western slopes of the Great Dividing Range. In NSW this species is not known to occur further west than Warrumbungle NP.	Wollemi NP Yengo NP Manobalai NR Watagans NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Eastern false pipistrelle *Falsistrellus tasmaniensis*	V (TSC)	This species prefers moist habitats, with trees over 20 m high, and generally roosts in eucalypt tree hollows or under bark.	This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast.	Wollemi NP Yengo NP Barrington Tops NP	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Southern myotis *Myotis macropus*	V (TSC)	This species generally roosts in groups of 10 to 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. This species forages over streams and pools catching insects and small fish by raking its feet across the water surface.	This species occurs along coastal Australia from the north-west of Australia, across the Top End and south to western Victoria. In NSW this species generally occurs east of the great dividing range, with scattered inland records in the south west of the state.	Wollemi NP Belford NP	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes
Greater broad-nosed bat *Scoteanax rueppellii*	V (TSC)	This species appears to prefer moist environments such as moist gullies in coastal forests, or rainforest. This species has also been found in gullies associated with wet and dry sclerophyll forests and open woodland. This species roosts in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings.	This species is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. This species extends to the coast over much of its range. In NSW this species is widespread on the New England Tablelands, however it does not occur at altitudes above 500 m.	Wollemi NP Yengo NP Barrington Tops NP	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Eastern cave bat *Vespadelus troughtoni*	V (TSC)	This species is a cave-roosting bat that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. This species has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals, and is occasionally found along cliff-lines in wet eucalypt forest and rainforest.	This species is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit is the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. In NSW this species appears to be bounded by the coast, the NSW-Queensland border at Bebo SF, Pilliga NR near Coonabarrabran, Toronto to the south and Wollemi NP to the south-west.	Wollemi NP Manobalai NR Yengo NP	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes
New Holland mouse *Pseudomys novaehollandiae*	V (EPBC)	This species inhabits a range of habitats from open heathlands, open woodlands with a heath understorey, as well as vegetated dunes. This species lives in a burrow which is shared with other individuals.	This species has a disjunct distribution across Tasmania, Victoria, Queensland and NSW.	This species is not known to occur in any reserves in the region.	This species has previously been recorded at nearby Mt Owen. Rehabilitation and early phase natural regeneraltion may provide important habitat types for this species. As such the species is potentially sensitive to the development.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Hastings River mouse *Pseudomys oralis*	E (TSC) E (EPBC)	This species is known to inhabit a variety of dry open forest types with dense, low ground cover and a diverse mixture of ferns, grass, sedges and herbs. Access to seepage zones, creeks and gullies is important, as is permanent shelter such as rocky outcrops. Nests may be in gully areas or ridges and slopes.	This species has a patchy distribution along the east side of the Northern Tablelands and great escarpment of north-east NSW, usually but not always at elevations between 500 and 1100 m above sea level.	Mt Royal NP Barrington Tops NP	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
MIGRATORY SPECIES						
Malleefowl *Leipoa ocellata*	E (TSC) V (EPBC) MIG (EPBC)	The malleefowl is typically found in semi-arid and arid areas of temperate Australia, in shrubland and low woodlands dominated by dense but discontinuous mallee vegetation. They are usually on loamy or sandy soils with an annual average rainfall between 200 and 450 mm. The malleefowl has been known to forage in open grassland and farmland areas; and breeds in areas with plentiful leaf litter.	The malleefowl is distributed across southern Australia. Typically found west of the Great Dividing Range, from the Pilliga south-west through to the Griffith and Wentworth districts. A small number of records have been identified from east of the Great Dividing Range in the Goulburn River NP.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Eastern great egret *Ardea alba*	MIG (EPBC)	This species typically inhabits areas of shallow, flowing waters, but also uses damp grasslands and other watered areas. This species can be observed both in flocks and on its own, and roosts during the night in groups.	This species is distributed throughout the world, and is common throughout most areas of Australia, with the exception of extremely arid areas.	Goulburn River NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes
Cattle egret *Ardea ibis*	MIG (EPBC)	The cattle egret can be found in grasslands, wetlands and woodlands. This species is commonly sighted at garbage dumps, pastures and croplands (especially where poor drainage is present).	This species is distributed throughout Asia, Africa, Europe and Australia. It is most commonly found in north-eastern WA, the NT and in south-eastern Australia from Bundaberg Queensland through to Port Augusta SA.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Australian painted snipe, painted snipe *Rostratula benghalensis australis*	E (TSC) E (EPBC) MIG (EPBC)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowal, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area is not considered to provide suitable habitat for this species and it has not been recorded within the Proposed Modification Area. It has, however been recorded recently along Bowmans Creek within 2 km of the Proposed Modification Area. This species is potentially sensitive to the Project.	Yes
White-bellied sea-eagle *Haliaeetus leucogaster*	MIG (EPBC)	This species is typically sighted perched in tall trees and soaring above water bodies and land. This species is territorial and forms permanent breeding pairs.	This species is distributed across Australia, China, India, Indonesia, New Guinea, and south-east Asia. Within Australia it is distributed along and near the coast.	Goulburn River NP	The Proposed Modification Area provides suitable habitat for this species and it has been recorded within the LCO holdings during monitoring events. This species is regularly recorded at nearby Mt Owen. This species is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Regent honeyeater *Anthochaera phrygia*	CE (TSC) E (EPBC) MIG (EPBC)	This species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine *Casuarina* woodlands. An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills.	Once recorded between Adelaide and the central coast of Queensland, this species range has contracted dramatically in the last 30 years to the area between north-eastern Victoria and south-eastern Queensland.	Wollemi NP Yengo NP	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
White-throated needletail *Hirundapus caudacutus*	MIG (EPBC)	This species is only in Australia approximately between the months of October and May. This species forages upon flying insects and drinks whilst in flight. Feeding is typically associated with rising thermal currents typical with storm fronts and bushfires.	This species is distributed over eastern and northern Australia.	Manobalai NR Mt Royal NP Yengo NP Wollemi NP Ravensworth SF	The Proposed Modification Area provides suitable habitat for this species and it has been recorded within the LCO holdings during monitoring events. This species is regularly recorded at nearby Mt Owen. This species is potentially sensitive to the Project.	Yes
Fork-tailed swift *Apus pacificus*	MIG (EPBC)	This species is mostly found in Australia through the months of October through to April. This species spends most of its time when in flight ahead of storm fonts and updraughts.	This species can be found throughout Australia during October to April. In Australia this species is most common west of the Great Dividing Range. This species is uncommon in Tasmania.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Lathams snipe, Japanese snipe *Gallinago hardwickii*	MIG (EPBC)	This species can be found in permanent and ephemeral wetlands up to 2000 m above sea level. These water bodies are usually freshwater with low, dense vegetation. This species forages in areas of mud with some vegetation cover and roosts nearby to these areas. This species does not breed in Australia.	This species has been recorded from Cape York through to south-east SA. The range of this species extends from inland of the eastern tablelands in south-east Queensland to west of the Great Dividing Range in NSW.	This species is not known to occur in any reserves in the region.	The Proposed Modification Area provides suitable habitat for this species, although it has not been recorded there during numerous surveys. If present, this species would be potentially sensitive to the Project.	No
Rainbow bee-eater *Merops ornatus*	MIG (EPBC)	The preferred habitat of this species is open forests and woodlands, shrublands, and cleared or semi-cleared areas (commonly farmland). These areas are usually in proximity to permanent water, however, during migration this bird may fly over areas of non-preferential habitat.	This species is distributed throughout most of mainland Australia as well as several near-shore islands.	Manobalai NR Wollemi NP Yengo NP Ravensworth SF	This species is known to occur in the Proposed Modification Area and is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Spectacled monarch *Symposiachris trivirgatus*	MIG (EPBC)	The spectacle monarch typically inhabits the thick understorey of rainforests, wet gullies, riparian vegetation and mangroves.	Primarily found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. Outside of Australia it is known from Papua new Guinea, Moluccas and Timor.	This species is not known to occur in any conservation reserves in the region.	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No
Black-faced monarch *Monarcha melanopsis*	MIG (EPBC)	This species can be identified in coastal scrub, damp gullies, eucalypt woodlands and rainforests. This species can be seen foraging for insects amongst foliage, and builds a deep, cup-shaped nest in a tree fork which is made of cobwebs, casuarinas needles, bark, moss and roots.	This species is distributed along the eastern coast of Australia, gradually becoming less common towards the south.	Wollemi NP Yengo NP Mt Royal NP Belford NP	The Proposed Modification Area does provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Satin flycatcher *Myiagra cyanoleuca*	MIG (EPBC)	This species typically inhabits wet areas of tall forests, particularly in gullies. This species moves north in the winter and is seldom seen in NSW, Tasmania, Victoria or SA during these times.	This species can be found in both Australia and New Guinea. In Australia it is distributed along the east coast from Cape York through to Tasmania, also covering parts of south-eastern SA.	Mt Royal NP	The Proposed Modification Area provides suitable habitat for this species and it has been recorded within the LCO holdings during monitoring events. This species is regularly recorded at nearby Mt Owen. This species is potentially sensitive to the Project.	Yes
Clamerous reed warbler *Acrocephalus stentoreus*	MIG (EPBC)	This species prefers dense vegetation, particularly alongside water, particularly in thick reed beds as well as tall crops, bamboo thickets and lantana.	The clamorous reed warbler is found throughout Australia in area of suitable habitat. It is also found from New Guinea to south-eastern Africa.	Goulburn River NP	This species has been recorded in the wider LCO however not within the Proposed Modification Area. This species is potentially sensitive to the Project.	Yes

Species	Legal Status	Specific Habitat	Distribution in Relation to Proposed Modification Area	Reservation in the Region (OEH 2013)	Occurrence in Proposed Modification Area and Potential for Significant Impact	Detailed Assessment of Significance Required?
Rufous fantail *Rhipidura rufifrons*	MIG (EPBC)	This species typically inhabits areas of dense wet forest, mangrove, rainforest or swamp woodlands. This species prefers areas where there is intense shade available and is often seen close to ground. In winter it is seldom found in NSW or Victoria.	This species is distributed across the north and eastern coast of Australia, but is also found in Guam, New Guinea, the Solomon Islands and Sulawesi.	Wollemi NP Mt Royal NP Belford NP Yengo NP	The Proposed Modification Area does not provide suitable habitat for this species and it has not been recorded there despite numerous surveys. There is no potential for a significant impact on this species.	No

Notes:

E:	Endangered
EPBC:	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EX:	Extinct
LGA:	Local Government Area
MIG:	Migratory
NP:	National Park
NR:	Nature Reserve
SF:	State Forest
SCA:	State Conservation Area
TSC:	NSW *Threatened Species Conservation Act 1995*
V:	Vulnerable

APPENDIX 3

Flora Species List

Appendix 3 - Flora Species List

The following list was developed from surveys of the Proposed Modification Area undertaken by ELA and by Umwelt (as indicated in Section 3.3 of the main report). It includes all species of vascular plants observed within the Proposed Modification Area during surveys undertaken. Although substantial, the list will not be comprehensive, because not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp. specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

asterisk (*) denotes species not native to the Proposed Modification Area;

subsp. subspecies; and

var. variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al*. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2013), the online plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources.

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																					Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Filicopsida (Ferns)																																
Adiantaceae	*Cheilanthes distans*	Bristly Cloak Fern																			X											
Adiantaceae	*Cheilanthes sieberia* subsp. *sieberi*	Poison Rock Fern																						2	2	2		1	1	1		1
Adiantaceae	*Cheilanthes sieberi*	Poison Rock Fern	X		X	X	X		X		X		X		X			X	X	X	X	X										
Magnoliopsida (Flowering Plants) – Liliidae (Monocots)																																
Iridaceae	**Romulea rosea*		X										X												1	2						
Juncaceae	**Juncus acutus*															X	X															
Juncaceae	*Juncus* sp.		X																													
Juncaceae	*Juncus usitatus*																									2						
Juncaginaceae	*Triglochin* sp.		X																													
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush	X			X	X	X	X		X		X		X			X	X	X	X	X										
Lomandraceae	*Lomandra* prob. *filiformis* subsp, *filiformis*																								2			1	1	1	1	
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	X			X												X	X		X											
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*																							1							1	1
Poaceae	**Aira cupaniana*	silvery hairgrass																														1
Poaceae	*Aristida leichhardtiana*														X			X														
Poaceae	*Aristida ramosa*	Purple Wiregrass	X		X	X	X	X	X	X	X	X	X		X			X		X	X			3	3		1		1	1	1	1
Poaceae	*Aristida* sp.																		X									1				
Poaceae	*Aristida vagans*	Threeawn Speargrass				X	X					X						X	X	X	X	X										
Poaceae	*Rytidosperma carphoides*	Short Wallaby Grass												X																		
Poaceae	*Rytidosperma fulvum*																										1	1				
Poaceae	*Rytidosperma racemosa*		X																													

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																					Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Poaceae	*Rytidosperma* sp.					X					X		X																			
Poaceae	*Rytidosperma tenuoir*																								2			1	1	1		
Poaceae	*Austrostipa scabra*	Speargrass	X									X	X								X	X		3			1			1	1	1
Poaceae	*Austrostipa verticillata*	Slender Bamboo Grass	X	X						X		X			X	X	X						X		2	3			1		1	
Poaceae	*Bothriochloa decipiens*	Red Grass				X	X					X	X	X	X			X	X	X	X	X						1			1	
Poaceae	*Bothriochloa macra*	Red Grass	X	X							X																					
Poaceae	*Bothriochloa* sp.																								3							
Poaceae	**Briza minor*	shivery grass																								2			1			
Poaceae	**Chloris gayana*	Rhodes Grass	X							X																						
Poaceae	*Chloris* sp.								X																							
Poaceae	*Chloris truncata*	Windmill Grass												X								X										
Poaceae	*Chloris ventricosa*	Tall Chloris	X		X					X	X	X	X								X	X	X									
Poaceae	*Chloris* prob. *ventricosa*																							2			1		1	1		1
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass			X		X	X	X	X	X	X	X		X			X	X	X	X	X		3	3	3	1	1	1	1	1	1
Poaceae	*Cynodon dactylon*	Common Couch	X	X	X	X	X			X		X			X	X		X	X	X		X				3			1	1		1
Poaceae	*Digitaria diffusa*																					X										
Poaceae	**Ehrharta erecta*	Panic Veldtgrass*	X	X												X							X									
Poaceae	**Eleusine* sp.									X																						
Poaceae	*Enteropogon acicularis*		X																													
Poaceae	*Enteropogon sp.*													X	X			X														
Poaceae	*Eragrostis brownii*	Brown's Lovegrass			X	X	X		X		X							X	X	X		X			2						1	1
Poaceae	**Eragrostis curvula*	African Lovegrass								X																						
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	X								X		X		X				X	X	X											
Poaceae	*Eragrostis* sp.		X		X	X					X																					
Poaceae	*Eriochloa pseudoacrotricha*	Early Spring Grass								X						X																

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																				Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Poaceae	*Hordeum leporinum*	barley grass																							2						
Poaceae	*Hyparrhenia hirta*	Coolatai Grass	X		X																										
Poaceae	*Lolium* sp.									X																					
Poaceae	*Melinis repens*	Red Natal Grass	X			X												X													1
Poaceae	*Microlaena stipoides*	Weeping grass	X	X	X					X	X	X				X		X	X		X										
Poaceae	*Oplismenus aemulus*	Basket grass																					X								
Poaceae	*Panicum effusum*	Poison or Hairy Panic	X		X	X	X				X				X				X	X	X	X									
Poaceae	*Panicum simile*	Panicum simile	X																												
Poaceae	*Panicum* sp.															X	X														
Poaceae	*Paspalidium* sp.														X							X									
Poaceae	*Paspalum dilatatum*	Paspalum	X		X	X					X			X		X					X										
Poaceae	*Paspalum distichum*	Water Couch	X																												
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass								X													X								
Poaceae	*Phragmites australis*	Common Reed		X																											
Poaceae	*Poa sieberiana*	Tussock Poa																			X	X						1			
Poaceae	*Setaria parviflora*			X	X	X	X			X	X					X				X	X		X								
Poaceae	*Sporobolus africanus*	Parramatta Grass			X	X																									
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass	X							X	X			X				X	X	X	X	X	X								
Poaceae	*Sporobolus* sp.											X																			
Poaceae	*Vulpia bromoides	squirrell tail fescue																							2						1
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi	X																												
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)																															
Acanthaceae	*Brunoniella australis*	blue trumpet																						2					1		
Aizoaceae	*Galenia pubescens*	Galenia		X						X	X	X	X	X	X		X					X	X	3	2	2					
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	X													X															
Anacardiaceae	*Schinus areira*	Pepper Tree	X																												
Anthericaceae	*Dichopogon* sp.																				X										

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																					Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Apiaceae	*Centella asiatica*	pennnywort	X																													
Asclepiadaceae	**Araujia sericifera*	Moth Vine																					X									
Asclepiadaceae	**Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	X													X			X										1			
Asteraceae	**Aster subulatus*	Wild Aster		X												X																
Asteraceae	**Bidens pilosa*	Cobbler's Pegs	X	X																	X		X									
Asteraceae	**Bidens subalternans*	Greater Beggar's Ticks	X							X													X									
Asteraceae	*Brachyscome* sp.											X																				
Asteraceae	*Calocephalus citreus*	Lemon Beauty-heads				X	X											X	X		X			2	2		1	1				
Asteraceae	*Calotis cuneata*	Mountain Burr-Daisy				X	X																									
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy	X										X									X					1	1				
Asteraceae	*Calotis* sp.																									2						
Asteraceae	**Carthamus lanatus*	Saffron Thistle	X								X	X		X																		
Asteraceae	*Cassinia aculeata*	Dolly Bush					X															X						1				
Asteraceae	**Centaurea* sp.										X																					
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting	X								X	X	X		X			X	X	X	X	X			2				1		1	
Asteraceae	**Cirsium vulgare*	Spear Thistle	X								X					X					X					3	1		1	1		
Asteraceae	**Conyza bonariensis*	Flaxleaf Fleabane								X	X			X									X									
Asteraceae	**Conyza* sp.		X			X						X					X				X											
Asteraceae	*Cymbonotus lawsonianus*	Bear's Ear	X																													
Asteraceae	*Euchiton involucratus*	Star Cudweed	X																													
Asteraceae	*Euchiton sphaericus*													X																		
Asteraceae	*Euchiton* sp.					X																										
Asteraceae	**Gamochaeta calviceps*																								2	1						
Asteraceae	**Gnaphalium americanum*									X				X						X												
Asteraceae	**Hypochaeris radicata*	Catsear		X	X	X	X												X		X				1	3			1			
Asteraceae	*Lagenifera stipitata*	Blue Bottle-daisy											X																			
Asteraceae	*Olearia* sp.		X																													

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																				Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Asteraceae	*Senecio madagascariensis*	Fireweed		X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	2	2	3	1	1	1	1	1	1
Asteraceae	*Sonchus oleraceus*	Common Sowthistle														X																
Asteraceae	*Sonchus* sp.			X																												
Asteraceae	*Tagetes minuta*	Stinking Roger	X																				X									
Asteraceae	*Vittadinia cuneata*	Fuzzweed											X									X										
Asteraceae	*Vittadinia muelleri*	Fuzzweed	X									X																				
Asteraceae	*Vittadinia pterochaeta*																								2							
Basellaceae	*Anredera cordifolia*	Madeira Vine	X																				X									
Boraginaceae	*Cynoglossum* prob. *australe*																								1			1				
Boraginaceae	*Cynoglossum suaveolens*		X																													
Boraginaceae	*Echium plantagineum*	patterson's curse																								2			1			
Brassicaceae	*Hirschfeldia incana*	Hairy Brassica	X							X													X									
Brassicaceae	*Lepidium africanum*									X				X									X									
Cactaceae	*Opuntia aurantiaca*	Tiger Pear	X							X		X	X									X	X	2			1	1				
Cactaceae	*Opuntia humifusa*	Creeping Pear						X	X					X	X			X				X		2			1	1		1		
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell									X		X	X							X											
Campanulaceae	*Wahlenbergia gracilenta*	Annual Bluebell											X																			
Campanulaceae	*Wahlenbergia gracilis*	Sprawling or Australian Bluebell	X																													
Campanulaceae	*Wahlenbergia* sp.		X																		X	X										
Caryophyllaceae	*Petrorhagia velutina*																												1			
Casuarinaceae	*Allocasuarina luehmannii*	Bulloak	X			X	X	X	X				X		X			X	X	X	X	X		3	4		1	1	1	1	1	1
Casuarinaceae	*Casuarina cunninghamiana*	River Oak	X							X													X									
Casuarinaceae	*Casuarina glauca*	Swamp Oak														X	X															
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush		X											X	X		X				X										

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																				Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Chenopodiaceae	*Einadia nutans subsp. nutans*																							1								
Chenopodiaceae	*Einadia trigonos*	Fishweed	X									X		X	X		X					X										
Chenopodiaceae	*Enchylaena* sp.		X																													
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush											x		X							X	X										
Chenopodiaceae	*Enchyleana* prob. *tomentosa*																							2			1					
Chenopodiaceae	*Maireana microphylla*		X	X											X	X							X										
Clusiaceae	*Hypericum gramineum*	Small St John's Wort																			X												
Clusiaceae	*Hypericum perforatum*	St. Johns Wort			X		X				X	X																					
Commelinaceae	*Commelina cyanea*	Native Wandering Jew																					X										
Convolvulaceae	*Dichondra repens*	Kidney Weed									X	X	X		X		X	X			X	X	X				1		1				
Convolvulaceae	*Dichondra* sp. A																							2									
Crassulaceae	**Bryophyllum daigremontiana*															X	X																
Crassulaceae	**Bryophyllum delagoense*	Mother of millions	X	X																			X										
Cyperaceae	*Carex inversa*	Knob Sedge	X										X																				
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge	X											X	X							X											
Cyperaceae	*Cyperus* sp.			X						X	X																						
Cyperaceae	*Eleocharis* sp.		X																														
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge			X	X					X								X														
Cyperaceae	*Schoenoplectus mucronatus*		X																														
Epacridaceae	*Melichrus urceolatus*	Urn Heath	X																														
Euphorbiaceae	Chamaesyce drummondii	caustic weed																										1					
Euphorbiaceae	*Phyllanthus virgatus*												X						X														
Euphorbiaceae	**Ricinus communis*	Castor Oil Plant	X																														
Fabaceae (Caesalpinioideae)	*Cassia aciphylla*														X																		
Fabaceae (Faboideae)	*Daviesia genistifolia*	Broom Bitter Pea	X																														

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																					Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Fabaceae (Faboideae)	*Daviesia ulicifolia*																										1					
Fabaceae (Faboideae)	*Desmodium brachypodum*	Large Tick-trefoil	X																													
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil										X										X										
Fabaceae (Faboideae)	*Glycine clandestina*		X						X												X	X										
Fabaceae (Faboideae)	*Glycine* sp.														X																	
Fabaceae (Faboideae)	*Glycine tabacina*	Glycine									X		X	X	X	X					X	X		2	2		1	1	1			
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	X										X																	1		
Fabaceae (Faboideae)	*Pultenaea microphylla*																										1					
Fabaceae (Faboideae)	*Templetonia stenophylla*	leafy templetonia																							2		1	1				
Fabaceae (Faboideae)	**Trifolium repens*	white clover																								1						
Fabaceae (Faboideae)	**Trifolium* sp.										X																					
Fabaceae (Faboideae)	*Zornia dyctiocarpa*														X																	
Fabaceae (Mimosoideae)	*Acacia decora*	western golden wattle																												1		
Fabaceae (Mimosoideae)	*Acacia falcata*		X																													
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle	X																													
Fabaceae (Mimosoideae)	*Acacia salicina*	Cooba		X									X		X									2				1	1	1		
Fabaceae (Mimosoideae)	*Acacia saligna*	Golden Wreath Wattle	X																													
Fabaceae (Mimosoideae)	*Acacia* sp.		X										X																	1		
Gentianaceae	**Centaurium* sp.													X																		
Gentianaceae	**Centaurium tenuiflorum*																												1			
Geraniaceae	*Geranium homeanum*		X																													
Geraniaceae	*Geranium solanderi*	Native Geranium	X		X							X		X							X											
Geraniaceae	*Geranium solanderi* var. *Soladeri*																									2						

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																				Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Goodeniaceae	*Brunonia australis*	Blue Pincushion																			X								1			
Goodeniaceae	*Goodenia* sp.		X									X									x											
Hydrocharitaceae	*Ottelia ovalifolia*	Swamp Lily	X																													
Lamiaceae	**Marrubium vulgare*	Horehound	X																				X									
Lamiaceae	*Mentha satureioides*	Native Pennyroyal			X						X							X			X		X									
Lamiaceae	*Mentha* sp.		X																													
Lauraceae	**Cinnamomum* sp.		X																													
Lobeliaceae	*Pratia purpurascens*	Whiteroot	X	X												X					X											
Loranthaceae	*Amyema cambagei*															X	X															
Malvaceae	*Abutilon* sp.																				X											
Malvaceae	**Modiola caroliniana*	Red-flowered Mallow														X																
Malvaceae	*Sida corrugata*		X									X	X										1			1					
Malvaceae	**Sida rhombifolia*	Paddy's Lucerne	X	X	X					X	X	X		X	X	X	X				X		X			1						
Malvaceae	*Sida* sp.		X																		X											
Marsileaceae	*Marsilea mutica*	Nardoo	X																				X									
Meliaceae	*Melia azedarach*	White Cedar	X																													
Myoporaceae	*Eremophila debilis*	Amulla	X									X	X					X						2			1					
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	X																										1			
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	X				X	X					X		X			X		X				3			1			1		
Myrtaceae	*Eucalyptus moluccana*	Grey Box	X																													
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	X	X																												
Oleaceae	**Olea europaea*	African Olive											X		X									2					1	1		
Oxalidaceae	*Oxalis perennans*			X	X	X					X	X				X	X				X											
Oxalidaceae	*Oxalis* sp.																						X									
Phormiaceae	*Dianella longifolia*		X										X																			
Phormiaceae	*Dianella revoluta*																	X														
Plantaginaceae	*Plantago debilis*				X							X																				
Plantaginaceae	**Plantago lanceolata*	Lamb's Tongues*								X	X									X						3						1
Plantaginaceae	*Plantago sp.*			X																												

Family/Subfamily	Scientific Name	Common Name	Species Identified by ELA																				Umwelt								
			Meander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	P01	P02	P03	R01	R02	R03	R04	R05	R06
Polygonaceae	*Rumex brownii*	Swamp Dock	X													X					X		X									
Potamogetonaceae	*Potamogeton* sp.		X																													
Rubiaceae	*Asperula conferta*	Common Woodruff	X								X		X								X											
Rubiaceae	*Galium* sp.											X																				
Rubiaceae	**Richardia stellaris*												X																			
Salicaceae	**Salix* sp.		X																													
Scrophulariaceae	*Gratiola pedunculata*		X																													
Scrophulariaceae	**Verbascum sp*.		X																													
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell	X			X					X		X									X										
Solanaceae	*Solanum* prob. *cinereum*	narrawa burr																						1						1		
Solanaceae	**Lycium ferocissimum*	African Boxthorn															X							1								
Solanaceae	**Solanum nigrum*	Black-berry Nightshade		X												X							X									
Solanaceae	**Solanum pseudocapsicum*	Madeira Winter Cherry	X																													
Solanaceae	*Solanum* sp.												X		X							X	X									
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia																X	X		X											
Sterculeacea	*Brachychiton populneaus* subp. *populneus*	Sterculeacea																									1					
Thymelaeaceae	Pimelea sp.																												1			
Urticaceae	**Urtica urens*	Small Nettle																					X									
Verbenaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum	X																													
Verbenaceae	**Verbena bonariensis*	Purpletop		X	X	X					X	X		X									X		1	2			1			
Verbenaceae	**Verbena brasiliensis*		X							X						X						X										
Verbenaceae	**Verbena rigida*	Veined Verbena	X		X																											

APPENDIX 4

EP&A Act 1979 Assessment of Significance

Appendix 4 – *Environmental Planning and Assessment Act 1979* Assessment of Significance

Part 3A of the EP&A Act requires a test for ecological significance relating to the potential impacts of the Project on listed threatened species, endangered populations or threatened ecological communities (TECs). A Test for Ecological Significance is provided below for those threatened species, endangered populations and TECs considered (within Appendix 3) to have the potential to be impacted by the Project. The following species, endangered populations and TECs are assessed:

- Painted diuris (*Diuris tricolor*) endangered population and threatened species;
- *Ozothamnus tesselatus*;
- Tiger orchid (*Cymbidium canaliculatum*) endangered population in the Hunter Catchment;
- Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC;
- Green and golden bell frog (*Litoria aurea*);
- Australian painted snipe (*Rostratula benghalensis australis*);
- Blue-billed duck (*Oxyura australis*);
- Freckled duck (*Stictonetta naevosa*);
- Spotted harrier (*Circus assimilis*);
- Little eagle (*Hieraaetus morphnoides*);
- Eastern grass owl (*Tyto longimembris*);
- Glossy black-cockatoo (*Calyptorhynchus lathami)*;
- Swift parrot (*Lathamus discolor*);
- Little lorikeet (*Glossopsitta pusilla*);
- Powerful owl (*Ninox strenua*);
- Masked owl (*Tyto novaehollandiae*);
- Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- Speckled warbler (*Chthonicola sagittata*);
- Regent honeyeater (*Anthochaera phrygia*);
- Black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*);
- Hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*);
- Scarlet robin (*Petroica boodang*);
- Flame robin (*Petroica phoenicea*);
- Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- Varied sittella (*Daphoenositta chrysoptera*);
- Diamond firetail (*Stagonopleura guttata*);
- Spotted-tailed quoll (*Dasyurus maculatus maculatus*);

- Squirrel glider (*Petaurus norfolcensis*);
- Grey-headed flying-fox (*Pteropus poliocephalus*);
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*);
- Eastern freetail-bat (*Mormopterus norfolkensis*);
- Little bentwing-bat (*Miniopterus australis*);
- Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Eastern long-eared bat (*Nyctophilus timoriensis*);
- Large-eared pied bat (*Chalinolobus dwyeri*);
- Eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- Southern myotis (*Myotis macropus*);
- Greater broad-nosed bat (*Scoteanax rueppellii*)*;* and
- Eastern cave bat (*Vespadelus troughtoni*).

All assessments are undertaken without any consideration of impact mitigation or offsetting opportunities or commitments. Impact mitigation and biodiversity offsetting commitments are addressed in Sections 6.0 and 7.0 of the main report.

Section 5A of the EP&A Act requires the seven-part test process consider potential impacts to the *viable local population* of an entity. The Department of Environment and Climate Change (DECC) (now OEH) (2007) *Threatened Species Assessment Guidelines* defines the 'local population' as the population that occurs in the 'study area' and also defines the 'study area' as the area directly affected by the proposal and any additional areas that are likely to be affected by the proposal, either directly or indirectly. The DECC (2007) *Threatened Species Assessment Guidelines* indicate that the study area should extend as far as is necessary to take all potential impacts into account.

Indirect impacts should be, and have been as part of the Ecological Assessment, considered on a case by case basis, because the potential for indirect impacts on each species, community or population is different. It is not possible to accurately map the expected indirect impacts caused by the Project. The area over which indirect impacts such as noise and dust pollution could impact on ecological communities, endangered populations and species is unique to each indirect impact type and to the ecological community, endangered population or species potentially affected. For example indirect impacts from dust will vary according to wind strength and direction and will also vary over time (from hourly to across seasons). Additionally indirect impacts may extend beyond the Proposed Modification Area to varying distances depending on the ecological community, endangered population or species potentially affected. While impacts on some species may be relatively localised, impacts on other species may extend a considerable distance from the impact area. For example impacts on a fauna species in one locality that reduce foraging efficiency could result in decreased survivorship of individuals within a population that may be contained within a remnant woodland patch or that extends across a number of patches. Indirect impacts should therefore be considered on a case by case basis, and were so within this Ecological Assessment.

Assessments of the direct and indirect impacts of the Project on *viable local populations/local occurrences* of all threatened species, endangered populations and TECs were undertaken on a case-by-case basis.

Test for Ecological Significance under EP&A Act

Threatened Flora Species

Painted diuris (*Diuris tricolor*) – Vulnerable Species and Endangered Population TSC Act

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

The Proposed Modification Area provides potential habitat for this species, although it has not been recorded there during numerous surveys (including targeted painted diuris (*Diuris tricolor*) surveys in 2011 by ELA). Although the Proposed Modification Area provides potential habitat for this species, it was considered that the potential for it to occur was low.

Given that painted diuris (*Diuris tricolor*) is not known to occur in the Proposed Modification Area and has a low potential for occurrence, it is not considered likely that the Project will 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.

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

The Proposed Modification Area provides potential habitat for this endangered population, although it has not been recorded there during numerous surveys (including targeted painted diuris (*Diuris tricolor*) surveys in 2011 by ELA). Although the Proposed Modification Area provides potential habitat for this endangered population, it was considered that the potential for it to occur was low.

Given that painted diuris (*Diuris tricolor*) is not known to occur in the Proposed Modification Area and has a low potential for occurrence, it is not considered likely that the Project will 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.

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

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

Not applicable.

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

Not applicable.

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

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

Approximately 65 hectares of potential grassland habitat for painted diuris (*Diuris tricolor*) will be removed as a result of the Project.

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

As there is no known habitat for painted diuris (*Diuris tricolor*) within the Proposed Modification Area, the Project will not cause the fragmentation or isolation of any known area of habitat for this species. There is a low likelihood for areas potentially containing this species to be fragmented or isolated from areas of currently connected habitat as a result of the Project.

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

Painted diuris (*Diuris tricolor*) has not been recorded within the Proposed Modification Area, and is considered to have low potential to occur in the areas of potential habitat within the Proposed Modification Area. Consequently, it is not considered likely that the Proposed Modification Area provides important habitat to the long-term survival of the threatened species and endangered population within the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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

The Project will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Act).

Conclusion

The Project is unlikely to have a significant impact on painted diuris (*Diuris tricolor*).

Ozothamnus tesselatus – Vulnerable TSC Act

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

Ozothamnus tesselatus has not been recorded in the Proposed Modification Area. There are no confirmed records of the species within 20 kilometres of the Proposed Modification Area. However, as there are unconfirmed records of this species near Mt Owen, the Proposed Modification Area is considered to provide potential habitat for the species. The species is considered to have a low likelihood of occurring in the Proposed Modification Area due to the presence of one unconfirmed record of the plant within 20 kilometres of the Proposed Modification Area, as well as the presence of long-standing mining activities and stock grazing over a large part of the Proposed Modification Area. The Project is not likely to have an adverse effect on the life cycle of *Ozothamnus tesselatus*, such that a viable local population of the species is likely to be placed at risk of extinction.

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

Not applicable.

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

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

Not applicable.

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

Not applicable.

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

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

Approximately 123 hectares of potential habitat for *Ozothamnus tesselatus* will be removed as a result of the Project.

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

There is no known habitat for *Ozothamnus tesselatus* within the Proposed Modification Area. As a consequence it is unlikely that areas of habitat for this species will be fragmented or isolated from other currently connected areas of habitat as a result of the Project.

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

Ozothamnus tesselatus is not known to occur in the Proposed Modification Area or within 5 kilometres of the Proposed Modification Area. Consequently, there is considered to be a low likelihood of the species being present within the Proposed Modification Area. The habitat to be removed for the Project is not considered to be important to the long-term survival of the species in the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Act).

Conclusion

The Project is unlikely to have a significant impact on *Ozothamnus tesselatus*.

Threatened Flora Populations

Tiger orchid (*Cymbidium canaliculatum*) in the Hunter Catchment – Endangered Population TSC Act

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

Not applicable.

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

One record of the tiger orchid (*Cymbidium canaliculatum*) has been made within the Proposed Modification Area. This record was located in Central Hunter Bulloak Forest within a regenerating bulloak (*Allocasuarina luehmannii*) tree. The individual was young and was not considered likely to be old enough to be capable of flowering at this stage. There is potential that individuals of this endangered population occurs elsewhere in low numbers within the Proposed Modification Area, however as the tiger orchid is largely dependent on tree hollows, there is not considered to be potential for a large population to be present in the locality due to the low number of hollow-bearing trees present. An additional tiger orchid (*Cymbidium canaliculatum*) is known to occur with the local area outside of the Proposed Modification Area, this record will not be impacted by the Project.

One known tiger orchid will be removed from the Proposed Modification Area as a result of the Project. However given the young age and lack of reproduction from this individual, it is considered highly unlikely that the Project will have an adverse effect on the life cycle of this species that constitutes the endangered population, such that a viable local population is likely to be placed at risk of extinction.

While not considered within the conclusions to this impact assessment, there is currently a successful program operating in the Hunter Valley which is salvaging this species and translocating it into host trees within secure areas (often biodiversity offset areas). This individual is likely to be highly suited to this process, as a result of its very small size, young age and position low within the tree.

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

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

Not applicable.

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

Not applicable.

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

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

One record of the tiger orchid (*Cymbidium canaliculatum*) is known to occur within the Proposed Modification Area. This species has the potential to occur within any of the treed vegetation areas of the Proposed Modification Area, however it will preferentially occur within areas of hollow-bearing trees, which are generally lacking from the Proposed Modification Area. Consequently, one known record and approximately 123 hectares of potential low quality habitat will be removed as a result of the Project.

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

One location of the tiger orchid (*Cymbidium canaliculatum*) is known to occur in the Proposed Modification Area. However, additional potential habitat for this endangered population may be present throughout the treed areas of the Proposed Modification Area. There is a low potential for areas containing this population to be fragmented or isolated from areas of habitat as a result of the Project.

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

There is one known location of tiger orchid (*Cymbidium canaliculatum*) within the Proposed Modification Area. The species is heavily dependent on the presence of hollow-bearing trees, of which there is low abundance in the Proposed Modification Area; consequently, approximately 123 hectares of potential low quality habitat available for this species throughout the remainder of the Proposed Modification Area. The habitat to be removed for the Project is not likely to be important for the long-term survival of the endangered population in the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

A recovery plan has not been prepared for this population. There are no threat abatement plans of relevance to the Project.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the population:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

It is unlikely that the Project would have a significant impact on the endangered population of the tiger orchid (*Cymbidium canaliculatum*).

Threatened Ecological Communities

Central Hunter Grey Box– Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions – Endangered Ecological Community TSC Act

The Project will result in the removal of approximately 56 hectares of Central Hunter Box – Ironbark Woodland which in commensurate with Central Hunter Grey Box – Ironbark Woodland EEC. Interrogation of the Hunter Remnant Vegetation Project (HRVP) shows that the mapped extent of this community across its distribution prior to 2006 was approximately 14,800 hectares (Peake 2006). Based on this, the Project represents a loss of approximately 0.38 per cent of the known 2006 distribution of this community. The current extent of the EEC in the central Hunter Valley is unknown, and could be less than that listed in Peake (2006), due to a number of major developments since 2006. In addition to reductions due to development approvals, the extent of EECs may have also increased due to natural regeneration of derived native grassland communities into EEC woodland communities.

The Central Hunter Grey Box – Ironbark Woodland currently present in the Proposed Modification Area is highly fragmented, and much of the current woodland areas have regenerated relatively recently after historic clearing and grazing disturbance.

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

Not applicable.

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

Not applicable.

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

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

Approximately 56 hectares of this EEC occurs within the Proposed Modification Area. The condition of this community is considered to be low to moderate condition and is highly fragmented, with a paucity of diversity in terms of shrubs/understory and groundcover species.

The removal of approximately 56 hectares of this community is likely to represent the removal of the majority of the local occurrence of this community in the immediate area (LCO).

The removal of approximately 56 hectares of the community is unlikely to have an adverse effect on the community in a regional context, as this community has been mapped (by Peake 2006) as occurring near to the LCO (see Figure 2.2 of the main text). The local occurrence of the community is likely to include that recorded within the Proposed Modification Area and small, fragmented remnants of the community occurring in proximity to the Proposed Modification Area. The removal of approximately 56 hectares of a small low condition remnant of the community could have an adverse

effect on the extent of the community such that its local occurrence would be placed at the risk of extinction. However, very large areas of derived native grassland form of this community occur in the local area, and depending on land management practices it is likely that a substantial proportion of this will regenerate into the EEC form of the community over a short time period. Thus, over time, it is unlikely that this community would become locally extinct.

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

The condition of this community is considered to be low to moderate and highly fragmented, with a paucity of diversity in terms of shrubs/understorey and groundcover species. All species identified within this community are considered to be locally common. The removal of approximately 56 hectares of a small low condition remnant of the community could have an adverse effect on the composition of the community such that its local occurrence would be placed at the risk of extinction. However, very large areas of derived native grassland form of this community occur in the local area, and depending on land management practices it is likely that a substantial proportion of this will regenerate into the EEC form of the community over a short time period. Thus, over time, it is unlikely that this community would become locally extinct.

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

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

Approximately 56 hectares (of which 33 hectares is regrowth vegetation) of this community will be removed as a result of the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the Project; and

Fragmentation of remaining remnants of the community within and adjoining the Proposed Modification Area is likely to increase as a result of the Project. However, this community largely occurs as fragmented remnants within the surrounding area and the increase in fragmentation is not considered critical for this community overall.

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

The Proposed Modification Area contains 56 hectares of relatively poor quality, highly fragmented EEC with low levels of diversity. There are very large areas of derived native grassland form of this community in the local area, and depending on land management practices it is likely that a substantial proportion of this will regenerate into the EEC form of the community over a short time period. The habitat for this community within the Proposed Modification Area is unlikely to be important to its long-term survival in the locality. However, there are no known occurrences of this EEC within the conservation reserves of the region and therefore the community is not considered to be adequately represented in conservation reserves.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

A recovery plan has not been prepared for this community. There are no threat abatement plans of relevance to the Project.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the EEC:

- Bushrock removal (TSC Act);
- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the Central Hunter Grey Box – Ironbark Woodland EEC.

Green and golden bell frog (*Litoria aurea*) – Endangered TSC Act

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

The green and golden bell frog has not previously been recorded within the Proposed Modification Area; however there are seven records of this species within a 20 kilometre radius of the Proposed Modification Area.

The Proposed Modification Area provides some limited areas of potential habitat for this species comprising riparian habitat and farm dam habitat containing reed beds. It is considered unlikely that the green and golden bell frog occurs within the Proposed Modification Area, given that it has not been recorded during any of the surveys undertaken since 2001 (including within the broader LCO). As such, the Project is unlikely 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.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides only a very small amount of potential habitat for this species in the form of farm dams. Many of these dams do not provide potential reed beds that would be potential for this species.

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

The green and golden bell frog has not been recorded within the Proposed Modification Area; however small areas of potential habitat in the form of farm dams with reed beds occur within the Proposed Modification Area. The Project would result in an increase in the level of isolation of remaining farm dams with reed beds within the Proposed Modification Area and surrounding areas.

Given that it is not considered likely to occur, the Project is unlikely to introduce barriers for this species such that it would prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat would not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

Given that this species has not been recorded within the Proposed Modification Area or the broader LCO, the removal of potential habitat for this species from the Proposed Modification Area is considered unlikely to adversely impact the long-term survival of this species. The potential habitat for this species within the Proposed Modification Area is unlikely to form an area of important habitat for the long-term survival of the species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

The 'Draft Recovery Plan for the Green and Golden Bell Frog *Litoria aurea*' (DEC 2005) is relevant to this species. The Project does not contravene any of the objectives or actions of this recovery plan as the green and golden bell frog is not known to occur within the Proposed Modification Area.

The 'Threat Abatement Plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis' (AGDEH 2006) is pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts); and
- Degradation of native riparian vegetation (FM Act).

Conclusion

The Project is unlikely to have a significant impact on the green and golden bell frog (*Litoria aurea*).

Australian painted snipe (*Rostratula benghalensis australis*) – Endangered TSC Act

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

This species has not been recorded in the Proposed Modification Area; however has been recorded within 2 kilometres of the Proposed Modification Area along Bowmans Creek. This record is considered to be highly unusual for this area of the Hunter Valley. There is a small amount of marginal quality habitat available for this species in the Proposed Modification Area.

This species may be an occasional or rare visitor to the Proposed Modification Area however the Project is unlikely to have an adverse effect on the life cycle of the species such that a local viable population is placed at risk of extinction due to their large foraging ranges and high levels of mobility.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides 5 hectares of potential foraging habitat for this species in the form of low quality Central Hunter Swamp Oak Forest. These areas are considered to be only marginal in quality for this species and would likely only be used while moving between areas of more potential habitat.

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

This species has not been recorded within the Proposed Modification Area and it is considered that the record of it within the LCO was a local anomaly. As a small extent of potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of equally and more potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation resulting from the Project is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas.

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

The Australian painted snipe has not been recorded within the Proposed Modification Area and is considered unlikely to occur. As discussed above, if this species were to occur, it would likely only be a rare visitor. The removal of potential habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the Australian painted snipe (*Rostratula benghalensis australis*).

Blue-billed duck (*Oxyura australis*) – Vulnerable TSC Act

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

The blue-billed duck (*Oxyura australis*) has not been recorded within the Proposed Modification Area and is considered unlikely to occur due to a lack of potential habitat (being deep dams edged by dense riparian vegetation). Despite this, there are records of this species within 500 metres of the Proposed Modification Area within the LCO. If this species were to use the habitats of the Proposed Modification Area, it would likely be only while moving between areas of higher quality habitat.

The Project is unlikely to have an adverse effect on the life cycle of the species such that a local viable population is placed at risk of extinction due to their large foraging ranges and high levels of mobility.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides marginal foraging habitat for this highly mobile species, in the form of a small number of farm dams with little fringing vegetation.

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

This species has not been recorded in the Proposed Modification Area and is not considered likely to occur there. As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the presence of known habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

As this species has not been recorded within the Proposed Modification Area and is considered unlikely to occur, the removal of low quality potential habitat for this species from the Proposed Modification Area is unlikely to be of importance to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts); and
- Degradation of native riparian vegetation (FM Act).

Conclusion

The Project is unlikely to have a significant impact on the blue-billed duck (*Oxyura australis*).

Freckled duck (*Stictonetta nervosa*) – Vulnerable TSC Act

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

The freckled duck (*Stictonetta nervosa*) has not been recorded within the Proposed Modification Area or within the local area despite many years of waterbird monitoring surveys targeting dams. The Proposed Modification Area provides a small amount of potential (albeit low quality) habitat for this species; however it has not been recorded there.

This species may be an occasional or rare visitor to the Proposed Modification Area however the Project is unlikely to have an adverse effect on the life cycle of the species such that a local viable population is placed at risk of extinction due to their large foraging ranges and high levels of mobility.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides marginal foraging habitat for this highly mobile species, in the form of a small number of farm dams with little fringing vegetation.

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

This species has not been recorded in the Proposed Modification Area and is not considered likely to occur there. As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the known presence of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

As this species has not been recorded within the Proposed Modification Area and is considered unlikely to occur, the removal of low quality potential habitat for this species from the Proposed Modification Area is unlikely to be of importance to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts); and
- Degradation of native riparian vegetation (FM Act).

Conclusion

The Project is unlikely to have a significant impact on the freckled duck (*Stictonetta nervosa*).

Spotted harrier (*Circus assimilis*) – Vulnerable TSC Act

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

The spotted harrier (*Circus assimilis*) has been recorded within the LCO during monitoring surveys, during the 2001 EIS surveys (Umwelt 2001) and during 2013 Umwelt fauna surveys. As the 2001 and monitoring records were made prior to it being listed as a threatened species, the locations of these records are unknown and were consequently assumed to occur within the Proposed Modification Area. The 2013 record was made within the LCO however was approximately 750 metres north of the Proposed Modification Area. The Proposed Modification Area provides known foraging habitat for this species, comprising primarily vegetated areas and grasslands.

It is considered likely that the spotted harrier (*Circus assimilis*) is an occasional visitor to the Proposed Modification Area, however the Project is unlikely to have an adverse effect on the life cycle of the species such that a local viable population is placed at risk of extinction due to their large foraging ranges and high levels of mobility.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of foraging habitat for this species, however the highly disturbed habitats of the Proposed Modification Area are expected to comprise marginal foraging habitat only for this highly mobile species.

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

As known habitat for this species will be removed as a result of the Project, the level of fragmentation and isolation will increase for this species. However, given the extensive area of habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

Given that this species is only considered to irregularly utilise the habitats of the Proposed Modification Area as part of a wider foraging range, the removal of 188 hectares of foraging habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the spotted harrier (*Circus assimilis*).

Little eagle (*Hieraaetus morphnoides*) – Vulnerable TSC Act

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

The little eagle (*Hieraaetus morphnoides*) has been recorded within the LCO, however as these records were made prior to the species being listed as a threatened species, their specific locations are unknown. This species has been recorded on two occasions within the LCO, once during surveys for the 2001 EIS (Umwelt 2001), and the other during the 2007 monitoring program (Umwelt 2007). Given the general paucity of records of this species over time, it is considered likely that this species would be utilising the habitats of the Proposed Modification Area as part of a much larger foraging range, and is unlikely to be breeding there. The Proposed Modification Area is considered to provide marginal foraging and nesting/roosting habitat for this species, comprising woodlands, adjacent grasslands and disturbed areas.

This species may be an occasional or rare visitor to the Proposed Modification Area; however the Project is unlikely to have an adverse effect on the life cycle of the species such that a local viable population is placed at risk of extinction given their large foraging ranges and high levels of mobility.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential foraging habitat for this species however the highly disturbed habitats of the Proposed Modification Area are expected to comprise marginal habitat for this highly mobile species.

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

As potential habitat for this species will be removed as a result of the Project, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

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

Given that this species is only considered likely to irregularly utilise the habitats of the Proposed Modification Area as part of a wider foraging range, the removal of 188 hectares of foraging habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the little eagle (*Hieraaetus morphnoides*).

Eastern grass owl (*Tyto longimembris*) – Vulnerable TSC Act

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

The eastern grass owl (*Tyto longimembris*) was identified by Umwelt during 2013 fauna surveys within the Central Hunter Box – Ironbark Derived Native Grassland in the central east of the Proposed Modification Area. The Proposed Modification Area contains approximately 65 hectares of appropriate habitat for this species. There have been no records made of this species previously in the LCO or within 20 kilometres of the Proposed Modification Area (BioNet 2013).

This record is atypical for the Hunter Valley as this species typically occurs in coastal areas, however it is known to experience fluctuations in population and distribution in response to prey species populations (particularly that of rodents). It is considered unlikely that the Proposed Modification Area contains a resident population of this species.

The Project is unlikely to have an adverse effect on the life cycle of this species such that a viable local population is placed at risk of extinction given its high levels of mobility and nomadic movements following fluctuating prey densities.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 65 hectares of potential foraging habitat for this species however the highly disturbed habitats of the Proposed Modification Area are expected to comprise marginal habitat for this highly mobile species.

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

As habitat for this species will be removed as a result of the Project, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact the eastern grass owl.

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

Given that this species is only considered likely to irregularly utilise the habitats of the Proposed Modification Area, the removal of 65 hectares of habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

Although the eastern grass owl (*Tyto longimembris*) has been recorded within the Proposed Modification Area, it is not considered likely that this record comprises a resident population given the absence of records from the LCO and the Hunter Valley, high levels of mobility of the species as it's nomadic foraging tendencies to follow fluctuating prey densities. It is not considered likely that the Project will have a significant impact on the eastern grass owl (*Tyto longimembris*).

Glossy black-cockatoo (*Calyptorhynchus lathami*) – Vulnerable TSC Act

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

This species has not been recorded within the Proposed Modification Area and there are no known NSW Wildlife Atlas records of this species within 20 kilometres of the centre of the Proposed Modification Area. Despite this, the Proposed Modification Area is considered to provide potential foraging habitat for this species in areas of Central Hunter Swamp Oak Forest (5 hectares) and Central Hunter Bulloak Forest (62 hectares). If this species were to occur in the Proposed Modification Area, it is unlikely that it would be breeding there due to a paucity of suitable hollow resources.

As the density of potential feed trees is not high enough to provide a consistent food resource and that there is an absence of potential breeding habitat, this species would only likely be a rare visitor to the Proposed Modification Area and as a consequence the Project is not likely to place a local viable population at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 67 hectares of potential foraging habitat for this species, however the habitats are expected to comprise marginal foraging habitat and no potential breeding habitat.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

As this species has not been recorded within the Proposed Modification Area and given that the Proposed Modification Area does not contain large hollow-bearing eucalypt species which this species is dependent upon for nest sites, it is not considered that the removal of potential habitat for this species from the Proposed Modification Area is important to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species.

The 'Threat Abatement Plan for Beak and Feather Disease Affecting Endangered Psittacine Species' (DEH 2005) is pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the glossy black-cockatoo (*Calyptorhynchus lathami*).

Swift parrot (*Lathamus discolor*) – Endangered TSC Act

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

Although this species has not been recorded in the Proposed Modification Area, it has been recorded within nearby Mt Owen, and has potential to utilise the areas of flowering eucalypt forest and woodland (56 hectares) as foraging habitat (albeit of a marginal quality). There are two NSW Atlas of Wildlife records for this species within 20 kilometres of the centre of the Proposed Modification Area, recorded in 2005. There is abundant better quality habitat for this species in areas surrounding the Proposed Modification Area, particularly that of conservation reserves.

The Proposed Modification Area provides small amounts of marginal potential winter foraging habitat for this species. As this species breeds in Tasmania only, the Proposed Modification Area does not provide breeding habitat. The Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends exclusively upon the Proposed Modification Area as winter foraging habitat, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

A total of 56 hectares of potential foraging habitat for this species will be removed from the Proposed Modification Area as a result of the Project. It is unlikely that (if this species were to use the habitats of the Proposed Modification Area), that it would depend exclusively on the Proposed Modification Area for foraging; and the highly disturbed habitats of the Proposed Modification Area are expected to comprise marginal foraging habitat for this mobile species.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

The Proposed Modification Area contains potential foraging habitat due to the presence of several species of winter flowering eucalypts. Because of the disturbed nature of the Proposed Modification Area, this is considered marginal foraging habitat. This is not expected to affect the long-term survival of the species as substantial foraging habitat for this species occurs in the surrounding area including surrounding farmland, the Barrington Tops, Wollemi and Yengo National Parks where high quality potential foraging habitat occurs.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species at the State level. A National Recovery Plan for the Swift Parrot has been prepared. The Project is likely to contravene the recovery plan by removing potential habitat for the species in the Hunter Region, which is a target area for the recovery of the species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to result in a significant impact on the swift parrot (*Lathamus discolor*).

Little lorikeet (*Glossopsitta pusilla*) – Vulnerable TSC Act

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

This species has not been recorded within the Proposed Modification Area or within the broader LCO. The Proposed Modification Area provides potential foraging and breeding habitat for this species and there are 11 NSW Atlas of Wildlife records for this species within 20 kilometres of the centre of the Proposed Modification Area. This nomadic and highly mobile species is likely to temporarily utilise the marginal quality flowering eucalypt habitats (56 hectares) of the Proposed Modification Area as part of a wider foraging range.

This species requires small tree hollows for breeding, of which shape, position and structure are important. The Proposed Modification Area provides only low levels of hollows, as a result of its disturbed nature and the generally young age of vegetation.

The Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that this species would depend exclusively upon the Proposed Modification Area as foraging or breeding habitat, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

Approximately 56 hectares of potential habitat for this species will be removed from the Proposed Modification Area as a result of the Project. It is unlikely that the species would depend exclusively on the Proposed Modification Area for foraging or breeding however the highly disturbed habitats of the Proposed Modification Area are expected to comprise marginal foraging and breeding habitat for this mobile species.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

This species has not been recorded within the Proposed Modification Area or within the broader LCO. Potential foraging habitat exists within the Proposed Modification Area; however it is likely that if this species were to occur that this would comprise only a small part of a much larger foraging range for the little lorikeet (*Glossopsitta pusilla*), and this is not expected to affect the long-term survival of the species in the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to result in a significant impact on the little lorikeet (*Glossopsitta pusilla*).

Powerful owl (*Ninox strenua*) – Vulnerable TSC Act

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

The powerful owl (*Ninox strenua*) has not been recorded within the Proposed Modification Area, and there are only two records of this species occurring within a 20 kilometre radius of the Proposed Modification Area. Despite the paucity of records, the Proposed Modification Area provides potential foraging habitat for this species. The Proposed Modification Area is not considered likely to provide potential breeding habitat for the species given that it requires large tree hollows for nesting and the Proposed Modification Area contains minimal vegetation that would have the capacity to support hollows of this size. If this species was to occur in the Proposed Modification Area it is likely that it would be using the habitats of the Proposed Modification Area as part of a much larger foraging range.

As this species has not been recorded within the Proposed Modification Area, the Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that this potential species would depend exclusively upon the Proposed Modification Area as foraging or breeding habitat, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 123 hectares of potential foraging habitat for this species. If this species were to occur, this would be likely to comprise only a small part of a much larger foraging range.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

As this species has not been recorded within the Proposed Modification Area and given that the Proposed Modification Area does not contain large hollow-bearing eucalypt species which this species is dependent upon for nest sites, it is not considered that the removal of potential habitat for this species from the Proposed Modification Area is important to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

The 'NSW Recovery Plan for the Large Forest Owls' (DEC 2006) is relevant to this species. The Project will slightly increase the level of fragmentation of habitat for this species. However, given the disturbed nature of the habitats to be cleared, the absence of potential breeding habitat, and the high mobility of this species, the Project is not likely to adversely impact this threatened species.

No threat abatement plan is pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to result in a significant impact on the powerful owl (*Ninox strenua*).

Masked owl (*Tyto novaehollandiae*) – Vulnerable TSC Act

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

The masked owl (*Tyto novaehollandiae*) has not been recorded within the Proposed Modification Area and only four records are known to occur within a 20 kilometre radius of the Proposed Modification Area. The Proposed Modification Area provides potential, albeit marginal quality, foraging habitat for this species in areas of forest, woodlands and their adjacent grasslands vegetation. Despite the presence of potential habitat, this species has not been recorded in the Proposed Modification Area.

Given that the Proposed Modification Area contains minimal vegetation that would have the capacity to support large hollow-bearing eucalypts for nesting, the Proposed Modification Area is not likely to provide potential breeding habitat for this species. If this species was to occur in the Proposed Modification Area it is likely that it would be using the habitats of the Proposed Modification Area as part of a much larger foraging range.

It is unlikely that the Project will disrupt the life cycle of this potential species such that a local viable population will be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential foraging habitat for this species; however the highly disturbed habitats of the Proposed Modification Area are expected to comprise marginal foraging habitat for this highly mobile species.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

As this species has not been recorded within the Proposed Modification Area and given that the Proposed Modification Area does not contain large hollow-bearing eucalypt species which this species is dependent upon for nest sites, it is not considered that the removal of potential habitat for this species from the Proposed Modification Area is important to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

The 'NSW Recovery Plan for the Large Forest Owls' (DEC 2006) is relevant to this species. The Project will slightly increase the level of fragmentation of habitat for this species. However, given the disturbed nature of the habitats to be cleared, the absence of potential breeding habitat, and the high mobility of this species, the Project is not likely to adversely impact this threatened species.

No threat abatement plan is pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to result in a significant impact on the masked owl (*Tyto novaehollandiae*).

Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) – Vulnerable TSC Act

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

The brown treecreeper has been recorded within the west of the Proposed Modification Area in the Central Hunter Swamp Oak Forest. This is a sedentary species that holds home ranges throughout the year and does not show migratory behaviour. Given this, it is likely that the 123 hectares of woodland and forest vegetation of the Proposed Modification Area supports a viable local population of this species. There are few records of this species known to occur within the immediate surrounds of the Proposed Modification Area, and few vegetation remnants likely to be able to support this species are present in the local area. Consequently this local population may be largely reliant on the habitats of the Proposed Modification Area. There is some vegetated connectivity available to this species along Bowmans Creek, however this is via a narrow strip of riparian vegetation. This species is regularly recorded from Mt Owen and associated Ravensworth State Forest. There is the potential that there is some interaction between the individuals from both sites, given the limited connectivity afforded by Bowmans Creek.

Given the loss of habitat from the Proposed Modification Area, limited dispersal ability and sedentary nature of this species, the Project has the potential to have an adverse effect on the life cycle of the species such that a viable local population may be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an endangered ecological community.

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

Not applicable – this species does not constitute an endangered ecological community.

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

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

This species is likely to make use of the 123 hectares of woodland/forest vegetation within the Proposed Modification Area.

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

The Project will remove 123 hectares of known habitat for this species occurring within the Proposed Modification Area. This is in the form of currently highly fragmented vegetation, with limited connectivity to other vegetation outside of the Proposed Modification Area, except along the narrow riparian corridor of Bowmans Creek. The Project will result in increased fragmentation and isolation for this species in the local area.

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

The woodland and forest habitat to be removed as a result of the Project comprises the largest remnant within LCO that is likely to be providing the majority of habitat for this species. This vegetation is currently fragmented and isolated from other substantial remnants outside of the Proposed Modification Area, except to the north via the narrow riparian vegetation strip along Bowmans Creek. The habitat to be removed is likely to be important to the long-term survival of this species in the local area.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

It is likely that the records of this species from the Proposed Modification Area comprise part of a local viable population. The habitats of the Proposed Modification Area are currently fragmented and isolated, with only limited connectivity via the narrow riparian vegetation strip along Bowmans Creek. As a result of the loss of this isolated habitat from the Proposed Modification Area, and the sedentary nature and limited dispersal ability of this species, there is the potential that the Project will result in a significant impact on the brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*).

Speckled warbler (*Chthonicola sagittata*) – Vulnerable TSC Act

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

The speckled warbler has been recorded throughout the east and west of the Proposed Modification Area. This is a relatively sedentary species, it is likely that the 123 hectares of woodland and forest vegetation of the Proposed Modification Area supports a viable local population of this species. There are 28 NSW Atlas of Wildlife records of this species within 20 kilometres of the centre of the Proposed Modification Area.

There is some vegetated connectivity available to this species along Bowmans Creek, however this is via a narrow strip of riparian vegetation. This species is regularly recorded from Mt Owen and associated Ravensworth State Forest. There is the potential that there is some interaction between the individuals from both sites, given the limited connectivity afforded by Bowmans Creek.

Given the loss of habitat from the Proposed Modification Area, limited dispersal ability and sedentary nature of this species, the Project has the potential to have an adverse effect on the life cycle of the species such that a viable local population may be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

This species is likely to make use of the 123 hectares of woodland/forest vegetation within the Proposed Modification Area.

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

The Project will remove 123 hectares of known habitat for this species occurring within the Proposed Modification Area. This is in the form of currently highly fragmented vegetation, with limited connectivity to other vegetation outside of the Proposed Modification Area, except along the narrow riparian corridor of Bowmans Creek. The Project will result in increased fragmentation and isolation for this species in the local area.

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

The woodland and forest habitat to be removed as a result of the Project comprises the largest remnant within LCO that is likely to be providing the majority of habitat for this species. This vegetation is currently fragmented and isolated from other substantial remnants outside of the Proposed Modification Area, except to the north via the narrow riparian vegetation strip along Bowmans Creek. The habitat to be removed is likely to be important to the long-term survival of this species in the local area.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

It is likely that the records of this species from the Proposed Modification Area comprise part of a local viable population. The habitats of the Proposed Modification Area are currently fragmented and isolated, with only limited connectivity via the narrow riparian vegetation strip along Bowmans Creek. As a result of the loss of this isolated habitat from the Proposed Modification Area, and the sedentary nature and limited dispersal ability of this species, there is the potential that the Project will result in a significant impact on the speckled warbler (*Chthonicola sagittata*). .

Regent honeyeater (*Anthochaera phrygia*) – Critically Endangered TSC Act

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

This species has not been recorded within the Proposed Modification Area or within the broader LCO. It has also not been recorded within the local area, despite many years of monitoring work. Despite the lack of records, this species has potential to utilise the areas of flowering eucalypt forest and woodland (56 hectares) as foraging habitat (albeit of a marginal quality). There is abundant better quality habitat for this species in areas surrounding the Proposed Modification Area, particularly that within conservation reserves.

The Proposed Modification Area provides small amounts of marginal potential winter foraging habitat for this species. It is unlikely that the Proposed Modification Area provides potential breeding habitat for this species, however it has been recorded breeding within the lower Hunter Valley at Kurri Kurri and Quorrobolong. The Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends in any substantial way upon the Proposed Modification Area as winter foraging habitat, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an endangered ecological community.

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

Not applicable – this species does not constitute an endangered ecological community.

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

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

A total of 56 hectares of potential foraging habitat for this species will be removed from the Proposed Modification Area as a result of the Project. It is unlikely that (if this species were to use the habitats of the Proposed Modification Area), it would depend exclusively on the Proposed Modification Area for foraging; and the highly disturbed habitats of the Proposed Modification Area are expected to comprise marginal foraging habitat only.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

The Proposed Modification Area contains potential foraging habitat due to the presence of several species of winter flowering eucalypts. Because of the disturbed nature of the Proposed Modification Area, this is considered to be marginal foraging habitat. This is not expected to affect the long-term survival of the species as substantial foraging habitat for this species occurs in the surrounding area including surrounding farmland, the Barrington Tops, Wollemi and Yengo National Parks where high quality potential foraging and breeding habitat occurs.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

The Regent Honeyeater Recovery Plan 1993 – 2003 (Menkhorst, Schedvin and Geering 1999) is pertinent to this species; however as this species is not known from the local area, the Project does not contravene this recovery plan.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project is unlikely to result in a significant impact on the regent honeyeater (*Anthochaera phrygia*).

Black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*) – Vulnerable TSC Act

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

This species has not been recorded within the Proposed Modification Area or within the broader LCO, however the Proposed Modification Area provides potential habitat for this species. There are four NSW Wildlife Atlas records of this species within 20 kilometres of the centre of the Proposed Modification Area, consequently the potential for this species to occur in the Proposed Modification Area is considered low. If this species were to be identified it would likely be as a rare visitor.

The Project is not likely to have an adverse effect on the life cycle of this potential species such that a viable local population would be placed at risk of extinction because it is not likely that the species would depend exclusively upon the Proposed Modification Area for breeding or foraging, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 56 hectares of potential foraging and breeding habitat for this species however the highly disturbed habitats of the Proposed Modification Area are expected to comprise marginal habitat only.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

As this species has not been recorded in the Proposed Modification Area and the Proposed Modification Area contains only marginal habitat for this species due to the highly disturbed nature of the habitats. The removal of potential habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project is unlikely to result in a significant impact on the black-chinned honeyeater (eastern subspecies) (*Melithreptus gularis gularis*).

Hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*) – Vulnerable TSC Act

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

The hooded robin has not been recorded within the Proposed Modification Area, however it has been recorded directly adjacent to the habitats occurring in the north-east part of the Proposed Modification Area. Given this is a sedentary species; it is likely that the 123 hectares of woodland and forest vegetation of the Proposed Modification Area supports a viable local population of this species. This species is likely to also make some use of grassland habitats within the Proposed Modification Area, primarily those in the grassland/woodland ecotone. There are few records of this species known to occur within the immediate surrounds of the Proposed Modification Area, and few vegetation remnants likely to be able to support this species are present in the local area. Consequently this local population may be largely reliant on the habitats of the Proposed Modification Area. There is some vegetated connectivity available to this species along Bowmans Creek, however this is via a narrow strip of riparian vegetation. This species is regularly recorded from Mt Owen and associated Ravensworth State Forest. There is the potential that there is some interaction between the individuals from both sites, given the limited connectivity afforded by Bowmans Creek.

Given the loss of habitat from the Proposed Modification Area, limited dispersal ability and sedentary nature of this species, the Project has the potential to have an adverse effect on the life cycle of the species such that a viable local population may be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

This species is likely to make use of the 123 hectares of woodland/forest vegetation within the Proposed Modification Area that would be removed, as well as some ecotonal grassland areas close to vegetated cover.

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

The Project will remove 123 hectares of likely habitat for this species occurring within the Proposed Modification Area. This is in the form of currently highly fragmented vegetation, with limited connectivity to other vegetation outside of the Proposed Modification Area, except along the narrow riparian corridor of Bowmans Creek. The Project is likely to result in some increased fragmentation and isolation for this species in the local area.

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

The woodland and forest habitat to be removed as a result of the Project comprises the largest remnant within LCO that is likely to be providing the majority of habitat for this species. This vegetation is currently fragmented and isolated from other substantial remnants outside of the Proposed Modification Area, except to the north via the narrow riparian vegetation strip along Bowmans Creek. The habitat to be removed is likely to be important to the long-term survival of this species in the local area.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

It is likely that the Proposed Modification Area is providing the majority of habitat for a local viable population of this species. The habitats of the Proposed Modification Area are currently fragmented and isolated, with only limited connectivity via the narrow riparian vegetation strip along Bowmans Creek. As a result of the loss of this isolated habitat from the Proposed Modification Area, and the sedentary nature and limited dispersal ability of this species, there is the potential that the Project will result in a significant impact on the hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*).

Scarlet robin (*Petroica boodang*) – Vulnerable TSC Act

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

Although the scarlet robin was not recorded within the Proposed Modification Area, it is considered to have potential to occur. The Proposed Modification Area provides potential (albeit marginal quality) foraging and breeding habitat for this species.

Given that the species has not been recorded within the marginal habitats of the Proposed Modification Area, the Project is not considered likely to have an adverse effect on the life cycle of this species or place it at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 123 hectares of potential marginal quality foraging habitat for this species, which will be removed as part of the Project.

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

As this species has not been recorded in the Proposed Modification Area and is considered to have a low potential to occur, it is not considered that habitat fragmentation or isolation as a result of the Project will have an adverse impact on this species.

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

This species has not been recorded in the Proposed Modification Area. The habitats provided by the Proposed Modification Area are considered to contain marginal habitat for this species due to the highly disturbed nature. The habitat that will be removed from the Proposed Modification Area is not considered to be important to this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project is unlikely to have a significant impact on the scarlet robin (*Petroica boodang*).

Flame robin (*Petroica phoenicea*) – Vulnerable TSC Act

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

The flame robin has not been recorded within the Proposed Modification Area and is considered to have a low potential to occur given that there are only three known records of this species within a 20 kilometre radius of the Proposed Modification Area (Bionet 2013). The Proposed Modification Area provides potential (albeit marginal quality) foraging and breeding habitat for this species.

Given that the species has not been recorded within the marginal habitats of the Proposed Modification Area, the Project is not considered likely to have an adverse effect on the life cycle of this species or place it at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Project will remove approximately 123 hectares of potential marginal quality foraging habitat for this species.

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

It is not considered that habitat fragmentation or isolation as a result of the Project will have an adverse impact on this species.

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

This species has not been recorded and is considered to have a low potential to occur in the Proposed Modification Area. The Proposed Modification Area contains marginal habitat for this species due to the highly disturbed nature of the habitats. For these reasons, the removal of potential habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project is unlikely to have a significant impact on the flame robin (*Petroica phoenicea*).

Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) – Vulnerable TSC Act

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

The grey-crowned babbler has been recorded within the Proposed Modification Area on a number of occasions. This is a sedentary species which defends home ranges throughout the year and does not show migratory behaviour. Given this, it is likely that the 123 hectares of woodland and forest vegetation of the Proposed Modification Area supports a local viable population of this species. There are few vegetation remnants likely to be able to support this species in the local area. Consequently this local population may be largely reliant on the habitats of the Proposed Modification Area. There is some vegetated connectivity available to this species along Bowmans Creek, however this is via a narrow strip of riparian vegetation. This species is regularly recorded from Mt Owen and associated Ravensworth State Forest. There is the potential that there is some interaction between the individuals from both sites, given the limited connectivity afforded by Bowmans Creek.

Given the loss of habitat from the Proposed Modification Area, limited dispersal ability and sedentary nature of this species, the Project has the potential to have an adverse effect on the life cycle of the species such that a viable local population may be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

This species is likely to make use of the 123 hectares of woodland/forest vegetation within the Proposed Modification Area.

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

The Project will remove 123 hectares of known habitat for this species occurring within the Proposed Modification Area. This is in the form of currently highly fragmented vegetation, with limited connectivity to other vegetation outside of the Proposed Modification Area, except along the narrow riparian corridor of Bowmans Creek. The Project will result in increased fragmentation and isolation for this species in the local area.

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

The woodland and forest habitat to be removed as a result of the Project comprises the largest remnant within LCO that is likely to be providing the majority of habitat for this species. This vegetation is currently fragmented and isolated from other substantial remnants outside of the Proposed Modification Area, except to the north via the narrow riparian vegetation strip along Bowmans Creek. The habitat to be removed is likely to be important to the long-term survival of this species in the local area.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

It is likely that the records of this species from the Proposed Modification Area comprise part of a local viable population. The habitats of the Proposed Modification Area are currently fragmented and isolated, with only limited connectivity via the narrow riparian vegetation strip along Bowmans Creek. As a result of the loss of this isolated habitat from the Proposed Modification Area, and the sedentary nature and limited dispersal ability of this species, there is the potential that the Project will result in a significant impact on the grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*).

Varied sittella (*Daphoenositta chrysoptera*) – Vulnerable TSC Act

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

The varied sittella has not been recorded within the Proposed Modification Area, however it is considered to have potential to occur. The Proposed Modification Area provides potential (albeit marginal quality) foraging and breeding habitat for this species and it is considered likely to be a regular visitor to the Proposed Modification Area.

The Project is not considered likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends exclusively upon the Proposed Modification Area as foraging and breeding habitat, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 123 hectares of potential foraging habitat for this species, which will be removed as part of the Project.

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

It is not considered that habitat fragmentation or isolation as a result of the Project will have an adverse impact on this species.

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

This species has not been recorded within the Proposed Modification Area, however has the potential to occur. The Proposed Modification Area contains marginal habitat for this species due to the highly disturbed nature of the habitats. For these reasons, the removal of potential habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project is unlikely to result in a significant impact on the varied sittella (*Daphoenositta chrysoptera*).

Diamond firetail (*Stagonopleura guttata*) – Vulnerable TSC Act

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

Although the diamond firetail was not recorded within the Proposed Modification Area, it is considered to have potential to occur. The Proposed Modification Area provides potential (albeit marginal quality) foraging and breeding habitat for this species.

The Project is not considered likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends exclusively upon the Proposed Modification Area as foraging and breeding habitat, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 123 hectares of potential foraging habitat for this species, which will be removed as part of the Project.

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

It is not considered that habitat fragmentation or isolation as a result of the Project will have an adverse impact on this species.

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

This species has not been recorded and is considered to have low potential to occur in the Proposed Modification Area. The Proposed Modification Area contains marginal habitat for this species due to the highly disturbed nature of the habitats. For these reasons, the removal of potential habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. There are no threat abatement plans pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project is unlikely to have a significant impact on the diamond firetail (*Stagonopleura guttata*).

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

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

There are a number of records of this species in the general locality (covering the Middle Foy Brook area), including records from the LCO holdings and regular records nearby Mount Owen. At Mount Owen, this species has been recorded annually between 1994 and 2013 (except 1998, 1999 and 2005) in Ravensworth State Forest and surrounding woodland and forest communities, including mine rehabilitation. There have also been a number of unconfirmed sightings of the species within the Mt Owen active mine area. Additional records come from along Bowmans Creek during ecological monitoring at Liddell (Umwelt 2008) and in the Ravensworth Operations Hillcrest Offset Area (Umwelt 2010b) (at least three recorded latrine sites). Records in the locality are generally concentrated on Bowmans Creek and Ravensworth State Forest, however also extend into the more disturbed areas (from operational mining, power stations or cleared agricultural areas) surrounding these core habitats.

Surveys undertaken by ELA during 2012 (within the LCO Holdings, including the Proposed Modification Area) identified the presence of one female spotted-tailed quoll and two joeys at a den site located near to Bowmans Creek. A larger individual (believed to be a male) was sighted near to this area by ELA also. Umwelt additionally recorded a latrine site, positive identifications of quolls via remote camera, tracks and several scats along the length of Bowmans Creek and its surroundings occurring within the LCO holdings.

A variety of survey methods have resulted in positive identification of this species in the general locality, including hair tube sampling, spotlighting, remote camera surveys, latrine searches, cage trapping and predator scat searches. Additionally, recent radio-tracking undertaken by Thiess in Mt Owen has shown a resident male occurring in Ravensworth State Forest and mine rehabilitation to the north and east of North Pit (Peter York pers. comm.). Other non-tagged individuals have also been recorded during remote camera surveys (Peter York pers. comm.).

All of the natural and derived vegetation communities in the local area provide potential foraging habitat for the spotted-tailed quoll. These include derived native grassland, woodland, forest, riparian, rainforest and rehabilitated vegetation. Thus the various habitats of the LCO holdings are likely to form part of the home range of the breeding female identified within the LCO holdings, and also likely an overlapping (although generally larger) male home range. The Proposed Modification Area itself does not contain known den or breeding sites for the spotted-tailed quoll, however the known breeding den is located approximately 1.75 kilometres north of the Proposed Modification Area.

There is potential that the Project will significantly impact upon this viable local population.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential foraging habitat for this species, comprising eucalypt forests, woodlands and treeless areas; which will be removed as part of the Project. Of this, 123 hectares is considered to be of a moderate quality in the form of woodland and forest, and the remaining 65 hectares is considered to form low quality habitat in the form of grasslands.

It is notable that there have not been any records of this species within the Proposed Modification Area, however the proximity of this area to numerous known records of the species indicates a high likelihood that the habitats within the Proposed Modification Area are used by this species, particularly the breeding female.

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

It is unlikely that the Project will fragment the existing population of this species. The majority of impact from the Project will occur to the south and west of the den and Bowmans Creek, and this Creek appears to be a key interchange area between the Liddell and Mt Owen habitats and records of this species. The majority of records of this species from the local area focus on the habitats running north/south along Bowmans Creek, and those running east/west from Ravensworth State Forest to the Hillcrest Offset Area. The Project will not impact on this connectivity, therefore it is not likely to fragment the local population into two or more populations. It will also not fragment the broader local population into two or more populations.

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

This species has very broad habitat requirements, and it is known to make use of woodland, forest, riparian, grassland, rainforest and rehabilitated landscapes in the local area, including mined land that has been rehabilitated at nearby Mount Owen. The Project will impact habitat used by a local population of this species, however not to the extent that it will adversely affect habitat critical to the survival of this species (as a whole).

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

The 'Recovery plan for *Dasyurus maculatus* (Spotted-tailed Quoll) 2005 – 2009' (Long and Nelson 2004) is relevant to this species. The Project contravenes with the following objective of the recovery plan: 'Reduce the rate of loss and fragmentation of Spotted-tailed Quoll habitat'. The Project will contribute to both the loss of spotted-tailed quoll (*Dasyurus maculatus maculatus*) habitat and slightly increase the level of fragmentation of habitat for this species. The Project contributes to the loss and fragmentation of spotted-tailed quoll habitat.

The 'Threat abatement plan for predation by the European red fox' (DEWHA 2008) is pertinent to this threatened species. The Project does not contravene any of the objectives or actions of this plan.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Bushrock removal (TSC Act);
- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project could potentially significantly impact on a local breeding (viable) population of the spotted-tailed (*Dasyurus maculatus maculatus*). While the Project will not directly impact the known breeding den within the LCO holdings, the loss of foraging habitat, from the Proposed Modification Area, for this breeding female is considered to have the potential to threaten future breeding success of this species in the immediate area.

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

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

The squirrel glider has not been recorded in the Proposed Modification Area and is considered to have a low potential to occur. The Proposed Modification Area provides potential (albeit marginal) habitat for the squirrel glider in areas of mature Central Hunter Box – Ironbark woodland.

If present, the squirrel glider would likely occur at a low density due to a low abundance of tree hollows and the fragmentation of woodland remnants within the Proposed Modification Area. Additionally due to the fragmentation of the woodland habitat within the Proposed Modification Area and the low density of potential tree hollows it is unlikely that a viable population would be present within the Proposed Modification Area. It is unlikely that the Project would result in an adverse effect on the life cycle of the species such that a viable local population of the species would be likely to be place at risk of extinction.

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

The Proposed Modification Area does not support an endangered population of this species.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

A total of 56 hectares of potential woodland habitat for this species would be removed as part of the Project.

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

The removal of 56 hectares of potential woodland habitat from the Proposed Modification Area will result in some minor fragmentation of some woodland and forest remnants.

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

The squirrel glider has not been recorded within the Proposed Modification Area. Potential habitat occurs in isolated remnants throughout the Proposed Modification Area. If present, the squirrel glider is likely present at low density (due to a low abundance of tree hollows and the fragmentation of woodland remnants) and the habitat areas present are likely of minimal value to the long-term survival of the population in the locality.

As a result of the above factors the habitat to be removed, modified, fragmented or isolated in considered of low importance to the long-term survival of the species or population in the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to result in a significant impact on the squirrel glider (*Petaurus norfolcensis*).

Grey-headed flying-fox (*Pteropus poliocephalus*) – Vulnerable TSC Act

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

This species has not been recorded in the Proposed Modification Area and the nearest known roosting camp is located approximately 20 kilometres to the south-east in Burdekin Park, Singleton. Although the grey-headed flying-fox was not recorded within the Proposed Modification Area, it is has the potential to occur as the Proposed Modification Area provides potential (albeit marginal quality) foraging habitat for this species.

Given that the species was not recorded utilising the habitats of the Proposed Modification Area, the Project is not considered likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends exclusively upon the Proposed Modification Area as foraging or breeding habitat, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 56 hectares of potential foraging habitat for this species, which will be removed as part of the Project.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

The Proposed Modification Area is not known to support a colony or any individual records of this species. Therefore, the removal of potential foraging habitat for this species from the Proposed Modification Area is unlikely to be important to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

The 'Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*' (DECCW 2009) is relevant to this species. Although the Project contravenes the objective of 'habitat loss', the habitat present is potential only and is consequently unlikely to be important to the recovery of this species.

No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project is unlikely to have a significant impact on the grey-headed flying-fox (*Pteropus poliocephalus*).

Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) – Vulnerable TSC Act

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

Although this species was not recorded, the Proposed Modification Area provides potential foraging habitat for this species. The Proposed Modification Area is considered to provide potential foraging habitat for this species in dry sclerophyll forest and woodland and grassland habitat.

The Proposed Modification Area is likely to provide minimal potential breeding habitat for the species given that it requires hollows for breeding and the Proposed Modification Area contains minimal vegetation that would have the capacity to support hollows. This species is likely to be an occasional visitor to the Proposed Modification Area that is only using the habitats of the Proposed Modification Area as part of a larger foraging range.

The Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends exclusively upon the Proposed Modification Area for breeding or foraging, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential foraging habitat for this species, comprising forest, woodland and grassland areas.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

This species has not been recorded and is considered to have a low potential to occur in the Proposed Modification Area (which does not generally contain hollow-bearing trees with potential hollows on which this species is dependent upon for roosting sites). Therefore, the removal of potential habitat for this species from the Proposed Modification Area is unlikely to adversely impact the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is considered unlikely to have a significant impact on the yellow-bellied sheathtail bat (*Saccolaimus flaviventris*).

Eastern freetail-bat (*Mormopterus norfolkensis*) – Vulnerable TSC Act

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

The Proposed Modification Area provides known habitat for this species in terms of foraging habitat and potential breeding habitat. This species requires tree hollows for breeding and roosting, although this is a limited resource within the regenerating vegetation of the Proposed Modification Area, recorded in only low densities. The general dearth of such hollows within the Proposed Modification Area, suggests that dependence on this habitat for breeding is unlikely. The Project is unlikely to have an adverse effect on the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential habitat for this species, comprising forest, woodland and grassland areas which will be removed as part of the Project.

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

This species is known to occur in the Proposed Modification Area and in the broader local area. The eastern freetail-bat is highly mobile, however increased fragmentation as a result of the Project will increase distances this species will have to travel between potential areas of foraging and breeding habitat.

The Project would be unlikely to introduce barriers for this species such that it would prevent the movement of individuals between proximate areas of habitat.

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

The habitat to be removed from the Proposed Modification Area provides known foraging habitat, however limited amounts of potential breeding/roosting habitat for this species. It is likely that these habitats are part of wider foraging ranges that extends outside of the Proposed Modification Area. The habitat present within the Proposed Modification Area is unlikely to be important to the long-term survival of this highly mobile species in the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the eastern freetail-bat (*Mormopterus norfolkensis*).

Little bentwing-bat (*Miniopterus australis*) – Vulnerable TSC Act

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

This species has not been recorded within the Proposed Modification Area or the broader LCO. There are only two records of its occurrence within 20 kilometres of the Proposed Modification Area (Bionet 2013). Although it has not been recorded, the Proposed Modification Area provides potential foraging habitat for this species in dry sclerophyll forest. Given the general paucity of records, it is considered that if this species were to occur that it would likely be an irregular visitor, utilising the habitats as part of a much larger foraging range.

This species requires caves, tunnels or road culverts for roosting, which are generally absent from the Proposed Modification Area. The Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends exclusively upon the Proposed Modification Area for breeding or foraging, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential foraging habitat for this species, comprising forest and woodland areas, which will be removed as part of the Project.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

This species has not been recorded in the Proposed Modification Area, and the Proposed Modification Area does not have caves, tunnels or road culverts which this species is dependent upon for roosting sites. Therefore, the removal of potential habitat for this species from the Proposed Modification Area is unlikely to be important for the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project is unlikely to have a significant impact on the little bentwing-bat (*Miniopterus australis*).

Eastern Long-eared Bat (*Nyctophilus timoriensis*) – Vulnerable TSC Act

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

This species has not been recorded within the Proposed Modification Area or within the broader LCO. Although it has not been recorded, the Proposed Modification Area is considered to provide potential foraging and limited roosting habitat for the eastern long-eared bat. This species requires tree hollows for roosting, which are limited within the Proposed Modification Area; however are present in small numbers.

The Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends exclusively upon the Proposed Modification Area for breeding or foraging, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential habitat for this species, comprising forest and woodland areas, which will be removed as part of the Project.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

As this species has not been recorded in the Proposed Modification Area and is considered to have a low potential to occur, it is not considered that the habitat being removed from the Proposed Modification Area is important to the long-term survival of the species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the eastern long-eared bat (*Nyctophilus timoriensis*).

Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) – Vulnerable TSC Act

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

The Proposed Modification Area and the broader LCO provide known habitat for this species and it is considered likely that it utilises the habitats provided as part of a wider foraging range. This species requires caves, tunnels or road culverts for breeding and roosting, which are absent from the Proposed Modification Area.

The Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species depends exclusively upon the Proposed Modification Area for breeding or foraging, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential foraging habitat for this species, comprising forest and woodland areas.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

Although this species has been recorded, the Proposed Modification Area does not contain caves, tunnels or road culverts which this species is dependent upon for roosting sites and consequently is only considered to provide foraging habitat for this species. It is likely that this species is using the habitats of the Proposed Modification Area as part of a wider foraging range. Therefore, the habitat that will be impacted by the Project is considered unlikely to be important to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

The Project would be unlikely to have a significant impact on the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Large-eared pied bat (*Chalinolobus dwyeri*) – Vulnerable TSC Act

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

Although it has not been recorded in the Proposed Modification Area or the wider LCO, it is considered that there is potential habitat for the large-eared pied bat (*Chalinolobus dwyeri*). This species requires caves, tunnels or road culverts for roosting, which are absent from the Proposed Modification Area, consequently it is likely that any potentially occurring individuals would only be utilising the available habitats as part of a much wider forging range.

The Project is not likely to have an adverse effect on the life cycle of this species or place it at risk of extinction because it is not likely that the species would depend exclusively upon the Proposed Modification Area for breeding or foraging, given potential habitat exists elsewhere in the locality.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential foraging habitat for this species, comprising forest and woodland areas, which will be removed as part of the Project.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

The Proposed Modification Area does not have caves, tunnels or road culverts which this species is dependent upon for roosting sites. Therefore, the removal of potential foraging habitat for this species from the Proposed Modification Area (which would likely only be utilised as part of a wider foraging range) is unlikely to be important to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

It is not likely that the Project would have a significant impact on the large-eared pied-bat (*Chalinolobus dwyeri*).

Eastern false pipistrelle (*Falsistrellus tasmaniensis*) – Vulnerable TSC Act

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

The eastern false pipistrelle has been recorded throughout the Proposed Modification Area, as well as in the wider LCO during annual monitoring events. This species requires tree hollows for breeding and roosting, although this is a limited resource within the regenerating vegetation of the Proposed Modification Area, recorded in only low densities. The general dearth of such hollows within the Proposed Modification Area, suggests that dependence on this habitat for breeding is unlikely. The Project is unlikely to have an adverse effect on the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential habitat for this species, comprising forest, woodland and grassland areas which will be removed as part of the Project.

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

This species is known to occur in the Proposed Modification Area and in the broader LCO. The eastern false pipistrelle is highly mobile, however increased fragmentation as a result of the Project will increase distances this species will have to travel between potential areas of foraging and breeding habitat.

The Project would be unlikely to introduce barriers for this species such that it would prevent the movement of individuals between proximate areas of habitat.

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

The habitat to be removed from the Proposed Modification Area provides known foraging habitat, however limited amounts of potential breeding/roosting habitat for this species. It is likely that these habitats are part of wider foraging ranges that extends outside of the Proposed Modification Area. The habitat present within the Proposed Modification Area is unlikely to be important to the long-term survival of this highly mobile species in the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the eastern false pipistrelle (*Falsistrellus tasmaniensis*).

Southern myotis (*Myotis macropus*) – Vulnerable TSC Act

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

The southern myotis has been recorded in the Proposed Modification Area, and in the wider LCO. This species uses tree hollows for breeding and roosting, as well as structures such as culverts and bridges. Tree hollows are a limited resource within the regenerating vegetation of the Proposed Modification Area, recorded in only low densities. There are no potential structures within the Proposed Modification Area that would provide potential breeding/roosting habitat for this species. The general dearth of breeding and roosting habitat within the Proposed Modification Area, suggests that dependence on this habitat for breeding is unlikely. The Project is unlikely to have an adverse effect on the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential habitat for this species, comprising forest, woodland and grassland areas which will be removed as part of the Project.

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

This species is known to occur in the Proposed Modification Area and in the broader LCO. The southern myotis is highly mobile, however increased fragmentation as a result of the Project will increase distances this species will have to travel between potential areas of foraging and breeding habitat.

The Project would be unlikely to introduce barriers for this species such that it would prevent the movement of individuals between proximate areas of habitat.

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

The habitat to be removed from the Proposed Modification Area provides known foraging habitat, however limited amounts of potential breeding/roosting habitat for this species. It is likely that these habitats are part of wider foraging ranges that extends outside of the Proposed Modification Area. The habitat present within the Proposed Modification Area is unlikely to be important to the long-term survival of this highly mobile species in the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the southern myotis (*Myotis macropus*).

Greater broad-nosed bat (*Scoteanax rueppellii*) – Vulnerable TSC Act

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

The greater broad-nosed bat is known to occur throughout the habitats of the Proposed Modification Area. This species requires tree hollows for breeding and roosting, and this is a limited resource within the regenerating vegetation of the Proposed Modification Area, recorded in only low densities. The general dearth of such hollows within the Proposed Modification Area, suggests that dependence on this habitat for breeding is unlikely. The Project is unlikely to have an adverse effect on the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 188 hectares of potential habitat for this species, comprising forest, woodland and grassland areas which will be removed as part of the Project.

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

This species is known to occur in the Proposed Modification Area and in the broader LCO. The greater broad-nosed bat is highly mobile, however increased fragmentation as a result of the Project will increase distances this species will have to travel between potential areas of foraging and breeding habitat.

The Project would be unlikely to introduce barriers for this species such that it would prevent the movement of individuals between proximate areas of habitat.

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

The habitat to be removed from the Proposed Modification Area provides known foraging habitat, however limited amounts of potential breeding/roosting habitat for this species. It is likely that these habitats are part of wider foraging ranges that extends outside of the Proposed Modification Area. The habitat present within the Proposed Modification Area is unlikely to be important to the long-term survival of this highly mobile species in the locality.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act);
- Human-caused climate change (TSC and FM Acts);
- Loss of hollow-bearing trees (TSC Act); and
- Removal of dead wood and dead trees (TSC Act).

Conclusion

The Project is unlikely to have a significant impact on the greater broad-nosed bat (*Scoteanax rueppellii*).

Eastern cave bat (*Vespadelus troughtoni*) – Vulnerable TSC Act

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

The eastern cave bat has been recorded within the Proposed Modification Area however would not be breeding or roosting there, due to its requirement for caves (which are absent from the Proposed Modification Area). It is considered likely that this species is a regular visitor to the site and is only likely to be using the available habitats as part of a wider foraging range.

Given that this species is unlikely to be utilising the available habitats for anything other than foraging as part of a wider foraging area, it is not considered likely that the Project would be likely to have an adverse effect on the life cycle of the species such that a viable local population would be placed at risk of extinction.

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

Not applicable – this species does not constitute an endangered population.

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

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

Not applicable – this species does not constitute an ecological community.

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

Not applicable – this species does not constitute an ecological community.

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

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

The Proposed Modification Area provides approximately 123 hectares of potential foraging habitat for this species.

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

As some potential habitat will be removed, the level of fragmentation and isolation will increase for this species. However, given the extensive area of potential habitat in the surrounding area and the high mobility of this species, the level of fragmentation and isolation increase is unlikely to adversely impact this species.

The Project will not introduce barriers for this highly mobile species such that it will prevent movement of individuals between proximate areas of habitat. Consequently, an area of known habitat will not be fragmented or isolated from currently interconnecting or proximate areas as a result of the Project.

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

The Proposed Modification Area does not contain caves or tunnels which this species is dependent upon for roosting and breeding sites. Therefore, the removal of 188 hectares of marginal quality foraging habitat for this species from the Proposed Modification Area is unlikely to be important to the long-term survival of this species.

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

The Proposed Modification Area is not located in proximity to any areas of declared or recommended critical habitat. The Project is not likely to have an adverse effect on any critical habitat.

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

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

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

The action proposed will contribute to the operation of the following key threatening processes relevant to the species:

- Clearing of native vegetation (TSC Act); and
- Human-caused climate change (TSC and FM Acts).

Conclusion

It is unlikely that the Project will result on a significant impact to the eastern cave bat (*Vespadelus troughtoni*).

APPENDIX 5

EPBC Act Assessment of Significance

Appendix 5 – *Environment Protection and Biodiversity Conservation Act 1999* Assessment of Significance

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the completion of an Assessment of Significance relating to the potential impacts of a Project on listed matters of National Environmental Significance (NES). A search of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Protected Matters Database (undertaken on 5 February 2013) identified threatened and migratory species (EPBC Act listed) known to occur or considered likely to occur, on the basis of habitat modelling, within 10 kilometres of the centre of the Proposed Modification Area. No EPBC Act listed threatened ecological communities (TECs) are known or have potential to occur within the Proposed Modification Area.

Table 1 presents the threatened and migratory species considered in the following assessment.

Table 1 – Threatened and Migratory Species Considered in the Following Assessment

Common Name	Scientific Name
Endangered Species	
Australian painted snipe	*Rostratula benghalensis australis*
Regent honeyeater	*Anthochaera phrygia*
Swift parrot	*Lathamus discolor*
Spotted-tailed quoll (SE mainland population)	*Dasyurus maculatus maculatus*
Vulnerable Species	
Green and golden bell frog	*Litoria aurea*
Grey-headed flying-fox	*Pteropus poliocephalus*
Large-eared pied bat	*Chalinolobus dwyeri*
Eastern long-eared bat	*Nyctophilus timoriensis*
New Holland mouse	*Pseudomys novaehollandiae*
Lobed blue-grass	*Bothriochloa biloba*
-	*Ozothamnus tesselatus*
Migratory Species	
Regent honeyeater	*Anthochaera phrygia*
Australian painted snipe	*Rostratula benghalensis australis*
Rainbow bee-eater	*Merops ornatus*
White-bellied sea eagle	*Haliaeetus leucogaster*
Great egret	*Ardea alba*
Cattle egret	*Ardea ibis*
Fork tailed swift	*Apus pacificus*
White-throated needletail	*Hirundapus caudacutus*
Satin flycatcher	*Myiagra cyanoleuca*
Clamorous reed warbler	*Acrocephalus stentoreus*

An Assessment of Significance (according to the significant impact criteria for each matter of NES) is provided below for those matters of NES identified within the Proposed Modification Area, or considered to be potentially impacted by the Project (as assessed within Appendix 3).

Endangered Species

The following EPBC Act listed endangered species are considered in this assessment:

- Australian painted snipe (*Rostratula benghalensis australis*);
- Regent honeyeater (*Anthochaera phrygia*);
- Swift parrot (*Lathamus discolor*); and
- Spotted-tailed quoll (SE mainland population) (*Dasyurus maculatus maculatus*).

An assessment in accordance with the DSEWPC significant impact criteria is provided below for these species.

Australian Painted Snipe (*Rostratula benghalensis australis*)

Three individuals of this species were recorded from two locations along Bowmans Creek as part of the targeted field surveys completed by Umwelt in 2012. The preferred habitat of the Australian painted snipe includes fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. The species was recorded in dense ground cover within the riparian corridor of Bowmans Creek. This species has not been recorded in the Proposed Modification Area or larger LCO during annual fauna monitoring surveys or other ecological surveys, and is not expected to make use of the habitats within the Proposed Modification Area with any frequency. Potential habitat for the species within the Proposed Modification Area is considered to be highly marginal and limited to a small number of highly modified farm dams only.

In this case, a 'population of a species' is defined as an occurrence of the species in a particular area. Occurrences include but are not limited to:

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

There are few records of this species in the Hunter Valley, with most records occurring in coastal locations. This migratory species is likely to move throughout the area as part of migratory patterns and as such, if the species were to occur in the Proposed Modification Area it would likely only be in passing moving between areas of more appropriate habitat.

Habitat for the species within the Proposed Modification Area is considered to be marginal and limited to small degraded farm dams only. The habitat within nearby Bowmans Creek is highly modified and in poor condition. The species is considered unlikely to occur in the Proposed Modification Area and is likely to be using the habitats of Bowmans Creek infrequently, while moving through its range. The records of this species from the LCO are not likely to be part of a *population of the species* as these records are likely to be transitory only, and are not believed to represent an occurrence of the species in the area. This is because the species is not likely to be resident in the area, is not likely to be breeding in the area and is not likely be making use of the habitats of the area with any frequency.

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, or;**

No *population* of this species has been recorded from the Proposed Modification Area, and it is unlikely that the records from Bowmans Creek comprise a *population* of the species. The Project will not impact on the habitats of Bowmans Creek. Potential habitat for the species within the Proposed Modification Area is considered to be highly marginal and limited to a small number of highly modified farm dams only. The Project is not likely to result in a long-term decrease in the size of a *population* of this species.

- **reduce the area of occupancy of the species, or;**

No *population* of this species has been recorded from the Proposed Modification Area, and it is unlikely that the records from Bowmans Creek comprise a *population* of the species. The Project will not impact on the habitats of Bowmans Creek, and will not remove habitat from the Proposed Modification Area that is likely to support this species. The Project is not likely to reduce the area of occupancy of a *population* of this species.

- **fragment an existing population into two or more populations, or;**

No *population* of this species has been recorded from the Proposed Modification Area, and it is unlikely that the records from Bowmans Creek comprise a *population* of the species. The Project will not impact on the habitats of Bowmans Creek, and will not remove habitat from the Proposed Modification Area that is likely to support this species. The Project is not likely to fragment an existing *population* into two or more populations.

- **adversely affect habitat critical to the survival of a species, or;**

The Project will not impact on the habitats of Bowmans Creek, and will not remove habitat from the Proposed Modification Area that is likely to support this species. The habitats along Bowmans Creek are not likely to be critical to the survival of this species.

- **disrupt the breeding cycle of a population, or;**

No *population* of this species has been recorded from the Proposed Modification Area, and it is unlikely that the records from Bowmans Creek comprise a *population* of the species. The Project will not impact on the habitats of Bowmans Creek, and will not remove habitat from the Proposed Modification Area that is likely to support this species. The Project is not likely to disrupt the breeding cycle of a *population* of this species.

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The Project will not impact on the habitats of Bowmans Creek, and will not remove habitat from the Proposed Modification Area that is likely to support this species. The habitats along Bowmans Creek are not likely to be critical to the survival of this species. The Project will not 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 critically endangered or endangered species becoming established in the endangered or critically endangered species habitat, or;**

The Project will not result in invasive species that are harmful to this species becoming established in the habitats along Bowmans Creek.

- **introduce disease that may cause the species to decline; or**

It is considered unlikely that the Project will introduce any disease that may cause the decline of the Australian painted snipe.

- **interferes substantially with the recovery of the species.**

The Project will not interfere substantially with the recovery of this species.

Conclusion

The Australian painted snipe was recorded along Bowmans Creek, within the LCO. It has not, however been recorded from the Proposed Modification Area, and this area is considered to have only marginal habitat for this species. The Project will not impact on the known habitats along Bowmans Creek, and is not expected to have a significant impact on this species.

Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*)

No records of the regent honeyeater (*Anthochaera phrygia*) or swift parrot (*Lathamus discolor*) have been made from within the Proposed Modification Area, despite numerous years of ecological survey. Despite the lack of records, habitat for these species occurs within the Proposed Modification Area in terms of foraging habitat within eucalypt woodland and riparian vegetation, albeit these are not considered to be high quality habitats.

The swift parrot has been recorded on two occasions (2005 and 2007) in the vicinity of Mt Owen within Ravensworth State Forest. There have been few records of the species within the central Hunter Valley in the past few years, however recent sightings have been recorded in the winter 2012 season in the Muswellbrook and Bulga areas. This species may make use of the open woodland habitats of the Proposed Modification Area, particularly where there are prolific flowering eucalypts and this migratory species is likely to move throughout the area in response to mass flowering events. This species does not breed on mainland Australia, and as such the Proposed Modification Area only represents foraging habitat for this species. The Project will result in the removal of approximately 56 hectares (eucalypt dominated habitats) of potential habitat for the species.

The regent honeyeater has not been previously recorded within the Proposed Modification Area, LCO or nearby Mt Owen. The potential habitat for this species corresponds to that of the swift parrot and therefore the species have been assessed together. Potential habitat for the species comprises box-gum woodlands within the Proposed Modification Area and due to the significant decrease in habitat for this species (throughout its range, including within the Hunter Valley) and the importance of potential habitat conservation, the removal of approximately 56 hectares of box-gum ironbark woodland within the Proposed Modification Area may reduce potential foraging habitat for the species in the local area.

In this case, a 'population of a species' is defined as an occurrence of the species in a particular area. Occurrences include but are not limited to:

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

The swift parrot occurs as a single population, although it migrates annually from breeding grounds in Tasmania to the winter foraging grounds on the coastal plains and slope woodlands of mainland eastern Australia (Saunders 2002). Approximately 200 mature birds (10 per cent of the total estimated population) are known to over-winter in the Lower Hunter Region of New South Wales (Saunders 2002). The vegetation of the LCO is sparse and highly fragmented, however could form a minor contribution to a regional dispersal route close to important winter foraging areas in the lower Hunter Valley.

Although there appears to be minor behavioural differences between regent honeyeaters in the three main areas inhabited by the species (the Bundarra-Barraba area in NSW, the Capertee Valley in NSW, and north-eastern Victoria), the direction and extent of movements, including evidence of movement between breeding sites, and a lack of discernible genetic differences between the sites suggest that the regent honeyeater occurs as a single, contiguous population (Garnett & Crowley 2000).

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, or;**

No populations of regent honeyeater or swift parrot have been recorded within the Proposed Modification Area or larger LCO. However, the swift parrot has been recorded on two occasions within nearby Mt Owen. The habitats of the Proposed Modification Area are likely to comprise potential foraging habitat for both species and the Project will reduce this potential foraging habitat by 56 hectares of eucalypt-dominated woodland. The Proposed Modification Area is not known as a historical or important foraging site for these species, however due to the reduction in habitat integrity elsewhere in the central Hunter Valley, other areas of box-gum woodlands may become important resources for the two species. In summary, it is unlikely that the Project will lead to a decrease in the size of a population (as defined above) of the swift parrot or regent honeyeater.

- **reduce the area of occupancy of the species, or;**

No populations of regent honeyeater or swift parrot have been recorded within the Proposed Modification Area or larger LCO. However, the swift parrot has been recorded on two occasions within nearby Mt Owen. The habitats of the Proposed Modification Area are likely to comprise potential known foraging habitat for both species and the Project will reduce this potential foraging habitat by 56 hectares of eucalypt-dominated woodland.

The loss of approximately 56 hectares of potential foraging habitat (of only moderate condition) will result in a reduction of the potential area of occupancy for the regent honeyeater and swift parrot, however this is unlikely to substantially reduce the area of known occupancy.

- **fragment an existing population into two or more populations, or;**

No populations of regent honeyeater or swift parrot have been recorded within the Proposed Modification Area or larger LCO. Both species are highly dispersive and it is unlikely that the Project will create a significant change to the species' dispersal capacity or create a significant barrier the movement of the species.

It is unlikely that the Project will result in the fragmentation of an existing population into two or more populations.

- **adversely affect habitat critical to the survival of a species, or;**

The loss of approximately 56 hectares of potential foraging woodland habitat within the Proposed Modification Area is unlikely to affect habitat that is critical to the survival of either species.

- **disrupt the breeding cycle of a population, or;**

The regent honeyeater mainly breeds in three key sites from the Bundarra-Barraba area NSW, the Capertee Valley in NSW, and north-eastern Victoria. Breeding has also been recorded within the Hunter Valley, with the species recorded breeding in open forest close to Kurri Kurri in the Lower Hunter region in 2007. Nests have also been recorded at Quorrobolong, north of the Watagan range in the Lower Hunter region, in lowland forest habitat. Low-lying forests and woodlands of the Hunter Valley are important habitat for the species being used as winter foraging habitat and potential breeding sites. The regent honeyeater has not been previously recorded in the Proposed Modification Area, or larger LCO.

The regent honeyeater population is considered to be in decline based on historic declines throughout much of the species' range, a range contraction, a decline in reporting frequency and the reduced size and occurrence of flocks (Garnett *et al*. 2011).

Currently, breeding season survey data suggest that the population of the swift parrot is at best stable, with an estimated 2000 breeding birds, or 1000 pairs (Garnett & Crowley 2000). The swift parrot breeds and nests exclusively in Tasmania and migrates to mainland Australia during the non-breeding season. There is no potential for breeding habitat to occur in the Proposed Modification Area.

The Project is not expected to disrupt the breeding cycle of the regent honeyeater or the swift parrot.

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The Project will involve the removal of approximately 56 hectares of woodland that provides potential foraging habitat for these species. The central Hunter Valley supports other areas of habitat that contain box-gum woodland vegetation that would also provide potential habitat for these species; however the regent honeyeater and swift parrot have not been recorded in many of these areas. It is considered unlikely that the Project will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the regent honeyeater and swift parrot 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, or;**

The Project is not likely to result in invasive species that are harmful to the regent honeyeater or swift parrot becoming established in their habitat.

- **introduce disease that may cause the species to decline; or**

Psittacine beak and feather disease (BFD) is a common and potentially deadly disease of parrots caused by a circovirus named beak and feather disease virus. The disease appears to have originated in Australia and is widespread and continuously present in wild populations of Australian parrots. BFD affecting endangered psittacine species (parrots and related species) was listed in April 2001 as a key threatening process under the EPBC Act.

It is considered unlikely that the Project will introduce BFD or any other disease that may cause regent honeyeater or swift parrot to decline.

- **interfere with the recovery of the species.**

The Project is unlikely to interfere substantially with the recovery of the regent honeyeater or swift parrot.

Conclusion

The Project is unlikely to result in a significant impact on the populations of the regent honeyeater or swift parrot. Although the Proposed Modification Area provides potential foraging habitat for these species and the swift parrot has been recorded in nearby Mt Owen, they have not been recorded utilising the woodland habitats within the Proposed Modification Area or larger LCO, despite many years of ecological survey and monitoring.

Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)

Spotted-tailed quoll records are generally confined to within 200 kilometres of the NSW coast and range from the Queensland border to Kosciuszko National Park. The species is known to occur in the Hunter Valley. According to the Draft National Recovery Plan for the species (Long and Nelson 2008) it is likely that the total number of mature adult spotted-tailed quolls is probably greater than 2000 but fewer than 10000 individuals in Australia. Home range estimates vary considerably according to location and habitat quality, however females can occupy home ranges up to 750 hectares and males up to 3500 hectares and both sexes usually traverse their ranges along densely vegetated creek lines. Extant populations of this species are highly fragmented and declining. The geographic distribution of the species is contracting and its subpopulations are becoming increasingly fragmented. Given the threatened status of the species, all habitats within its current distribution that are known to be occupied are considered to be important (Long and Nelson 2008).

There are few recent records of this species occurring from the floor of the Hunter Valley. There are, however more frequent records of this species from the habitats of the western and southern footslopes of the Barrington Tops and associated areas to the north of the Hunter Valley floor. It is likely that the fragmented habitats of the Hunter Valley floor (as well as major road, rail and other infrastructure networks crossing it) would limit genetic exchange from the Barrington Tops area in a southerly direction, thus providing a likely genetic barrier to individuals of this species in the Wollemi/Yengo National Parks areas. The Barrington Tops and Mount Royal Range areas provide reasonable geographic features with which to bound the population to the north, although there is likely to be no firm discontinuity in

species records between the Proposed Modification Area and habitats to the north of Barrington Tops. For the purpose of this assessment, it is taken that a regional population of this species is focused on the footslopes to the south and west of the Barrington Tops and that this is likely to be genetically distinct and fragmented from those on the southern side of the Hunter Valley. This area comprises some 1800 km^2 of land, of which approximately 48 per cent is wooded, with about 52 per cent comprising agricultural lands. This includes an area centred on middle Foy Brook, to the east of the LCO DA boundary, which is regarded for the purposes of this assessment as supporting a local population of the species.

There are a number of records of this species in the general locality (covering the middle Foy Brook area, which comprises the land to the east and north-east of Lake Liddell and to the north of the New England Highway), including records from LCO and nearby at Mt Owen. At Mt Owen, this species has been recorded annually between 1994 and 2013 (except 1998, 1999 and 2005) in Ravensworth State Forest and surrounding woodland and forest communities, including mine rehabilitation and within existing Mt Owen offset areas. There have also been a number of unconfirmed sightings of the species within the Mt Owen active mine area. Additional records come from along Bowmans Creek during ecological monitoring at LCO (Umwelt 2008) and in the Ravensworth Operations Hillcrest Offset Area (Umwelt 2010) (at least three recorded latrine sites). Records in the locality are generally concentrated on Bowmans Creek and Ravensworth State Forest, however also extend into the more disturbed areas (from operational mining, power stations or cleared agricultural areas) surrounding these core habitats.

Surveys undertaken by ELA during 2012 (within the LCO, including the Proposed Modification Area) identified the presence of one female spotted-tailed quoll and two joeys at a den site located near to Bowmans Creek. A larger individual (believed to be a male) was sighted near to this area by ELA also. Umwelt additionally recorded a latrine site, positive identifications of quolls via remote camera, tracks and several scats along the length of Bowmans Creek and its surroundings occurring within the LCO DA boundary. It is noted however that these recordings were all outside the Proposed Modification Area.

A variety of survey methods have resulted in positive identification of this species in the middle Foy Brook area, including hair tube sampling, spotlighting, remote camera surveys, latrine searches, cage trapping and predator scat searches. Additionally, recent radio-tracking undertaken by Thiess in Mt Owen has shown a resident male occurring in Ravensworth State Forest and mine rehabilitation to the north and east of North Pit (Peter York pers. comm.). Other non-tagged individuals have also been recorded during remote camera surveys (Peter York pers. comm.).

All of the natural and derived vegetation communities in the local area provide potential foraging habitat for the spotted-tailed quoll. These include derived native grassland, woodland, forest, riparian, rainforest and rehabilitated vegetation. Thus the various habitats of the Proposed Modification Area are likely to form part of the home range of the breeding female identified within the LCO, and also likely an overlapping (although generally larger) male home range. The Proposed Modification Area itself does not contain known den or breeding sites for the spotted-tailed quoll, however the known breeding den is located approximately 1.75 kilometres north of the Proposed Modification Area.

In this case, a 'population of a species' is defined as an occurrence of the species in a particular area. Occurrences include but are not limited to:

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

There is very little research-based literature that allows confident definition of population size or population boundaries for the spotted-tailed quoll. Given the extent of the known records and breeding in the LCO, a local breeding population of this species is considered to be present in the middle Foy Brook area. This is likely to encompass a number of individuals, including one known female, two known juveniles, one known male and likely other adults. There are few areas within the central Hunter Valley lowlands (the main Hunter Valley) that are of sufficient size to support the large home ranges for this species, as such the presence of this local breeding population is significant in that context. This local population is likely to form part of the broader Barrington Tops footslopes regional population, which is likely to be regionally distinct from the southern populations from the Wollemi/Yengo National Parks due to barriers such as highly developed parts of the Hunter Valley floor, the New England Highway and Golden Highway. The Barrington Tops and Mount Royal Range areas provide reasonable geographic features with which to bound the population to the north, although there is likely to be no firm discontinuity in species records between the subject area and habitats to the north of Barrington Tops. This area comprises some 1800 km^2 of land, of which approximately 48 per cent is wooded, with about 52 per cent comprising agricultural lands.

Therefore, for the purposes of this impact assessment the local population will be taken to represent the middle Foy Brook area records of this species, and the regional population will relate to the broader regional Barrington Tops footslopes (southern and western footslopes) population. Unless otherwise specified in the assessment, a population will ultimately be assessed at the regional level.

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; or**

There are a number of records of this species within the LCO; however none of these occur within the Proposed Modification Area. The records in the local area suggest that the intact vegetation of Ravensworth State Forest and the riparian vegetation along Bowmans Creek could provide the most important habitat for this species in the locality. The woodland and grassland habitats associated with the Proposed Modification Area are likely to comprise potential foraging habitat for the species as part of a wider home range.

The Project will directly reduce 188 hectares of this potential foraging habitat for the local population. This habitat loss is staged however, and the resulting impact to potential habitat for this species will occur over a number of years. The impact comprises 123 hectares of woodland/forested habitat (moderate value potential foraging habitat) and 65 hectares of grassland habitat (lower value potential foraging habitat). Although the woodland/forested habitat is of relatively higher value to the spotted-tailed quoll than the derived grassland habitat, it is still of somewhat limited utility as it is structurally poor (more restricted prey opportunities) and provides little opportunity for den or latrine sites. It is notable that there have not been any records of this species within the Proposed Modification Area; however the proximity of this area to numerous known records of the species indicates a high likelihood that the habitats within the Proposed Modification Area are used by this species, particularly the breeding female.

The Project will reduce the area of potential foraging habitat available to this local population and could result in a reduction to the home range of the female associated with the den site. It is important to note, however that the potential indirect impacts from the Project (such as noise, dust, vibration and errant lighting) will be further away from the known den site than they currently are as part of current mining operations. It is not expected that the Project will increase these indirect impacts on the known den site.

There is a real chance or possibility that the Project may lead to a long-term decrease in the size of a local population if the loss of this potential foraging habitat reduces the ability of this species to sustain breeding in this area. While there is very little data relating to the size or distribution of the broader Barrington Tops footslopes regional population, it is unlikely that the impacts from the LCO Project on the local population would have any substantial flow on effects on the broader Barrington Tops footslopes regional population.

The very large home range of this species and its ability to use various habitat types (including grasslands and rehabilitation) somewhat reduces the severity of this impact to potential foraging habitat, however the positioning of this local population within an active mining landscape makes it particularly vulnerable to cumulative impacts from the Project and the Mt Owen and Ravensworth mines to the east and south (respectively). While the continued presence (and breeding) of this species within this area is demonstrative of its ability to persist in highly modified landscapes, these mines have currently approved expansion projects (or applications for expansion) and the cumulative impacts from these have the potential to cause the loss of habitat for this local population, to the extent that it may decline. Despite this, it is not likely that a potential decrease in the size of the local population would result in a decrease in the larger regional population of this species over the long term.

- **reduce the area of occupancy of the species; or**

The Project will directly remove 188 hectares of potential foraging habitat for this species (comprising 123 hectares of woodland/forested habitat and 65 hectares of derived grassland habitat), and this will, necessarily, reduce the potential area of occupancy (being the extent of the species' range that is actually occupied by the species) of the species. This habitat loss is staged however, and the resulting impact to potential habitat for this species will occur over a number of years. The Project will pose no direct impact to the known breeding den, however a reduction in suitable habitat, and resulting potential decrease in home range of the breeding female, has the potential to make current occupied home ranges unsuitable for occupation or breeding.

- **fragment an existing *population* into two or more populations; or**

It is unlikely that the Project will fragment the existing population of this species. The majority of impact from the Project will occur to the south and west of the den and Bowmans Creek, and this creek appears to be a key interchange area between the LCO and Mt Owen habitats and records of this species. The majority of records of this species from the Foy Brook local area focus on the habitats running north/south along Bowmans Creek, and those running east/west from Ravensworth State Forest to the Hillcrest Offset area. The Project will not impact on this connectivity, therefore is not likely to fragment the local population into two or more populations. It will also not fragment the broader regional population into two or more populations.

- **adversely affect habitat critical to the survival of a species; or**

This species has very broad habitat requirements, and it is known to make use of woodland, forest, riparian, grassland, rainforest and rehabilitated landscapes in the local area, including mined land that has been rehabilitated at nearby Mt Owen. The Project will impact habitat used by a local population of this species, however not to the extent that it will adversely affect habitat critical to the survival of this species (as a whole).

- **disrupt the breeding cycle of a population; or**

This species dens in rock shelters, small caves, hollow logs or tree hollows and utilises numerous dens within its home range. It is a highly mobile species and there are numerous records of overnight movements of several kilometres.

A known den site is present on the western side of Bowmans Creek within LCO, however outside of the Proposed Modification Area (about 1.75 kilometres to the north). It is likely that this breeding female utilises other den sites in the home range in rotation. The Project will not have a direct impact on this den site; however will remove 188 hectares of potential foraging habitat (comprising 123 hectares of moderate quality woodland/forested habitat and 65 hectares of poorer quality grassland habitat). This habitat loss is staged however, and the resulting impact to potential habitat for this species will occur over a number of years. Although the species has persisted in this locality for some time, the breeding cycle of the local population could be disrupted if the loss of this potential foraging habitat reduces the ability of this species to sustain breeding in this area.

The Liddell Project has the potential to impact on the breeding cycle of the local population, and thus the breeding cycle of the regional population may be subject to minor flow-on effects from this.

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The Project will remove 188 hectares of potential foraging habitat for the local population of this species. This comprises 123 hectares of woodland/forested habitat (moderate value potential foraging habitat) and 65 hectares of grassland habitat (lower value potential foraging habitat). The central Hunter Valley supports other areas of suitable habitat for this species; however the spotted-tailed quoll has not been recorded in many of these areas. It is considered unlikely however that the Project will modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species (as a whole) 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;**

The local area is known to contain foxes, feral cats and feral dogs. Feral cats and foxes were recorded from a number of the remote camera stations that were employed by ELA and Umwelt. There are current photographs of a fox investigating the den site, posing a potentially substantial threat to the adults and juveniles. All of these species are likely to be impacting on the local population of the spotted-tailed quoll; however it is not likely that the Project will cause an increase in the numbers of such species. The Project is not likely to result in an increase invasive species that are harmful to an endangered species becoming established in its habitat.

- **introduce disease that may cause the species to decline; or**

The spotted-tailed quoll is not known to be affected by specific diseases that are causing the species to decline. The Project will not introduce disease that may cause the species to decline.

- **interfere with the recovery of the species.**

The Project will reduce potential foraging habitat for this species, and this has the potential to interfere with the breeding cycle of this species. As this impact relates only to a local population (being a sub-population of the species as a whole), it is not likely that the Project will interfere with the recovery of the species.

Conclusion

There is a local population of spotted-tailed quolls making regular use of the various habitat types within the local Foy Brook area. A known female breeding den site occurs to the west of Bowmans Creek within the LCO and about 1.75 kilometres to the north of the Proposed Modification Area. A number of known male den sites are located nearby at Mt Owen.

The presence of this local population is of importance as there are few areas within the central Hunter Valley lowlands (the main Hunter Valley) that are of sufficient size to support the home ranges of this species and that contain such a concentration of known records, including confirmed breeding dens.

The Project will directly impact on 188 hectares of potential foraging habitat for this local population; however it will not directly impact on the known breeding den site. There is the potential for indirect impacts, through the removal of potential foraging habitat, to disrupt the ongoing use of the den site by the breeding female.

In summary, the Project could reduce the area of occupancy of the species and has a real chance or possibility to disrupt the breeding cycle of a local population (thus causing minor flow-on affects to the regional population).

Although the potential for a significant impact on this species is unclear, the provision of biodiversity offsets to compensate for the loss of habitat of the spotted-tailed quoll from the Project will provide long term conservation of alternate areas of habitat for the species. The biodiversity offset areas and other potential on-site impact mitigation measures will be developed as part of the on-going development of the Project.

Vulnerable Species

The following EPBC Act listed vulnerable species are considered in this assessment:

- Green and golden bell frog (*Litoria aurea*);
- Large-eared pied bat (*Chalinolobus dwyeri*);
- Eastern long-eared bat (*Nyctophilus timoriensis*);
- Grey-headed flying-fox (*Pteropus poliocephalus*);
- New Holland mouse (*Pseudomys novaehollandiae*);
- *Ozothamnus tesselatus*; and
- Lobed blue-grass (*Bothriochloa biloba*).

An assessment in accordance with the DSEWPC significant impact criteria is provided below for these species.

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

None of the above listed vulnerable species have been recorded within the Proposed Modification Area, however all are considered to have potential to occur in areas of appropriate habitat. As no potential occurrences of these species would fulfil the criteria above, if they were to occur in the Proposed Modification Area, it is unlikely that they would constitute an *important population*.

Other Vulnerable Species Recorded near to (but not within) the Proposed Modification Area

- Green and golden bell frog (*Litoria aurea*);
- Large-eared pied bat (*Chalinolobus dwyeri*);
- Eastern long-eared bat (*Nyctophilus timoriensis*);
- Grey-headed flying-fox (*Pteropus poliocephalus*);
- New Holland mouse (*Pseudomys novaehollandiae*);
- *Ozothamnus tesselatus*; or
- Lobed blue-grass (*Bothriochloa biloba*).

Green and Golden Bell Frog (*Litoria aurea*)

The species has not been recorded in the Proposed Modification Area, or the LCO. It has been recorded in nearby Mt Owen on four occasions over a 15 year period, with the last confirmed record from 1999 (Forest Fauna Surveys and Newcastle Innovation 2012). Mt Owen forms part of the Upper Hunter Green and Golden Bell Frog Key Population consisting of one main diffuse population at, or in the vicinity of, the Ravensworth and Liddell area and bordering areas of the Singleton and Muswellbrook local government areas (DECC 2007). The Upper Hunter Key Population is one of two inland populations of the species and is known from eight verified locations. The population is assumed to have a diffuse distribution across lands encompassed by these locations and has been recorded sporadically, probably caused by climatic circumstances and/or seasonal life cycle changes of the species (DECC 2007). It is considered highly likely that the precipitous state of the Upper Hunter population is directly due to the impact of disease rather than habitat or other ecological factors (Forest Fauna Surveys and Newcastle Innovation 2012).

An additional unconfirmed record of the species exists from the north-west shore of Lake Liddell in 2006 (DECC 2007) and the species was recently recorded during surveys for the Ravensworth North Project in 2009.

Large-eared Pied Bat (*Chalinolobus dwyeri*)

The species has not been recorded in the Proposed Modification Area or the LCO and is not expected to be impacted by the Project. The large-eared pied bat has been recorded through analysis of echolocation calls on four occasions during monitoring at Mt Owen (Forest Fauna Surveys and Newcastle Innovation 2012). All woodland vegetation within the Proposed Modification Area is expected to provide potential foraging habitat for this species, however no roosting habitat for this cave roosting species has been identified. The Proposed Modification Area is considered to comprise part of a large area of foraging habitat for this species however is unlikely to contain significant breeding and roosting habitat.

Eastern Long-eared Bat (*Nyctophilus timoriensis*)

This species has not been recorded in the Proposed Modification Area, was not recorded within a 20km radius of the Proposed Modification Area as a result of database searches (Bionet 2013) and is not expected to be impacted by the Project. All woodland vegetation within the Proposed Modification Area is expected to provide potential foraging habitat for this species, however no roosting habitat for this cave roosting species has been identified. The Proposed Modification Area is considered to comprise part of a large area of foraging habitat for this species however is unlikely to contain significant breeding and roosting habitat.

Grey-headed Flying-fox *(Pteropus poliocephalus)*

The species has not been recorded in the Proposed Modification Area, or the LCO. The grey-headed flying-fox has been previously recorded on six occasions during monitoring of Mt Owen (Forest Fauna Surveys and Newcastle Innovation 2012). All woodland vegetation within the Proposed Modification Area is expected to provide potential foraging habitat for this species. Camp sites (breeding habitat) have not been identified in the local area and are not expected to occur due to a lack of preferred habitat. The Proposed Modification Area is considered to comprise part of a large area of potential foraging habitat for this species and is unlikely to contain significant breeding and roosting habitat.

New Holland Mouse (*Pseudomys novaehollandiae*)

The species has not been recorded in the Proposed Modification Area, or the LCO. The New Holland mouse has been recorded during five of the last 16 years of fauna monitoring in Mt Owen, between 2003 and 2007 (Forest Fauna Surveys and Newcastle Innovation 2012). The species has been recorded in areas of rehabilitation in the North Pit at Mt Owen and to the east of Ravensworth State Forest. The species selectively prefers habitats which have been disturbed by events in which it rapidly colonises following the event (Forest Fauna Surveys and Tunra 2007). Populations of the species remain high for a period following disturbance and decline in abundance in areas not subjected to disturbance.

Habitat preferences of the species include open heathland; open woodland with a heathland understorey; and vegetated sand dunes. Due to the largely granivorous nature of the species, sites where the New Holland mouse is found are often high in floristic diversity, especially leguminous perennials, and the species has been found to peak in abundance during the early to mid stages of vegetation succession three to five years after fire (DSEWPC 2012). Habitats in the Proposed Modification Area do not conform to the preferred habitat types in which the species is typically located.

It is considered likely that this successional species will utilise the habitats within Proposed Modification Area when conditions are optimal, followed by the decline of the species once rehabilitated habitats improve in habitat complexity, thereby reducing the area of habitat that can be successfully occupied by the species. It is considered likely that post mining rehabilitation occurring on mine sites throughout the Hunter Valley provides areas of habitat conducive to the occupation of the New Holland mouse.

Lobed Blue-grass (*Bothriochloa biloba*)

Lobed blue-grass grows in woodlands and grasslands on poorer soils. The species has not been recorded in the Proposed Modification Area or the LCO and is not expected to be impacted by the Project. The species is regionally recorded across much of the central and upper Hunter Valley with fewer records in the lower Hunter but as far east as Maitland. The Proposed Modification Area is considered to provide potential habitat for this species.

Ozothamnus tesselatus

Until recently, this species had been thought to be restricted to a few locations north of Rylestone. However it was recorded in 2003 in Ravensworth State Forest (Cole *et al*. 2004) in Mt Owen. *Ozothamnus tesselatus* has not been recorded within the Proposed Modification Area, or the LCO, and is not expected to be impacted by the Project. The Proposed Modification Area is considered to provide an area of potential habitat for the species.

An assessment in accordance with the DSEWPC significant impact criteria is provided below for these species.

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

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

The identification of potential habitat for these vulnerable species within the Proposed Modification Area does not constitute the presence of an 'important population' as defined by the criteria listed above. As there are no confirmed records within the Proposed Modification Area (or indeed LCO) from which to conclude a key source population for breeding or dispersal; or a population important for the maintenance of genetic diversity of the species; or a population of the species' at the limits of their ranges.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

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

Given that none of these species have been recorded in the Proposed Modification Area and that the Project will remove only potential habitat for these species, it is considered unlikely that the Project will lead to a long-term decrease in the size of an *important population* of any of these species.

- **reduce the area of occupancy of an important population, or;**

The Proposed Modification Area does not contain an *important population* of the green and golden bell frog, large-eared pied bat, eastern long-eared bat, grey-headed flying fox, New Holland mouse, *Ozothamnus tesselatus* or *Bothriochloa biloba* and therefore will not reduce the area of occupancy of an *important population* of these species.

- **fragment an existing important population into two or more populations, or;**

The Proposed Modification Area does not contain an *important population* of the green and golden bell frog, large-eared pied bat, eastern long-eared bat, grey-headed flying fox, New Holland mouse, *Ozothamnus tesselatus* or *Bothriochloa biloba* and therefore the Project is not likely to fragment an existing *important population* into two or more populations.

- **adversely affect habitat critical to the survival of a species, or;**

The Proposed Modification Area is not considered to provide habitat that is critical to the survival of any of these potentially occurring species.

- **disrupt the breeding cycle of an *important population*, or;**

The Project is not considered likely to disrupt the breeding cycle of an *important population* of any of these species given that they are only considered to have potential to occur.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or;**

The Project is unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat for any of these potentially occurring species to the extent that the species are likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat, or;**

The Project is unlikely to result in an invasive species that is harmful to these species becoming established in their habitats.

- **interferes substantially with the recovery of the species.**

As none of these species have been identified occurring in the Proposed Modification Area, it is considered unlikely that the Project would interfere substantially with the recovery of these species.

Conclusion

The Project is unlikely to result in a significant impact on an *important population* of green and golden bell frog (*Litoria aurea*), large-eared pied bat (*Chalinolobus dwyeri*), eastern long-eared bat (*Nyctophilus timoriensis*) grey-headed flying-fox (*Pteropus poliocephalus*), New Holland mouse (*Pseudomys novaehollandiae*), *Ozothamnus tesselatus* or lobed blue-grass (*Bothriochloa biloba*).

Migratory Species

The following EPBC Act listed migratory species are considered in this assessment:

- Regent honeyeater (*Anthochaera phrygia*);
- Australian painted snipe (*Rostratula benghalensis australis*);
- Rainbow bee-eater (*Merops ornatus*);
- White-bellied sea-eagle (*Haliaeetus leucogaster*);
- Great egret (*Ardea alba*);
- Cattle egret (*Ardea ibis*);
- Fork-tailed swift (*Apus pacificus*);
- White-throated needletail (*Hirundapus caudacutus*);
- Satin flycatcher (*Myiagra cyanoleuca*); and
- Clamorous reed warbler (*Acrocephalus stentoreus*).

An assessment in accordance with the DSEWPC significant impact guidelines is provided below for these species.

An area of important habitat is:

- **habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; or**
- **habitat utilised by a migratory species which is at the limit of the species range; or**
- **habitat within an area where the species is declining.**

The Proposed Modification Area is not regarded to comprise *important habitat* or an ecologically significant proportion of a population for any of the occurring and potentially-occurring listed migratory species, based on the criteria described above.

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

- **substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles of altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

The Proposed Modification Area is not regarded to comprise important habitat for any of the occurring and potentially-occurring listed migratory species, based on the criteria described above. As such, no further assessment is required.

- **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**

The Proposed Modification Area is not regarded to comprise important habitat for any of the occurring and potentially-occurring listed migratory species, based on the criteria described above. As such, no further assessment is required.

- **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species**

The Proposed Modification Area is not regarded to comprise an ecologically significant proportion of the population for any of the occurring and potentially-occurring listed migratory species. As such, no further assessment is required for any EPBC Act listed migratory species.

Conclusion

The Project is unlikely to result in a significant impact on any EPBC Act listed migratory species.

APPENDIX 6

Mountain Block Field Survey Methods

Appendix 6 - Mountain Block Field Survey Methods

1.0 Mountain Block Property Survey Methodology

This Appendix describes the flora and fauna survey methodology undertaken across the Mountain Block property.

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the ecological features of the Mountain Block property. The methods included a detailed literature review of relevant reports and vegetation mapping, as well as searches of relevant ecological databases. Information gathered from the literature reviews and database searches was then used to assist in the design of the field survey program, targeting potential threatened flora and fauna species, endangered populations, threatened ecological communities (TECs), and their habitats.

Details on each of the methods used in this assessment are provided in the following sections.

1.1 Literature Review

A review of all relevant and available literature was undertaken in order to gain a greater understanding of the known and potential ecological values of the Mountain Block property and the broader locality. Due to the proximity of the Mountain Block property to the Proposed Modification Area, literature reviewed was similar to that from the main report. Documents reviewed included previous ecological studies relating to the Mountain Block property (particularly that of ELA 2012), regional vegetation mapping and ecological studies completed in the local area. The literature review also included a search of relevant ecological databases to identify threatened flora and fauna species, endangered populations and TECs that have been previously recorded or have potential to occur in, or with proximity to, the Mountain Block property.

1.1.1 Ecological Database Searches

In order to identify all potential threatened species, endangered populations, and TECs with the potential to occur in the local area, a detailed assessment of relevant ecological databases was completed. These database sources comprised:

- a 20 kilometre radius search from the centre of the Mountain Block property from the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (as of August 2013);
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) EPBC Act Protected Matters Search Tool Results for a 20 kilometre radius search from the centre of the Mountain Block property (August 2013); and
- records from these database searches were combined with records from a number of other sources (including literature reviews, other records and professional opinion) to develop a list of potentially occurring threatened species. Furthermore, a number of additional species that are not listed under the TSC Act were included such as species listed under the EPBC Act and rare or threatened Australian plant (ROTAP) species considered likely to have potential habitat within the Mountain Block property. The information contained within this table was then used to assist in the development of the survey methods, as particular attention was paid to targeting potentially occurring threatened species, endangered populations and TECs during field surveys.

1.1.2 Context of Other Contemporary Ecological Studies

Eco Logical Australia (ELA) was commissioned by LCO to identify and map vegetation and condition of the Mountain Block property to assess its potential biodiversity offsetting value. Field surveys for this work were undertaken on 17 and 18 July 2012, and results were presented in a letter report dated 2 August 2013.

While Umwelt was later engaged to complete the potential offset site assessment, these initial surveys and resulting data from ELA are highly relevant and were used as a foundation for the vegetation mapping of the Mountain Block property and the fauna data has been incorporated into the fauna species list for the site (Appendix 9).

1.2 Flora Survey

The flora survey aimed to identify threatened flora species, endangered populations, TECs and species of local or regional significance occurring or considered to potentially occur within the Mountain Block property. Information obtained from field surveys and literature review (particularly that of ELA 2012) was used to prepare preliminary mapping of the vegetation communities within the Mountain Block property.

Field surveys in the Mountain Block property were conducted on 6 and 7 June 2013.

The flora survey was based on the use of systematic plot-based sampling, as well as non-quantitative survey to assist in the delineation of vegetation communities and refinement of vegetation mapping. A large component of the flora surveys consisted of ground-truthing work undertaken by ELA (2012). These are described individually in the following sections.

1.2.1 Systematic Plot Based Survey

The plot-based systematic vegetation survey was undertaken using methods that are relatively standard in most NSW government vegetation management agencies and elsewhere. This ensured that data collected by other surveys could be incorporated into the current work, and that the data from the current study could be analysed in an equivalent way to that collected by other recognised studies. A total of six plots were undertaken within the Mountain Block property during the survey, as shown in Figure 7.2.

When undertaking systematic sampling to assist vegetation community mapping and description, plot-based (or quadrat) surveys have several distinct advantages over non-quantitative transects, including:

- providing a quantitative examination of species distribution and abundance;
- being likely to detect inconspicuous or rare species (especially forbs and grasses) within the given sampling area, as a smaller area is surveyed in a concentrated search; and
- providing a basis for any subsequent monitoring required.

Systematic survey sites were selected by considering a range of attributes that were considered to influence or determine the type of vegetation communities present. This stratification was done intuitively, but based on existing topographic, soil, vegetation and geological mapping. Other factors considered included the spacing of sites across the Mountain Block property, as well as topographic position (see **Schematic 1.1** below) and aspect.

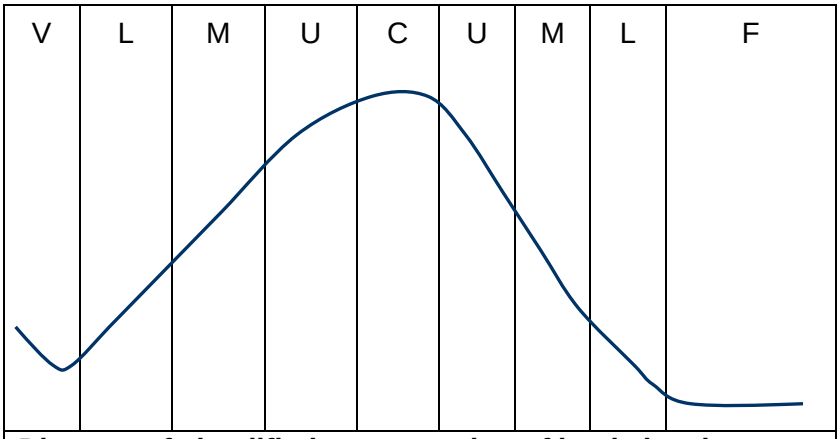

Diagram of simplified cross section of land showing:

- **crest (C)**
- **upper slope (U)**
- **mid slope (M)**
- **lower slope (L)**
- **valley (V)**
- **flat (F)**

Schematic 1.1 - Topographic Positions Sampled in the Field Survey

Data on topography, soil type and geology were sourced from existing maps. Not all stratification was done *a priori*, as the selection of survey sites in the field was undertaken to ensure that obvious variability in aspect, slope, elevation and micro-terrain were sampled.

Systematic 400 m^2 plots were used to undertake semi-quantitative sampling of vegetation. The typical dimensions of the plot are 20 x 20 metres. This plot size is used widely, including by the Royal Botanic Gardens Sydney and OEH.

At each plot, two ecologists spent roughly 45 to 60 minutes searching for all vascular flora species present within the plot. Searches of each plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of the shrub, mid-understorey, canopy and emergent layers were also thoroughly examined. Effort was made to search the canopy and tree trunks for mistletoes, vines and epiphytes.

Species within the plot were assigned a cover-abundance value to reflect their relative cover and abundance in the plot. Species located outside the plot were marked as present but were not assigned a cover-abundance value. A modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore 1955 and Austin *et al*. 2000) was used to estimate cover-abundances of all plant species within each plot. **Table 1.1** shows the cover-abundance categories used.

Table 1.1 - Modified Braun-Blanquet Crown Cover-abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20% cover	-
4	20 – less than 50% cover	-
5	50 – less than 75% cover	-
6	75 – 100% cover	-

Note: * Modified Braun-Blanquet scale (Poore 1955; Austin *et al*. 2000)

All flora species that were readily identified in the field were recorded on pro forma field survey datasheets. All flora species that could not be immediately identified and samples of all threatened flora species were collected, dried and identified or sent to the National Herbarium of NSW for identification.

In addition, information was gathered on the condition of the vegetation at each of the survey sites, including fire history and the density of weeds and evidence of disturbance such as feral animals.

1.2.2 Rapid Vegetation Assessments

Rapid vegetation assessments were completed at 11 locations across the Mountain Block property, primarily to assist in the delineation and refinement of vegetation mapping. These assessment sites were located within each broadly mapped vegetation community to allow data collection for each community without confounding effects from adjacent communities. Dominant, common and some uncommon plant taxa were recorded within each vegetation community at each location. The location of rapid vegetation assessments completed within the Mountain Block property was recorded using a handheld GPS and are provided on Figure 7.2.

The rapid vegetation assessments did not utilise a quantitative sampling approach, described in **Section 1.2.1**, as this method was designed to allow rapid collection of non-quantitative species dominance data across the Mountain Block property within limited timeframes. This technique involved documenting the dominant canopy, understorey and ground layer flora species at a point and taking four systematic photographs of the surrounding vegetation in a sequential North, East, South and West order. Rapid vegetation assessments were selected instead of the plot-based method because it increased the amount of data that could be collected within the available survey time, thereby maximising the quality and coverage of vegetation description and mapping. This technique also facilitates the recording of general species richness, assists in the delineation of vegetation community boundaries and targets the presence of threatened and significant flora species, endangered populations and TECs.

1.2.3 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within quadrats and along transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al*. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2013), the online plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens Sydney.

1.2.4 Biases and Limitations

The survey was influenced by seasonal factors as the only survey was conducted during winter, however spring and summer are the peak flowering periods for many cryptic species, such as orchids.

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. In this case specimens were always forwarded to the National Herbarium of New South Wales if they were considered to be of potential significance or importance.

1.2.5 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Mountain Block property. Vegetation mapping involved the following key steps:

- preparation of draft vegetation community map based on landform elements and preliminary delineation of vegetation community floristics via aerial photograph interpretation;
- ground-truthing of vegetation map based on survey results; and
- revision of vegetation community floristic delineations based on review of plot data.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were then aligned with similar vegetation communities identified in both the Vegetation of the Central Hunter Valley (Peake 2006) and also assigned a BioMetric Vegetation Type (BVT) (OEH 2013).

The vegetation community profiles provided in Peake (2006) and BVTs recognised by OEH (2013) were interrogated to identify those communities that contained similar species and structural compositions to ensure that, where possible, the communities identified in the Mountain Block property were aligned with similar communities known to occur elsewhere in the region.

The preliminary vegetation communities were grouped into four vegetation formations, which were based solely on structural characteristics and location on landform rather than floristic components. These comprised:

- rainforest on sheltered, protected gullies (dominated by trees of 40 to 70 per cent cover);
- woodland on steep and upper slopes (dominated by trees of 15 to 30 per cent cover, with or without a mid-understorey or understorey);
- open forest on lower slopes and plains (dominated by trees of 15 to 30 per cent cover, with or without a mid-understorey or understorey);
- grassland (dominated by grasses and forbs, with trees and shrubs very sparse or absent).

1.2.6 Determination of Threatened Ecological Communities

Vegetation communities identified in the Mountain Block property were compared to TECs listed under the TSC Act and EPBC Act and identified as having the potential to occur within the study area or in the surrounding area. The assessment of similarity with TECs was made using the following approach:

- comparison with published species lists for listed TECs;
- comparison with habitat descriptions and distributions for listed TECs;
- assessment of relevant guidelines published by the Commonwealth DSEWPC and NSW OEH;
- comparison with other assessments of white box woodland or other TECs in the region; and
- comparison against determinations, guidelines, listing advices, recovery plans and conservation advice provided for each TEC, particularly those from the NSW Scientific Committee and the Commonwealth Threatened species Scientific Committee.

1.2.7 Flora Survey Timing and Effort

The total flora survey effort undertaken across the Mountain Block property is shown in **Table 1.2**.

Table 1.2 – Flora Field Survey Timing and Effort

Date of Surveys	Survey Method	Survey Effort
7 June 2013	Systematic Plots	6 plots (Umwelt)
	Rapid Assessments	11 rapid assessments (Umwelt)
17 and 18 July 2012	Reconnaissance	2 days reconnaissance surveys (ELA)

1.3 Fauna Survey

The following sections document the methods undertaken during the fauna surveys of the Mountain Block property. Fauna survey effort was undertaken in consideration of the OEH Draft Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities (DEC 2004). Fauna surveys were undertaken by Umwelt from 6 to 17 June 2013.

Fauna surveys of the Mountain Block property were undertaken primarily to map habitat and survey for species of ecological significance including threatened woodland birds and the spotted-tailed quoll (*Dasyurus maculatus maculatus*). As such no general fauna surveys were undertaken within Mountain Block. Fauna surveys placed emphasis on the assessment of importance of the Mountain Block property as habitat for the spotted-tailed quoll (*Dasyurus maculatus maculatus*) and other key threatened species.

Locations of fauna survey effort locations are provided in Figure 7.2 of the main report. Details of each survey method undertaken are provided in the following sections.

1.3.1 Targeted Spotted-tailed Quoll Surveys (*Dasyurus maculatus maculatus*)

1.3.1.1 Remote Camera Surveys

Baited remote sensing cameras were placed in the Mountain Block property on 6 and 7 June and collected on 17 June. These surveys consisted of a total of four baited camera stations, one station was left out over a total of eleven nights and the other three stations were left out for a total of 10 nights.

Each station was baited with a chicken carcass and fish oil so that in the event the chicken was taken, fauna would still be attracted by the fish oil.

1.3.1.2 Diurnal Walking Surveys

Diurnal walking surveys were undertaken to search for signs of presence of the spotted-tailed quoll (*Dasyurus maculatus maculatus*) such as tracks, latrines and scats. These searches also targeted key habitat features such as latrine sites, log piles, boulder piles and den sites. These diurnal walking surveys were undertaken over a two day period.

Scat collections were made as they were encountered for expert identification. Any collections made targeted aged scats in order to minimise disturbance of latrine sites as territory marking and communication sites between individual quolls. All scats collected were sent to Barbara Triggs for expert analysis, with prey remains identified to a species level where possible.

1.3.1.3 Nocturnal Spotlighting

Nocturnal spotlighting was undertaken of two sites containing potential spotted-tailed quoll (*Dasyurus maculatus maculatus*) habitat within the Mountain Block property.

Spotlighting searches were undertaken on foot and were undertaken by two observers for a period of at least 30 minutes (1 person hour) on each occasion using head torches and 30 watt handheld spotlights. Although spotlighting surveys were primarily undertaken to search for the spotted-tailed quoll (*Dasyurus maculatus maculatus*), all vertebrate fauna encountered were recorded (particularly potential prey species to the spotted-tailed quoll (*Dasyurus maculatus maculatus*)).

1.3.2 Diurnal Bird Surveys

Figure 7.2 of the main report shows the locations of bird surveys. Three separate sites were surveyed for birds, each on two separate occasions (totalling 6 person hours).

Bird surveys were undertaken in a range of different habitat types at various times of the day, primarily in early to mid morning and mid to late afternoon. Bird searches were undertaken by two observers for a minimum of 30 minutes. Opportunistic observations were recorded during all other aspects of the field survey, particularly while checking traps and when travelling throughout the Mountain Block property. Bird species were identified from characteristic calls (where confident) and/or by observation using 10 × 42 binoculars.

Bird surveys were scheduled to occur during winter to target threatened winter migratory bird species known to occur in the region, the regent honeyeater (*Anthochaera phrygia*) and the swift parrot (*Lathamus discolor*).

Focal habitat areas such as large dams and patches of heavily-flowering eucalypts were targeted for opportunistic bird surveys, whenever encountered.

1.3.3 Habitat Assessment

Habitat assessments were undertaken at a total of four sites across the Mountain Block property in 2013 (Figure 7.2 of the main report). The assessment targeted potential habitat and resources for fauna species, particularly for threatened fauna species. Records of a number of habitat features were made at each habitat assessment site, including:

- evidence of disturbance such as fire, weeds, feral animals, dumping, erosion and logging;
- presence of stumps and stags;
- presence of groundcover features such as rock, litter, grasses, logs, boulder, soil and lichen;
- presence of dieback, insect attack or mistletoe;
- presence of perch sites, fallen and loose bark;
- vegetation strata and composition;
- tree size class (trunk diameter), and age (old growth, mature, regenerating, saplings);
- presence and quantity of SEPP 44 – koala feed tree species;
- presence of other species specific feed resources (such as for cockatoos and honeyeaters); and
- collection of detailed hollow data, including tree species and height, hollow size, orientation, position and height.

Habitat features such as tree hollows and fallen logs were inspected for any evidence of fauna occupation such as scratches on the trunks of trees, chewed entrances to hollows, scratchings or diggings near logs, and scats at the base of trees or near logs.

1.3.4 Opportunistic Observations

Searches for signs of animal presence were conducted opportunistically during all survey activities, particularly during habitat searches and reptile and amphibian searches. Due to the opportunistic nature of signs of presence surveys, the level of survey effort was not recorded. Evidence of presence included scats, feathers, nests, burrows, footprints, bones, tufts of hair and scratch marks on trees. All hair, scat and bone samples were sent to Barbara Triggs (an industry recognised expert) for expert analysis.

1.3.5 Fauna Survey Timing and Effort

The total survey effort undertaken across the Mountain Block property is shown in **Table 1.3**.

Table 1.3 – Fauna Field Survey Timing and Effort

Date of Surveys		**Survey Method**	**Survey Effort**
7 and 12 June 2013 – General fauna surveys		Diurnal bird surveys	3 sites on two separate occasions
		Habitat assessment	4 sites
Targeted spotted-tailed quoll surveys	7 to 17 June 2013	Baited remote camera surveys	1 station for 11 nights 3 stations for 10 nights
	7 and 12 June 2013	Daytime walking searches for signs of presence	2 days
		Nocturnal Spotlighting	1 night across two sites
		Scat sample collection	Scat collections from potential latrine sites

APPENDIX 7

Mountain Block Property Survey Results

Appendix 7 – Mountain Block Property Survey Results

This Appendix describes the flora and fauna survey results from surveys undertaken across the Mountain Block property.

1.1 Literature Review

A review of suitable database and literature sources was undertaken to generate a list of potentially occurring threatened flora and fauna species, endangered populations (EPs), threatened ecological communities (TECs) and migratory species with the potential to occur within the Mountain Block property. **Table 1** identifies the 18 threatened flora species that have potential to occur based upon a 20 kilometre radius search from the centre of the Mountain Block property.

Table 1 – Threatened Flora Species Recorded or Predicted to Occur within a 20 Kilometre Radius of the Mountain Block Property

Common Name	Scientific Name	Status		Likelihood of Occurrence
		TSC	EPBC	
Threatened Flora				
	Acacia dangarensis	E1		Low
Lobed bluegrass	*Bothriochloa biloba*		V	Medium
Finger panic grass	*Digitaria porrecta*	E1	E	Low
Painted diuris	*Diuris tricolor*	V		Medium
Slaty red gum	*Eucalyptus glaucina*	V	V	Low
Narrow-leaved black peppermint	*Eucalyptus nicholii*	V	V	Low
	Euphrasia arguta	X, PD, E4A	CE	Low
Basalt peppercress	*Lepidium hyssopifolium*	E1	E	Low
	Macrozamia machinii		V	Low
	Ozothamnus tesselatus	V	V	Low
Bodalla pomaderris	*Pomaderris bodalla*	V		Low
Denman pomaderris	*Pomaderris reperta*	E4A	CE	Low
	Prasophyllum sp. Wybong		CE	Low
Illawarra greenhood	*Pterostylis gibbosa*	E1	E	Low
Siahs backbone	*Streblus pendulensis*		E	Low
Silky swainson-pea	*Swainsona sericea*	V		Low
Austral toadflax	*Thesium australe*	V	V	Medium
	Tylophora linearis	V	E	Low

Status (TSC Act):
E1 Schedule 1, Part 1: Endangered Species
E4A Schedule 1 a, Part 1: Critically Endangered Species
V Schedule 2: Vulnerable Species
X Extinct
PD Preliminary determination

Status (EPBC Act):
CE Critically endangered
E Endangered species
V Vulnerable species

Table 2 identifies the four endangered populations that have potential to occur based upon a 20 kilometre radius search from the centre of the Mountain Block property.

Table 2 – Endangered Flora Populations Recorded or Predicted to Occur within a 20 Kilometre Radius of the Mountain Block Property

Endangered Flora Population	Status		Likelihood of Occurrence
	TSC Act	EPBC Act	
Painted diuris (*Diuris tricolor*) in the Muswellbrook LGA	E2		Medium
Weeping myall (*Acacia pendula*) in the Hunter Catchment	E2		Low
Tiger orchid (*Cymbidium canaliculatum*) population in the Hunter Catchment	E2		Recorded
River red gum (*Eucalyptus camaldulensis*)	E2		Low

Status (TSC Act):
E2 Schedule 1, Part 2: Endangered Population

Table 3 identifies the 12 TECs that have potential to occur based upon a 20 kilometre radius search from the centre of the Mountain Block property.

Table 3 – TECs Recorded or Predicted to Occur within a 20 Kilometre Radius of the Mountain Block Property

TEC	Status		Likelihood of Occurrence
	TSC Act	EPBC Act	
Central Hunter Grey Box– Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC		Known
Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions	EEC		Known
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC		Low
Hunter Lowland Redgum Forest	EEC		Low
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC		Low
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion	EEC		Low
Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions	EEC		Low
Lowland Rainforest of Subtropical Australia		CEEC	Low
Natural Grasslands on Basalt and fine-textured alluvial plains of Northern NSW and Southern Queensland.		CEEC	Low
River– flat Eucalypt Forest on Coastal Floodplains	EEC		Low
Weeping Myall Woodland		EEC	Low
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands	EEC	CEEC	Low

EEC Endangered Ecological Community
VEC Vulnerable Ecological Community
CEEC Critically Endangered Ecological Community

Table 4 identifies the 54 threatened fauna species that have potential to occur based upon a 20 kilometre radius search from the centre of the Mountain Block property.

Table 4 – Threatened Fauna Species Recorded or Predicted to Occur within a 20 Kilometre Radius of the Mountain Block Property

Common Name	Scientific Name	Status		Likelihood of Occurrence
		TSC Act	EPBC Act	
Amphibians				
Green and golden bell frog	*Litoria aurea*	E	V	Low
Booroolong frog	*Litoria booroolongensis*	E	E	Low
Reptiles				
Pink-tailed worm lizard	*Aprasia parapulchella*	V	V	Low
Birds				
Spotted harrier	*Hieraaetus morphnoides*	V		Known
Little eagle	*Circus assimilis*	V		Medium
Red goshawk	*Erythrotriorchis radiatus*	CE	V	Low
Square tailed kite	*Lophoictinia isura*	V		Medium
Black falcon	*Falco subniger*	V		Medium
Australian painted snipe	*Rostratula benghalensis australis*	E	E + MIG	Low
Freckled duck	*Stictonetta naevosa*	V		Low
Blue-billed duck	*Oxyura australis*	V		Low
Black-necked stork	*Ephippiorhynchus asiaticus*	E1		Low
Red-backed button-quail	*Turnix maculosa*	V		Low
Malleefowl	*Leipoa ocellata*	E	V	Low
Australasian bittern	*Botaurus poiciloptilus*	E	E	Low
Eastern bristlebird	*Dasyornis brachypterus*	E	E	Low
Glossy black-cockatoo	*Calyptorhynchus lathami*	V		Medium
Gang-gang cockatoo	*Callocephalon fimbriatum*	V		Medium
Turquoise parrot	*Neophema pulchella*	V		Medium
Little lorikeet	*Glossopsitta pusilla*	V		High
Powerful owl	*Ninox strenua*	V		Medium
Barking owl	*Ninox connivens*	V		Medium
Masked owl	*Tyto novaehollandiae*	V		Medium
Sooty owl	*Tyto tenebricosa*	V		Medium
Brown treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V		High
Speckled warbler	*Chthonicola sagittata*	V		Known
Swift parrot	*Lathamus discolor*	E	E	Medium
Regent honeyeater	*Anthochaera phrygia*	CE	E MIG	Medium
Black-chinned honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V		Medium

Table 4 – Threatened Fauna Species Recorded or Predicted to Occur within a 20 Kilometre Radius of the Mountain Block Property (cont.)

Common Name	Scientific Name	Status		Likelihood of Occurrence
		TSC Act	EPBC Act	
Hooded robin (south-eastern form)	*Melanodryas cucullata cucullata*	V		High
Scarlet robin	*Petroica boodang*	V		High
Flame robin	*Petroica phoenicea*	V		High
Grey-crowned babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V		High
Varied sittella	*Daphoenositta chrysoptera*	V		High
Diamond firetail	*Stagonopleura guttata*	V		High
Mammals				
Spotted-tailed quoll	*Dasyurus maculatus maculatus*	V	E	Known
Brush-tailed phascogale	*Phascogale tapoatafa*	V		Low
Koala	*Phascolarctos cinereus*	V	V	Medium
Yellow-bellied glider	*Petaurus australis*	V		Low
Squirrel glider	*Petaurus norfolcensis*	V		Medium
Brush-tailed rock-wallaby	*Petrogale penicillata*	E	V	Medium
New Holland mouse	*Pseudomys novaehollandiae*	V		Low
Hastings River mouse	*Pseudomys oralis*	E	E	Low
Grey-headed flying-fox	*Pteropus poliocephalus*	V	V	Medium
Yellow-bellied sheathtail bat	*Saccolaimus flaviventris*	V		High
Eastern freetail-bat	*Mormopterus norfolkensis*	V		High
Little bentwing-bat	*Miniopterus australis*	V		High
Eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	V		High
Corbens long-eared bat	*Nyctophilus corbeni*	V	V	Medium
Large-eared pied bat	*Chalinolobus dwyeri*	V	V	High
Eastern false pipistrelle	*Falsistrellus tasmaniensis*	V		Medium
Southern myotis	*Myotis macropus*	V		High
Greater broad-nosed bat	*Scoteanax rueppellii*	V		High
Eastern cave bat	*Vespadelus troughtoni*	V		High

CE Critically Endangered
E Endangered
V Vulnerable
MIG Migratory species

Table 5 identifies the 15 migratory species that have potential to occur within the Mountain Block property based upon a 20 kilometre radius search from the centre of the Mountain Block property.

Table 5 – Migratory Species Predicted to Occur within a 20 Kilometre Radius of the Mountain Block Property

Migratory Species		Status		Likelihood of Occurrence
		TSC Act	EPBC Act	
Malleefowl	*Leipoa ocellata*	E	V + MIG	Low
Australian painted snipe	*Rostratula benghalensis australis*	E	E + MIG	Low
Great egret	*Ardea alba*		MIG	Low
Cattle egret	*Ardea ibis*		MIG	Medium
White-bellied sea-eagle	*Haliaeetus leucogaster*		MIG	Medium
White-throated needletail	*Hirundapus caudacutus*		MIG	Medium
Caspian tern	*Hydroprogne caspia*		MIG	Low
Fork-tailed swift	*Apus pacificus*		MIG	Low
Rainbow bee-eater	*Merops ornatus*		MIG	High
Black-faced monarch	*Monarcha melanopsis*		MIG	Low
Spectacled monarch	*Monarcha trivirgatus*		MIG	Low
Satin flycatcher	*Myiagra cyanoleuca*		MIG	High
Latham's snipe	*Gallinago hardwickii*		MIG	Low
Regent honeyeater	*Anthochaera phrygia*	CE	E + MIG	Medium
Rufous fantail	*Rhipidura rufifrons*		MIG	Medium

1.2 Flora Survey Results

A total of 84 plant species were identified in the Mountain Block property from surveys during 2013. Plants were recorded from two major vascular plant classes, being: ferns and flowering plants (**Table 6**) and included trees, shrubs, forbs, grasses, sedges, rushes, reeds, ferns, lithophytes, vines and twiners. The full list of flora species recorded within the Mountain Block property is provided in Appendix 8.

Table 6 - Composition of Plant Classes and Families Recorded

Plant class	Sub-class	Number of Families	Number of Species
Filicopsida (ferns)	-	3	5
Magnoliopsida (flowering plants)	Magnoliidae (dicots)	6	21
Magnoliopsida (flowering plants)	Liliidae (monocots)	34	58
Totals (all plants)		**43**	**84**

A total of 43 plant families were recorded (**Table 6**). Poaceae (grasses) was the most speciose family with 16 species recorded, followed by Asteraceae (daisies) with 8 species recorded and Myrtaceae (eucalypts and paperbarks) with 5 species recorded.

Of the 84 species recorded, 22 (26 per cent) were introduced species. Introduced species recorded that are considered environmental weeds include cobblers pegs (*Bidens pilosa*), galenia (*Galenia pubescens*), narrow-leaved cotton bush (*Gomphocarpus fruticosus*), African boxthorn (*Lycium ferocissimum*), African olive (*Olea europaea* subsp. *cuspidata*), creeping pear (*Opuntia humifusa*), common prickly pear (*Opuntia stricta* var. *stricta*), blackberry complex (*Rubus fruticosus*) and pepper tree (*Schinus areira*). Four species recorded (5 per

cent of the flora of the Mountain Block property) are declared noxious in the Upper Hunter County Council control area. Declared noxious weeds recorded in the Mountain Block property are listed in **Table 7**.

Table 7 - Noxious Weeds Recorded on the Mountain Block Property

Family	Botanical name	Common name	Noxious weed control objective
Cactaceae	* *Opuntia humifusa*	creeping pear	4
Cactaceae	* *Opuntia stricta* var. *stricta*	common prickly pear	4
Rosaceae	* *Rubus fruticosus*	blackberry complex	4
Solanaceae	**Lycium ferocissimum*	African boxthorn	4

Notes: Control objectives:

4 Minimise the negative impact of those plants on the economy, community or environment of NSW.

* Denotes introduced – not native to Australia.

1.2.1 Vegetation Communities

Six remnant vegetation communities were delineated in the proposed Mountain Block property following the surveys, the locations of which are shown in Figure 7.3. An additional two non native vegetation communities and one water body community were also identified within the Mountain Block property. All of the mapped vegetation communities, except Derived Native Grasslands and Cleared Land, are naturally-occurring, although many of these have been significantly modified during the past two centuries through extensive management, including clearing and regeneration. **Table 8** lists the vegetation communities identified within the Mountain Block property and the extent of each of these vegetation communities.

Table 8 – Vegetation Communities of the Mountain Block Property

Vegetation Community Name	HRVP[1]	BVT[2]	Legal Status		Area (ha)[3]
			TSC Act	EPBC Act	
Narrow-leaved Ironbark – Spotted Gum Woodland	MU 27	HU818	EEC	-	35
Narrow-leaved Ironbark – Spotted Gum Woodland DNG	MU 27	HU818	-	-	33
Grey Myrtle – Kangaroo Vine Dry Rainforest	MU 3	HU757	-	-	1.1
Rusty Fig Dry Rainforest	MU 3	HU757	-	-	6.9
Narrow-leaved Ironbark – Bulloak Open Forest	MU 10	HU905	EEC	-	22
Narrow-leaved Ironbark – Bulloak Open Forest DNG	MU 10	HU905	-	-	60
Disturbed Land	-	-	-	-	7.7
Dam	-	-	-	-	0.58
TOTAL					**166**

Notes

[1] = Vegetation map unit described in Hunter Remnant Vegetation Project (Peake 2006).

[2] = BioMetric Vegetation Type (OEH, 2013).

[3] = Rounding of totals applied (numbers less than 1 – 2 decimal places, numbers between 1 and 10 – 1 decimal place, and greater than 10 no decimal places).

Most vegetation communities are widespread in the local area, while some occur much more extensively across a broader range of over 100 kilometres. Some communities, however, have a more restricted local occurrence.

Detailed descriptions are provided for all of the vegetation communities identified within the Mountain Block property, however regenerating variants or highly similar variants are grouped, where relevant. The following sub-sections are provided for vegetation community:

- a floristic and structural description;
- the occurrence of each community in the Mountain Block property; and
- the conservation status of the community.

1.2.1.1 Narrow-leaved Ironbark – Spotted Gum Woodland

Corresponding BVT (OEH 2013) community: HU818: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter.

Corresponding HRVP (Peake 2006) community: MU 27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest.

Narrow-leaved Ironbark – Spotted Gum Woodland occurred on low to mid slopes, particularly in the north of the Mountain Block property. It totalled an area of 35 hectares.

The community supports a tall open canopy (to 15 per cent cover) ranging 18 to 23 metres in height. The open forest canopy is dominated by spotted gum (*Corymbia maculata*) and narrow-leaved ironbark (*Eucalyptus crebra*), while forest red gum (*E. tereticornis*) also occurred in low numbers. An open sub-canopy (to 15 per cent cover) comprising recruiting canopy species also occurred to 10 metres in height.

A mid-sparse shrub later (to 15 per cent cover), up to 2.5 metres in height, occurred with species including coffee bush (*Breynia oblongifolia*) and velvet mock olive (*Notelaea microcarpa* var. *microcarpa*).

The ground cover layer was generally dense (to 60 per cent cover), and was dominated by native grasses and forbs. An upper layer (to 1.3 metres in height) of native grasses was recorded with commonly recorded species including barbed wire grass (*Cymbopogon refractus*), *Aristida* sp. and forest hedgehog grass (*Echinopogon ovatus*), while a lower layer (less than 0.1 metres in height) of native forbs, dominated by poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), kidney weed (*Dichondra repens*), was also recorded. Introduced flora species were also common, namely cobblers pegs (*Bidens pilosa*), flatweed (*Hypochaeris radicata*) and stinking Roger (*Tagetes minuta*).

Narrow-leaved Ironbark – Spotted Gum Woodland conforms with the Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions Endangered Ecological Community.

Field data collected within this community was carefully analysed to ensure it was aligned with the correct regional vegetation community. Peake (2006) describes three similar vegetation communities: MU 25 – Barrington Footslopes Dry Spotted Gum Forest; MU 26 – Lower Hunter Spotted Gum – Ironbark Forest; and MU 27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest. The Narrow-leaved Ironbark – Spotted Gum Woodland identified within the proposed Mountain Block property was least similar with MU26 due to the absence of broad-leaved ironbark (*Eucalyptus fibrosa*) with spotted gum (*Corymbia maculata*) and narrow-leaved ironbark (*Eucalyptus crebra*) being the dominant canopy

species. Peake (2006) acknowledges that the dominance of these two canopy species is more closely related to MU 27. Although the proposed Mountain Block property occurs in the general geopgraphic location for MU 25 according to Peake (2006), the composition of species within the mid-understorey and understorey present was more consistent with MU 27. Of particular note was the dominance of barbed wire grass (*Cymbopogon refractus*), forest hedgehog grass (*Echinopogon ovatus*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*) and kidney weed (*Dichondra repens*) in the ground layer.

1.2.1.2 Narrow-leaved Ironbark – Spotted Gum Woodland DNG

Corresponding BVT (OEH 2013) community: HU818: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter.

Corresponding HRVP (Peake 2006) community: MU 27 – Central Hunter Ironbark – Spotted Gum – Grey Box Forest.

This derived grassland variant community occurs on the upper and mid slopes located in the northern extent of the Mountain Block property. It is likely that this grassland is derived from Narrow-leaved Ironbark – Spotted Gum Woodland. It totals an area of 33 hectares.

This community is composed of a mix of native and introduced grasses and forbs and is largely devoid of mature and regenerating trees.

The community was dominated by a tall, dense layer of native grasses to 1.5 metres in height and 60 per cent cover. Commonly recorded native species include barbed wire grass (*Cymbopogon refractus*), slender rats tail grass (*Sporobolus creber*), tall chloris (*Chloris ventricosa*) and *Aristida* sp. A sparse layer of native and introduced forbs occurred less than 0.5 metres in height and to 15 per cent cover. Dominant species included kidney weed (*Dichondra repens*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), stinking Roger (*Tagetes minuta*), cobblers pegs (*Bidens pilosa*), fireweed (*Senecio madagascariensis*) and cotton bush (*Gomphocarpus fruticosus*).

This Derived Native Grassland variant community comprises a similar ground cover to that which is commonly found in Narrow-leaved Ironbark – Spotted Gum Woodland, although the occurrence of introduced species was usually higher.

While this native grassland is derived from the Central Hunter Ironbark-Spotted Gum-Grey Box Forest EEC, grasslands are not covered by the final determination for this EEC (NSW Scientific Committee 2010). Therefore this Derived Native Grassland variant community is not considered part of the EEC.

1.2.1.3 Grey Myrtle – Kangaroo Vine Dry Rainforest

Corresponding BVT (OEH 2013) community: HU757: Rusty Fig - Native Quince - Native Olive Dry rainforest of the Central Hunter Valley.

Corresponding HRVP (Peake 2006) community: MU 3 – Upper Hunter Depauperate Dry Rainforest.

Grey Myrtle – Kangaroo Vine Dry rainforest was restricted to a single small patch within the Mountain Block property. It occurred on a very protected and sheltered gully along Coalhole Creek in the north western corner of the site and totalled an area of 1.1 hectares.

The community supported an assemblage of distinct dry rainforest canopy species including grey myrtle (*Backhousia myrtifolia*) and kangaroo vine (*Cissus antarctica*). The canopy was typically dense (up to 70 per cent cover) and up to 15 metres in height. Due to the restricted nature of this community within the Mountain Block property it is heavily influenced by the surrounding Narrow-leaved Ironbark – Spotted Gum Woodland community. Subsequently, the community also supports a tall emergent layer of forest red gum (*E. tereticornis*) and rough-barked apple (*Angophora floribunda*) to 18 metres in height and 15 per cent cover.

The understorey was sparse due to the rocky substrate on which it occurred. A low shrub layer was recorded to 5 metres in height and 15 per cent cover. Dominant species included rusty fig (*Ficus rubiginosa*), velvet mock olive (*Notelaea microcarpa* var. *microcarpa*) and grey myrtle (*Backhousia myrtifolia*).

This community occurred on a very rocky substrate (approximately 50 per cent cover) which supported a layer of lichen (to 20 per cent cover) and sparse covering of horseshoe felt fern (*Pyrrosia confluens* var*. confluens*) to 10 per cent cover.

The remaining understorey comprised an open layer (to 20 per cent cover) of native grasses, vines and ferns. Common species included wombat berry (*Eustrephus latifolius*), Australian basket grass (*Oplismenus aemulus*), common maidenhair (*Adiantum aethiopicum*) and sickle fern (*Pellaea falcata*). Introduced flora species were also common, namely stinking Roger (*Tagetes minuta*) and cobblers pegs (*Bidens pilosa*).

Grey Myrtle – Kangaroo Vine Dry Rainforest is not consistent with any listed TEC under the TSC Act or EPBC Act. This community was compared to the vulnerable ecological community (VEC) *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions*, however it was found not to conform to the scientific determination.

1.2.1.4 Rusty Fig Dry Rainforest

Corresponding BVT (OEH 2013) community: HU757: Rusty Fig - Native Quince - Native Olive Dry Rainforest of the Central Hunter Valley.

Corresponding HRVP (Peake 2006) community: MU 3 – Upper Hunter Depauperate Dry Rainforest.

Rusty Fig Dry Rainforest is restricted within the property, occurring only on protected (generally south facing) rocky slopes within the Mountain Block property. The community totals only 6.9 hectares.

The sheltered vegetation was characterised by an open canopy, to 30 per cent cover and between 17 and 23 metres in height, dominated by rusty fig (*Ficus rubiginosa*), rough-barked apple (*Angophora floribunda*) and forest red gum (*Eucalyptus tereticornis*). Influences from the nearby Narrow-leaved Ironbark – Spotted Gum Woodland meant that narrow-leaved ironbark (*Eucalyptus crebra*) were also present.

A mid-sparse shrub layer, to 15 per cent canopy cover and up to 5 metres in height, occurs with species including velvet mock olive (*Notelaea microcarpa* var. *microcarpa*), sweet pittosporum (*Pittosporum undulatum*) and coffee bush (*Breynia oblongifolia*). The introduced shrub species, African olive (*Olea europaea* subsp. *cuspidata*) was also common within the community.

The modified ground cover vegetation comprised two dominant layers, an upper and lower. The dense upper stratum (to 1.4 metres in height and 60 per cent cover) of native grasses and weed species was dominated by blady grass (*Imperata cylindrical*), slender bamboo grass (*Austrostipa verticillata*), stinking Roger (*Tagetes minuta*), cobblers pegs (*Bidens*

pilosa) and Paddys lucerne (*Sida rhombifolia*). The lower component (less than 0.2 metres in height and 20 per cent cover) consisted of native vines and ferns, namely wombat berry (*Eustrephus latifolius*), common maidenhair (*Adiantum aethiopicum*), Australian basket grass (*Oplismenus aemulus*), kidney weed (*Dichondra repens*), native grape (*Cayratia clematidea*) and hairy clerodendrum (*Clerodendrum tomentosum*).

Rusty Fig Dry Rainforest is not consistent with any listed TEC under the TSC Act or EPBC Act. This community was compared to the vulnerable ecological community (VEC) *Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions*, however it was found not to conform to the scientific determination.

1.2.1.5 Narrow-leaved Ironbark – Bulloak Open Forest

Corresponding BVT (OEH 2013) community: HU905: Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter.

Corresponding HRVP (Peake 2006) community: MU10– Central Hunter Box – Ironbark Woodland.

A stand of Narrow-leaved Ironbark – Bulloak Open Forest occurs on the lower plains in the south of the Mountain Block property. The forest is generally young in age with only the occasional mature tree observed. It totals an area of approximately 22 hectares.

Narrow-leaved ironbark (*Eucalyptus crebra*) dominates the young canopy with scattered occurrences of bulloak (*Allocasuarina luehmannii*) occurring throughout. The canopy is generally open (to 25 per cent cover) and only 10 to 13 metres in height. Old growth narrow-leaved ironbark (*Eucalyptus crebra*) trees were also common throughout the community.

This community was associated with MU 32 – Central Hunter Bulloak Forest Regeneration as described by Peake (2006). However the dominance of mature and recruiting narrow-leaved ironbark (*Eucalyptus crebra*) trees throughout this community had it more closely aligned with MU 10 – Central Hunter Box – Ironbark Woodland (Peake 2006).

A low, sparse shrub layer of small-leaf bluebush (*Maireana microphylla*) occurred in less disturbed areas (to 5 per cent canopy cover) to a height of 0.5 metres; however the shrub layer is typically absent. The introduced shrub, African boxthorn (*Lycium ferocussimum*), was also recorded in low densities throughout the community.

The understorey cover is moderately dense (to 65 per cent cover) between three distinct layers, upper, lower and ground. A sparse upper layer (to 10 per cent cover) of slender bamboo grass (*Austrostipa verticillata*) was recorded to 1.3 metres in height. A lower stratum of native grasses was recorded to 1.1 metres in height and 40 per cent cover, with common species including barbed wire grass (*Cymbopogon refractus*), windmill grass (*Chloris truncata*) and *Aristida* sp. An open ground layer of native and introduced forbs was recorded, less than 0.3 metres in height and 15 per cent cover. Dominant native ground stratum species included winter apple (*Eremophila debilis*), climbing saltbush (*Einadia nutans* subsp. *nutans*) and blue trumpet (*Brunoniella australis*). Introduced species included ribwort (*Plantago lanceolata*), galenia (*Galenia pubescens*), fireweed (*Senecio madagascariensis*) and common prickly pear (*Opuntia stricta* subsp. *stricta*).

Narrow-leaved Ironbark – Bulloak Open Forest conforms with the Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC.

1.2.1.6 Narrow-leaved Ironbark – Bulloak Open Forest DNG

Corresponding BVT (OEH 2013) community: HU905: Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter.

Corresponding HRVP (Peake 2006) community: MU10– Central Hunter Box – Ironbark Woodland.

This derived grassland variant community occurs on the lower slopes located on the southern extent of the Mountain Block property. It is likely that this grassland is derived from Narrow-leaved Ironbark – Bulloak Open Forest. It totals an area of 60 hectares.

This community is composed of a mix of native grasses and forbs and is largely devoid of mature trees. The community does however support a low density of regenerating narrow-leaved ironbark (*Eucalyptus crebra*) in areas adjacent to the remnant patches.

The community was virtually lacking a shrub layer other than very sparse occurrences of small-leaf bluebush (*Maireana microphylla*) to 1.3 metres in height and to 5 per cent cover.

The community was dominated by a tall, dense layer of native grasses to 1.2 metres in height and 70 per cent cover. Commonly recorded native species include barbed wire grass (*Cymbopogon refractus*), slender rats tail grass (*Sporobolus creber*), tall chloris (*Chloris ventricosa*) and *Aristida* sp. A sparse layer of native forbs occurred less than 0.5 metres in height and included blue trumpet (*Brunoniella australis*), winter apple (*Eremophila debilis*), kidney weed (*Dichondra repens*) and clustered everlasting (*Chrysocephalum apiculatum*). Introduced species were also common, namely galenia (*Galenia pubescens*) and flatweed (*Hypochaeris radicata*).

This Derived Native Grassland community comprises a similar ground cover to that which is commonly found in Narrow-leaved Ironbark – Bulloak Open Forest, although the occurrence of introduced species was usually higher.

While this native grassland is derived from the Central Hunter Grey Box-Ironbark Woodland EEC, grasslands are not covered by the final determination for this EEC (NSW Scientific Committee 2011). Therefore this Derived Native Grassland variant community is not considered part of the EEC.

1.2.1.7 Disturbed Land

Corresponding BVT (OEH 2013) community: Nil.

Corresponding HRVP (Peake 2006) community: Nil.

Disturbed Land comprised all remaining land not identified as native vegetation within in the Mountain Block property. It consists of access tracks, heavily eroded drainage lines (in the south of the property) and previously cleared land (previous quarry). It totals an area of 7.7 hectares.

Introduced flora species dominated vegetation within the Disturbed Land community. Common species included galenia (*Galenia pubescens*), cotton bush (*Gomphocarpus fruticosus*) and Rhodes grass (*Chloris gayana*).

This community does not conform with any TECs listed under the TSC Act or EPBC Act.

1.2.1.8 Dam

Corresponding BVT (OEH 2013) community: Nil.

Corresponding HRVP (Peake 2006) community: Nil.

Farm Dams were identified within the Mountain Block property as a 'Dam' community. They comprised areas of open water and did not include any fringing, emergent or floating native vegetation. They had all been used for stock grazing and had moderate levels of pugging disturbance along the banks. Dams totalled an area of 0.58 hectares.

This community does not conform with any TECs listed under the TSC Act or EPBC Act.

1.2.2 Threatened Flora Species, Endangered Flora Populations and Threatened Ecological Communities

The following sections outline the threatened flora species, endangered flora populations and TECs recorded in the Mountain Block property during the survey. Figure 7.3 shows the locations of threatened flora species, endangered populations and TECs recorded in the Mountain Block property.

1.2.2.1 Threatened Flora Species

No threatened flora species were recorded in the Mountain Block property during the surveys. Although no threatened flora species were recorded in the Mountain Block property, four were considered to have a moderate potential to occur (see **Table 1**).

1.2.2.2 Regionally Significant Flora Species

The Mountain Block property occurs within the Upper Hunter region, within which there are numerous flora species considered to have conservation significance (Peake *et al*. 2003). The Hunter Rare Plants Committee of the Hunter Region Botanic Gardens developed a register of regionally significant plant species, populations and vegetation communities using a formal assessment of potential significant species through committee consensus using several assessment criteria. The criteria used to list regionally significant species include:

- endemic taxa – known distribution restricted to this region;
- uncommon taxa – less than 50 known populations;
- records close to the limit of the species' geographical range; and
- significant reductions in population size or area occupied.

The Hunter Rare Plants Database (Peake *et al.* 2003) provides an extensive list of flora species within the Hunter region that are considered to be significant. From this database, there are nine regionally significant flora species which were recorded within the Mountain Block property (**Table 9**).

Table 9 - Regionally Significant Species Recorded within the Mountain Block Property

Family	Species	Significance Criteria
Filicopsida		
Polypodiaceae	*Pyrrosia confluens*	W
Magnoliopsida (Flowering Plants) – Liliidae (Monocots)		
Luzuriagaceae	*Eustrephus latifolius*	W
Magnoliopsida (Flowering Plants) – Magnoliidae (Dicots)		
Chenopodiaceae	*Maireana microphylla*	E?
Fabaceae (Mimosoideae)	*Acacia salicina*	E
Myrtaceae	*Corymbia maculata*	W
Oleaceae	*Notelaea microcarpa* var. *microcarpa*	S
Solanaceae	*Solanum brownii*	W E
Verbenaceae	*Clerodendrum tomentosum*	W
Vitaceae	*Cissus antarctica*	W

Key to Criteria:
S, E or W = southern, eastern or western distributional limit in Hunter Region
? = code is uncertain

These nine regionally significant flora species emphasise the ecological values of the vegetation of the Mountain Block property, however many of these species are relatively widespread throughout the region, being significant due to the Hunter Valley being the limit of their distribution.

1.2.2.3 Endangered Flora Populations

One endangered flora population was recorded on the Mountain Block property during the survey, being *Cymbidium canaliculatum* population in the Hunter Catchment. One record was made in the south of the Mountain Block property (refer to Figure 7.3). This flora population is listed as Endangered under the TSC Act.

One further endangered population was considered to have a moderate potential of occurrence, being the painted diuris (*Diuris tricolor*) (see **Table 2**).

1.2.2.4 Threatened Ecological Communities

Two threatened ecological communities (TECs) listed under the TSC Act were recorded in the Mountain Block property during the field survey, these TECs are discussed below.

Central Hunter Grey Box – Ironbark Woodland in the Sydney Basin Bioregion (EEC – TSC Act)

The Narrow-leaved Ironbark – Bulloak Open Forest community identified throughout the south of Mountain Block Offset Area is consistent with one TEC listed as Endangered under the TSC Act, namely Central Hunter Grey Box – Ironbark Woodland in the Sydney Basin Bioregion. This community covered a total area of approximately 22 hectares (refer to Figure 7.3).

Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions (EEC – TSC Act)

The Narrow-leaved Ironbark – Spotted Gum Woodland community identified across much of the north of Mountain Block Offset Area is consistent with one TEC listed as Endangered under the TSC Act, namely Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions (EEC – TSC Act). This community covered a total area of approximately 35 hectares (refer to Figure 7.3).

1.3 Fauna Survey Results

A total of 49 fauna species have been recorded within the Mountain Block property, a full list of species recorded is provided in Appendix 9 and a summary of the birds, mammals, reptiles and amphibian recorded are provided below.

1.3.1 Birds

Surveys undertaken by Umwelt in the Mountain Block property in 2013 identified 36 bird species from a total of 18 families. The most speciose family identified was the Meliphagidae (honeyeaters) with six species, followed by the Acanthizidae (Australasian warblers) with five species recorded. Some of the more frequently observed bird species were the yellow-faced honeyeater (*Lichenostomus chrysops*), noisy miner (*Manorina melanocephala*), spotted pardalote (*Pardalotus punctatus*) and grey fantail (*Rhipidura albiscapa*). All of these species are common woodland bird species in the Hunter region.

A further five bird species were identified in the Mountain Block property by ELA 2012 being the masked lapwing (*Vanellus miles*), sulphur-crested cockatoo (*Cacatua galerita*), crimson rosella (*Platycercus elegans*), white-winged chough (*Corcorax melanorhamphos*) and red wattlebird (*Anthochaera carunculata*).

Two threatened bird species, both listed as vulnerable under the TSC Act, were recorded in the Mountain Block property by Umwelt in 2013, these being:

- spotted harrier (*Circus assimilis*); and
- speckled warbler (*Chthonicola sagittata*).

One introduced bird species was identified in the Mountain Block property being the common starling (*Sturnus vulgaris*).

1.3.2 Mammals

Three mammals species have been recorded within the Mountain Block property during Umwelt 2013 surveys, being the spotted-tailed quoll (*Dasyurus maculatus maculatus*), common wallaroo (*Macropus robustus*) and the introduced pig (*Sus scrofa*). The most commonly identified mammal species was the common wallaroo (*Macropus robustus*).

A further three mammal species were recorded by ELA in 2012 being the eastern grey kangaroo (*Macropus giganteus*), red-necked wallaby (*Macropus rufogriseus*) and the wombat (*Vombatus ursinus*).

A number of records of the threatened spotted-tailed quoll (*Dasyurus maculatus maculatus*) have been made in the Mountain Block property including scat records, latrine sites and camera records.

1.3.3 Reptiles

No reptile species were recorded within the Mountain Block property during Umwelt or ELA surveys, however this does not indicate absence of this group as no surveys were targeted for this fauna group.

No threatened or introduced reptile species have been recorded in the Mountain Block property.

1.3.4 Amphibians

Two amphibian species were recorded in the Mountain Block property from the Umwelt 2013 surveys and ELA 2012 surveys, being the Verreaux's tree frog (*Litoria verreaux*ii) and the common brown froglet (*Crinia signifera*).

No threatened or introduced amphibian species have been recorded in the Mountain Block property.

1.3.5 Fauna Habitat in the Mountain Block property

Four general fauna habitat types occurred within the Mountain Block property. Each of these broad habitat types has a range of characteristics which influence the habitat value, and the range of fauna species which are likely to be identified within each type. The broad habitat types recorded within the Mountain Block property comprised of rainforest, woodland, grassland and water bodies.

1.3.5.1 Rainforest Habitat

The rainforest habitat of the Mountain Block property was small in size comprising only 8 hectares and two communities (being Rusty Fig Dry Rainforest and Grey Myrtle – Kangaroo Vine Dry Rainforest). The canopy was dominated by rusty fig (*Ficus rubiginosa*), rough-barked apple (*Angophora floribunda*) and forest red gum (*Eucalyptus tereticornis*). The canopy height ranged from 17 to 23 metres with a foliage cover of 30 per cent.

The rainforest habitat provides a number of specific habitat resources for bird species, specifically for fructivorous birds and nectarivorous birds, including the potentially occurring threatened species little lorikeet (*Glossopsitta pusilla*), regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*). Such flowering resources attract large numbers of insects which provide foraging habitat for a diversity of threatened micro-bats. Many of the understorey species are valuable flowering resources utilised by a diversity of nectarivorous bird species. Bird assemblages would be likely to vary considerably according to seasonal flowering events.

Hollow-bearing tree densities in this habitat are low with no large hollows identified. Hollows are likely to be limited to small or very small hollows (<50 millimetres in size), which are likely to predominantly provide habitat for tree-hollow roosting micro-bat species.

Large amounts of terrestrial habitat (leaf litter, rocky areas, low vegetation and fallen timber) provide protection and foraging resources for small terrestrial mammals, such as small mammals and reptiles.

Rocks and boulder habitat occurred within this habitat providing potentially denning sites for numerous small terrestrial mammal species including potentially the threatened spotted-tailed quoll (*Dasyurus maculatus maculatus*).

1.3.5.2 Woodland Habitat

Woodland habitat occurred on lower and upper slopes covering approximately 37 hectares of the Mountain Block property, generally in flat or undulating terrain on fertile soils. Due to the terrain and fertile soils, this habitat type has been subjected to previous land clearing for livestock grazing.

Woodland habitat was characterised by an open to sparse canopy layer, generally with an absent shrub layer and dense ground cover layer. The canopy height ranged from 10 to 23 metres with a foliage cover of between 10 and 20 per cent. The trees were generally consistent in age and health across this habitat type within the Mountain Block property with canopy species generally young with an occasional mature tree observed. The eucalypt species present within the Woodland habitat provide seasonal foraging resources for a number of nectarivorous bird species and mammals, as well as insectivorous birds. Although no hollow-bearing trees were identified, it was considered that eucalypt species present were likely to provide hollow resources in low numbers (less than 10 hollows per hectare).

The shrub layer was typically absent however scattered logs and rocks occurred adjacent to the scattered mature trees which provide refuge and foraging habitat for small mammal, reptile and amphibian species. Minimal fallen timber, rocks or boulders were identified.

The grassy understorey provided foraging habitat for macropods and for omnivorous birds such as the Australian magpie (*Gymnorhina tibicen*). Grass cover ranged from 70 to 100 per cent and ranged in height from 0.1 to 1 metre. The woodlands contained predominately native grass species with few exotic occurring mainly along the ecotones between this habitat type and the grazed grasslands.

1.3.5.3 Grassland Habitat

Grassland habitat covered approximately 104 hectares of the Mountain Block Property. Canopy trees were typically absent from this habitat type however occasional mature trees were recorded, which potentially provide hollow resources and woody debris from bird and reptile species.

A scattered shrub layer contained a low level of species and structural diversity. Ground cover was dominated by grass and sedge cover. Areas of soil, litter, lichen, and boulder/solid rock ground cover were recorded. Grassland habitat areas were typically comprised of a mixed native species which provides foraging habitat for macropods and for omnivorous birds.

1.3.5.4 Water Habitat

Although no water bodies flow through the Mountain Block property, several dams are present throughout that provide a drinking source and habitat for aquatic species as well as refuge for amphibian species.

1.3.6 Threatened Fauna

A total of three threatened species were recorded across the Mountain Block property (**Table 10**).

Table 10 – Threatened Fauna Species Recorded within the Mountain Block Property

Species Name	Scientific Name	Status	
		TSC Act	EPBC Act
Speckled warbler	*Chthonicola sagittata*	V	
Spotted harrier	*Circus assimilis*	V	
Spotted-tailed quoll	*Dasyurus maculatus maculatus*	V	E

1.3.6.1 Speckled warbler (*Chthonicola sagittata*)

The speckled warbler, listed as Vulnerable under the TSC Act, was recorded at two occasions in a gully on the northern boundary of Mountain Block (see Figure 7.3 of the main report). It is likely that a resident population of this species occurs in the Mountain Block property.

1.3.6.2 Spotted Harrier (*Circus assimilis*)

The spotted harrier, listed as Vulnerable under the TSC Act, was recorded on two occasions (likely as a single individual) foraging over grassland directly north of Hebden Road (see Figure 7.3 of the main report). It is likely that this species would forage throughout the habitats provided within the Mountain Block property.

1.3.6.3 Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)

The spotted-tailed quoll (*Dasyurus maculatus maculatus*) is listed as vulnerable under the TSC Act and as endangered under the EPBC Act. There have been 12 records of this species made within the Mountain Block property. It is likely that this species forages across the Mountain Block holdings

Latrine sites were identified at eight locations in the Mountain Block (see Figure 7.3 of the main report), including one large and regularly used latrine at the top of the hill. A total of six spotted-tailed quolls were positively identified as using this latrine between 6 and 17 June, with multiple individuals visiting the latrine during a single 24 hour period on three occasions. Scat samples were collected from seven latrines for dietary analysis.

A den site containing fresh scats was identified under a boulder amongst rock outcropping near to the large latrine in Mountain Block (see Figure 7.3 of the main report). This was monitored with a remote sensing camera and recorded individuals investigating, entering and leaving the den on several occasions.

Movement of an individual from Mountain Block south along Bowmans Creek was recorded from remote cameras on 8 June, however it is likely that other individuals would also use the Bowmans Creek corridor for movement in a north/south direction. The female recorded in 2012 was not identified in the northern section of Bowmans Creek or Mountain Block, but was recognised from a remote camera station placed by Enright Land Management approximately 400 metres east of where Umwelt recorded her in 2012. Scat samples were collected from four latrine sites along Bowmans Creek, including three previously known and one newly discovered latrine (see Figure 7.3 of the main report). One previously known latrine showed a high level of activity with many fresh scats and multiple rocks used.

1.3.7 Endangered Fauna Populations

No endangered fauna populations were recorded or are considered likely to occur within the Mountain Block property.

1.3.8 Threatened Fauna Species and Endangered Fauna Populations With Potential to Occur Within the Mountain Block Property

Although only three threatened fauna species were identified within the Mountain Block property, a further 16 threatened fauna species (including eight birds and eight mammals) were considered to have a high potential to occur and a further 19 species (13 birds and six mammals) were considered to have a moderate potential to occur (see **Table 4**).

Table 5 identified a further two bird species listed as migratory under the EPBC Act with a high potential to occur and a further five migratory bird species with a moderate potential to occur in the Mountain Block property

1.3.9 SEPP 44 (Koala Habitat) Assessment Results

A total of 6 sites were assessed for the presence and percentage composition of SEPP 44 Schedule 2 tree species. Based on these assessments, two sites were identified as potential koala (*Phascolarctos cinereus*) habitat, as the upper and lower strata consisted of 15 per cent or more of Schedule 2 tree species. The Schedule 2 feed tree species identified was forest red gum (*Eucalyptus tereticornis*).

No koalas or evidence of koala presence was identified in the Mountain Block property. Whilst no koala core habitat was identified it does not exclude the potential for the Mountain Block property to provide core koala habitat.

APPENDIX 8

Mountain Block Flora Species List

Appendix 8 – Mountain Block Flora Species List

The following list (**Table 1**) was developed from surveys of the Mountain Block property as detailed in Appendix 6. It includes all species of vascular plants observed within the Mountain Block property during fieldwork completed by Umwelt in 2013. Although substantial, the list will not be comprehensive because not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp.	specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

1 to 6	modified Braun-Blanquet cover-abundance score (see Section 1.2.1 of Appendix 6);
asterisk (*)	denotes species not native to Mountain Block;
subsp.	subspecies; and
var.	variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al*. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2013), the online plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources.

Table 1 - Flora Species Recorded on Mountain Block Property

Family	Scientific Name	Common Names	MBQ1	MBQ2	MBQ3	MBQ4	MBQ5	MBQ6	Opps
Filicopsida									
Adiantaceae	*Adiantum aethiopicum*	common maidenhair	3			2			
Adiantaceae	*Cheilanthes sieberi* subsp. *sieberi*	poison rock fern		2	3		1		
Adiantaceae	*Pellaea falcata*	sickle fern	3						
Dennstaedtiaceae	*Pteridium esculentum*	bracken				1			
Polypodiaceae	*Pyrrosia confluens*	horseshoe felt fern	3						
Magnoliopsida (flowering plants) – Liliidae (monocots)									
Anthericaceae	*Dichopogon strictus*	chocolate lily			1				
Cyperaceae	*Lepidosperma laterale*	variable saw-sedge				2			
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*			1			1		
Luzuriagaceae	*Eustrephus latifolius*	wombat berry	3			2			
Phormiaceae	*Dianella* sp.		2		1	1			
Poaceae	*Aristida* sp.			3	3		3	3	
Poaceae	*Austrostipa scabra subsp. falcata*							2	
Poaceae	*Austrostipa verticillata*	slender bamboo grass				3	2	3	
Poaceae	*Bothriochloa macra*	red grass		2	2				
Poaceae	*Chloris truncata*	windmill grass						3	
Poaceae	*Chloris ventricosa*	tall chloris		2	2		3		
Poaceae	*Cymbopogon refractus*	barbed wire grass		4	4		3	3	
Poaceae	*Echinopogon ovatus*	forest hedgehog grass			3				
Poaceae	*Eragrostis* sp.			2	1		2	2	
Poaceae	*Imperata cylindrica*					3	1		
Poaceae	*Oplismenus aemulus*	basketgrass	3			2			
Poaceae	*Panicum effusum*	poison or hairy panic		2	2		2		
Poaceae	*Poa sieberiana*			1					
Poaceae	*Rytidosperma setaceum*							1	
Poaceae	*Sporobolus creber*	slender rats tail grass		4			4	2	
Poaceae	*Themeda australis*	kangaroo grass		2			2	2	

Family	Scientific Name	Common Names	MBQ1	MBQ2	MBQ3	MBQ4	MBQ5	MBQ6	Opps
Magnoliopsida (flowering plants) – Magnoliidae (dicots)									
Acanthaceae	*Brunoniella australis*	blue trumpet					3	2	
Aizoaceae	**Galenia pubescens*	galenia					1	3	
Anacardiaceae	**Schinus areira*	pepper tree			2				1
Asclepiadaceae	**Gomphocarpus fruticosus*	narrow-leaved cotton bush		3			2		
Asteraceae	**Bidens pilosa*	cobblers pegs	3	3	2	4			
Asteraceae	**Cirsium vulgare*	spear thistle		1					
Asteraceae	**Conyza bonariensis*	flaxleaf fleabane						1	
Asteraceae	**Hypochaeris radicata*	catsear		2	1		2		
Asteraceae	**Senecio madagascariensis*	fireweed		2	2	2	3	2	
Asteraceae	**Tagetes minuta*	stinking Roger	2	3	2	3			
Asteraceae	*Chrysocephalum apiculatum*	common everlasting, yellow but			2		3		
Asteraceae	*Vittadinia cuneata*	fuzzweed						1	
Brassicaceae	**Lepidium africanum*	peppercress						1	
Cactaceae	**Opuntia humifusa*	creeping pear			1				
Cactaceae	**Opuntia stricta* var. *stricta*	common prickly pear			1	1		1	
Campanulaceae	*Wahlenbergia gracilis*	sprawling or Australian bluebell		1			1		
Caryophyllaceae	**Stellaria media*	common chickweed		1	1		2		
Chenopodiaceae	*Atriplex semibaccata*	creeping saltbush					1		
Chenopodiaceae	*Einadia nutans* subsp. *nutans*							1	
Chenopodiaceae	*Maireana microphylla*	eastern cottonbush					3	3	
Convolvulaceae	*Dichondra repens*	kidney weed	2	2	3	3	2	2	
Dilleniaceae	*Hibbertia obtusifolia*	hoary guinea flower			1				
Euphorbiaceae	*Breynia oblongifolia*	coffee bush			3	2			
Fabaceae (Faboideae)	*Daviesia ulicifolia*	gorse bitter pea					1		
Fabaceae (Faboideae)	*Glycine clandestina*			2					
Fabaceae (Faboideae)	*Glycine tabacina*			2	2		2	2	

Family	Scientific Name	Common Names	MBQ1	MBQ2	MBQ3	MBQ4	MBQ5	MBQ6	Opps
Fabaceae (Mimosoideae)	*Acacia salicina*	cooba			2				
Linaceae	*Linum marginale*	native flax					1		
Malvaceae	**Sida rhombifolia*	Paddys lucerne				2	2	2	
Malvaceae	*Sida corrugata*						1		
Moraceae	*Ficus rubiginosa*	Port Jackson fig, rusty fig	3			3			
Myoporaceae	*Eremophila debilis*	amulla					3	3	
Myrtaceae	*Angophora floribunda*	rough-barked apple	3			3			
Myrtaceae	*Backhousia myrtifolia*	grey myrtle	4						
Myrtaceae	*Corymbia maculata*	spotted gum			3				
Myrtaceae	*Eucalyptus crebra*	narrow-leaved ironbark			3	2		4	
Myrtaceae	*Eucalyptus tereticornis*	forest red gum	3			3			
Oleaceae	**Olea europaea* subsp. *cuspidata*	African olive				3			
Oleaceae	*Notelaea microcarpa* var. *microcarpa*	native olive	3		3	2			
Phytolaccaceae	**Phytolacca octandra*	inkweed				1			
Pittosporaceae	*Pittosporum undulatum*	sweet pittosporum				2			1
Plantaginaceae	**Plantago lanceolata*	lambs tongues			1		2		
Plantaginaceae	**Plantago major*	large plantain						1	
Polygonaceae	*Rumex brownii*	swamp dock		1					
Rosaceae	**Rubus fruticosus*	blackberry complex				1			
Rubiaceae	*Asperula conferta*	common woodruff			2		2		
Rubiaceae	*Galium propinquum*	Maori bedstraw				1			
Rutaceae	*Geijera salicifolia*	brush wilga							1
Solanaceae	**Lycium ferocissimum*	African boxthorn			2	1			
Solanaceae	*Solanum brownii*	violet nightshade			1	1		1	
Sterculiaceae	*Brachychiton populneus* subsp. *populneus*	kurrajong			1				1
Thymelaeaceae	*Pimelea* sp.				2				
Urticaceae	*Urtica incisa*	stinging nettle			2				
Verbenaceae	**Verbena bonariensis*	purpletop		2			2		
Verbenaceae	**Verbena rigida*	veined verbena		2					

Family	Scientific Name	Common Names	MBQ1	MBQ2	MBQ3	MBQ4	MBQ5	MBQ6	Opps
Verbenaceae	*Clerodendrum tomentosum*	hairy clerodendrum				2			
Vitaceae	*Cayratia clematidea*	slender grape				2			
Vitaceae	*Cissus antarctica*	water vine	4						

APPENDIX 9

Mountain Block Fauna Species List

Appendix 9 – Mountain Block Fauna Species List

The following list was developed from the fauna field surveys of the Mountain Block property detailed in the main report. It includes all species of vertebrate fauna recorded within the Mountain Block property during fieldwork completed by Umwelt. This list also includes fauna species recorded during ELA 2012 surveys.

The following abbreviations or symbols are used in the list:

asterisk (*)	denotes species not indigenous to the Mountain Block property;
MAR	Listed marine species under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act);
V	Vulnerable under Schedule 2 of the *Threatened Species Conservation Act* 1995 (TSC Act) or EPBC Act; and
x	Identified from visual sighting or characteristic call.

Birds recorded were identified using descriptions in Slater *et al*. (2003) and the scientific and common name nomenclature of Birds Australia. Reptiles recorded were identified using keys and descriptions in Cogger (2000), Swan *et al*. (2004) and Wilson & Swan (2010) and the scientific and common name nomenclature of Cogger (2000).

Amphibians recorded were identified using keys and descriptions in Cogger (2000) and Robinson (2002) and the scientific and common name nomenclature of Cogger (2000). Mammals recorded were identified using keys and descriptions in Van Dyke and Strahan (2008), Churchill (2008) and Menkhorst and Knight (2011) and the scientific and common name nomenclature of Van Dyke and Strahan (2008).

Scientific Name	Common Name	Conservation Status		Umwelt Records	ELA Records
		TSC Act	EPBC Act		
AMPHIBIANS					
Myobatrachidae					
Crinia signifera	common eastern froglet			x	x
Hylidae					
Litoria verreauxii	Verreauxs tree frog			x	
BIRDS					
Charadriidae					
Vanellus miles	masked lapwing				x
Columbidae					
Phaps chalcoptera	common bronzewing			x	
Ocyphaps lophotes	crested pigeon			x	
Accipitridae					
Accipiter fasciatus	brown goshawk		MAR	x	
Circus assimilis	spotted harrier	V		x	
Aquila audax	wedge-tailed eagle			x	x
Cacatuidae					
Cacatua galerita	sulphur-crested cockatoo				x
Psittacidae					
Alisterus scapularis	Australian king-parrot			x	
Platycercus elegans	crimson rosella				x
Platycercus eximius	eastern rosella			x	
Halcyonidae					
Dacelo novaeguineae	laughing kookaburra			x	
Climacteridae					
Corombates leucophaea	white-throated treecreeper			x	x
Maluridae					
Malurus cyaneus	superb fairy-wren			x	x
Acanthizidae					
Sericornis frontalis	white-browed scrubwren			x	
Chthonicola sagittata	speckled warbler	V		x	
Smicrornis brevirostris	weebill			x	
Acanthiza nana	yellow thornbill			x	
Acanthiza reguloides	buff-rumped thornbill			x	
Pardalotidae					
Pardalotus punctatus	spotted pardalote			x	x
Pardalotus striatus	striated pardalote			x	
Meliphagidae					
Acanthorhynchus tenuirostris	eastern spinebill			x	x
Meliphaga lewinii	Lewins honeyeater			x	x
Lichenostomus chrysops	yellow-faced honeyeater			x	x
Lichenostomus leucotis	white-eared honeyeater			x	

Scientific Name	Common Name	Conservation Status		Umwelt Records	ELA Records
		TSC Act	EPBC Act		
Manorina melanocephala	noisy miner			x	x
Entomyzon cyanotis	blue-faced honeyeater			x	
Anthochaera carunculata	red wattlebird				x
Pachycephalidae					
Pachycephala pectoralis	golden whistler			x	x
Artamidae					
Cracticus torquatus	grey butcherbird			x	
Gymnorhina tibicen	Australian magpie			x	x
Strepera graculina	pied currawong			x	x
Corcoracidae					
Corcorax melanorhamphos	white-winged chough				x
Rhipiduridae					
Rhipidura albiscapa	grey fantail			x	x
Rhipidura leucophrys	willie wagtail			x	
Corvidae			MAR		
Corvus coronoides	Australian raven			x	x
Monarchidae					
Grallina cyanoleuca	magpie-lark			x	
Petroicidae					
Eopsaltria australis	eastern yellow robin			x	x
Timaliidae					
Zosterops lateralis	silvereye		MAR	x	
Hirundinidae					
Hirundo neoxena	welcome swallow		MAR	x	x
Hirundo nigricans	tree martin		MAR	x	
Sturnidae					
**Sturnus vulgaris*	common starling			x	
MAMMALS					
Dasyuridae					
Dasyurus maculatus	spotted-tailed quoll	V	E	x	
Vombatidae					
Vombatus ursinus	common wombat				x
Macropodidae					
Macropus giganteus	eastern grey kangaroo				x
Macropus rufogriseus	red-necked wallaby				x
Macropus robustus	common wallaroo			x	
Suidae					
**Sus scrofa*	pig			x	

TSC = *Threatened Species Conservation Act 1995*

EPBC = *Environment Protection and Biodiversity Conservation Act 1999*

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