Volume 2

Balranald Mineral Sands Project

Commonwealth Environmental Impact Statement

Prepared for Iluka Resources Limited
July 2016

Appendix C - Biodiversity Statement

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Appendix C

Biodiversity Assessment

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Environment and Heritage

Balranald Mineral Sands Project

Biodiversity Assessment for the Environmental Impact Statement

Prepared for Iluka Resources Ltd

June 2016

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Cover photograph: Emus adjacent to project area

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Glossary

Term	Definition
Critical habitat	A critical habitat as defined under the *Threatened Species Conservation Act 1995* includes, the whole or any part or parts of the area or areas of land comprising the habitat of an endangered species, population or ecological community or critically endangered species or ecological community that is critical to the survival of the species, population or ecological community.
Cumulative impacts	Combination of individual effects of the same kind due to multiple actions from various sources over time.
Direct impacts	Those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development. Direct impacts will result in the direct removal of 5160.4 hectares of native vegetation.
Indirect impacts	Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development.
Key threatening process	As defined under the *Threatened Species Conservation Act 1995*, a key threatening process is any listed process under the Act that adversely affects threatened species, populations or ecological communities, or that could cause species, populations or ecological communities that are not threatened to become threatened.
Local population	The population that occurs in the project area. The assessment of the local population may be extended to include individuals beyond the project area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the project area, according to the following definitions. The local population of a threatened plant species comprises those individuals occurring in the project area or the cluster of individuals that extend into habitat adjoining and contiguous with the project area that could reasonably be expected to be cross-pollinating with those in the project area. The local population of resident fauna species comprises those individuals known or likely to occur in the project area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the project area. The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the project area from time to time.
Project area	Means the subject site and any additional areas which are likely to be affected by the Balranald Project, either directly or indirectly.
Subject site	Means the area directly affected by the Balranald Project. The Balranald Project will result in the direct removal of 5160.4 hectares of native vegetation.
Threatened ecological community (TEC)	An ecological community identified by the *Threatened Species Conservation Act 1995* or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* as critically endangered, endangered or vulnerable.

Abbreviations

Acronym	Term/Definition
ANHAT	Australian Natural Heritage Assessment Tool
BBAM	BioBanking Assessment Methodology
BMP	Biodiversity Management Plan
CMA	Catchment Management Authority
DGRs	Director-General's requirements
DoE	Commonwealth Department of Environment (formerly DoE)
DPI	Department of Planning and Infrastructure
DTIRIS	NSW Department of Trade and Investment, Regional Infrastructure and Services
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Act 1999*
FM Act	*Fisheries Management Act 1997*
ha	Hectare/s
HMC	Heavy mineral concentrate
JAMBA	Japan-Australia Migratory Bird Agreement
Km	Kilometre
KTP	Key Threatening Process
LGA	Local Government Area
Mm	Millimetre
MNES	Matters of National Environmental Significance (from the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*)
NPWS	National Parks and Wildlife Service
OEH	Office of Environment and Heritage
REF	Review of Environmental Factors
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SEARs	Secretary's environmental assessment requirements
SEPP	State Environmental Planning Policy
SEPP 44	*State Environmental Planning Policy 44 – Koala Habitat Protection*
SMCA	Southern Mallee Conservation Areas
SRA	Sustainable Rivers Audit
SSD	State Significant Development
TEC	Threatened Ecological Community
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
TSF	Tailings storage facility
VCA	Voluntary Conservation Agreement
WMA	*Water Management Act 2000*
WSP	Water sharing plan

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Niche Environment and Heritage Pty Ltd (Niche) acknowledges the contribution made by Ecotone Ecological Consultants (Ecotone) to the biodiversity assessment for the Balranald Mineral Sands Project. Ecotone Ecological Consultants were originally contracted by Iluka Resources Limited to undertake aspects of the assessment and reporting which have contributed to the report text, field work and data collection, GIS data and impact assessments in this report. For the ease of preparing and reading this document use of Ecotone's data, text and other elements of the report have not been individually acknowledged.

Niche would also like to acknowledge the input of the following people and organisations in the preparation of this report:

- Julianne Goode – Iluka Resources
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- Kate Cox – EMM
- Brett McLennan – EMM
- Peter Ewin – NSW OEH
- Peter Irish – DoE
- Joe Benshemesh – Malleefowl Recovery Group

Executive summary

Context

Iluka Resources Limited (Iluka) proposes to develop a mineral sands mine in south-western New South Wales (NSW), known as the Balranald Mineral Sands Project (the Balranald Project). The Balranald Project includes construction, mining and rehabilitation of two linear mineral sand deposits, known as West Balranald and Nepean deposits, located approximately 12 km and 66 km north-west of the town of Balranald, respectively. Niche Environment and Heritage was commissioned to undertake a flora and fauna assessment for the State Significant Development (SSD) application for the Balranald Project.

Iluka received development consent under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Balranald Project on the 5th April 2016. Iluka is continuing to seek Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999* for the project, which broadly comprises:

- open cut mining of the West Balranald and Nepean deposits, referred to as the West Balranald and Nepean mines, including progressive rehabilitation
- processing of extracted ore in the project area to produce heavy mineral concentrate (HMC) and ilmenite
- road transport of HMC and ilmenite from the project area to Victoria
- backfilling of the mine voids with overburden and tailings, including transport of by-products from the processing of HMC in Victoria back to the project area for backfilling in the mine voids
- return of hypersaline groundwater extracted prior to mining to its original aquifer by a network of injection borefields
- an accommodation facility for the construction and operational workforce
- gravel extraction from local sources for construction requirements
- a water supply pipeline from the Murrumbidgee River to provide fresh water during operation.

Aims

The primary objective of this report is to describe and assess the ecological values within the project area and surrounds and determine whether the Balranald Project is likely to have a significant impact on threatened biodiversity listed on the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The report also seeks to highlight mitigation and offset measures that will reduce and manage ecological impacts from the Balranald Project.

Methods

In completing this biodiversity assessment, a number of threatened species databases and previous documents relevant to the Balranald Project have been reviewed.

Flora and fauna field survey work was performed broadly in two phases:

1. Survey of the West Balranald and Nepean mines and access roads (conducted by Ecotone 2011-2013).
2. Survey of proposed additional ancillary infrastructure areas such as gravel extraction and injection borefields (Niche 2013 - 2014).

Parts of the ecological surveys were conducted outside of the current project area as the mine plan was progressively amended during feasibility investigations in response to mine planning, and geological, geotechnical, ecological, heritage and other environmental constraints.

Overall, the completed survey effort represents a comprehensive body of work from October 2011 until December 2014.

The flora survey methodology followed the BioBanking Assessment Methodology (BBAM) (OEH 2014) with additional information recorded on the basis of current best practice flora survey guidelines for a flora assessment over a large site, particularly the Office of Environment and Heritage (OEH) Working Draft Threatened Biodiversity Survey and assessment – Guidelines for Developments and Activities (DEC 2004).

Fauna survey undertaken was consistent with various State and Federal Government guidelines including OEH's Working Draft Threatened Biodiversity Survey and assessment. The survey involved targeted fauna trapping including pitfall traps, camera traps, Elliot trapping, Anabats, harp traps, and bird, reptile and amphibian survey.

Key results

Eleven BioMetric vegetation types were identified within the project area with two additional vegetation types created to recognise highly modified vegetation communities.

None of the vegetation types within the project area are listed as Threatened Ecological Communities (TECs) under the NSW TSC Act or the Commonwealth EPBC Act.

During the field surveys, 198flora were recorded, including a total of 46 introduced species. No threatened flora listed by either the TSC Act or EPBC Act were recorded within the project area.

Based on the results of the field survey and literature review, seven threatened flora species have been identified with a low-moderate likelihood of occurrence within the project area. All of these are listed under the TSC Act and six are listed under the Commonwealth EPBC Act. These include: Mossgiel Daisy (*Brachyscome papillosa*) (EPBC Act listed), Winged Peppercress (*Lepidium monoplocoides*) (EPBC Act listed), Chariot Wheels (*Maireana cheelii),* Greenhood Orchid (*Pterostylis cobarensis*) (EPBC Act listed), Bitter Quandong (*Santalum murrayanum*) (EPBC Act listed), Slender Darling-pea (*Swainsona murrayana*) (EPBC Act listed), and Yellow Swainson-pea (*Swainsona pyrophila*) (EPBC Act listed) (hereafter referred to by botanical name).

Within and around the project area, 240 vertebrate species were recorded consisting of five frog, 156 bird, 46 reptile and 33 mammal species.

Twenty threatened fauna species were detected during field survey and are considered to be 'affected' species. All of these species are listed under the NSW TSC Act and three species are also listed under the Commonwealth EPBC Act. Species detected were: Chestnut Quail-thrush (*Cinclosoma castanotum*), Corben's Long-eared Bat(*Nyctophilus corbeni*)(EPBC Act listed), Grey-crowned Babbler*(Pomatostomus temporalis temporalis)*, Hooded Robin (*Melanodryas cucullata cucullata*),Inland Forest Bat (*Vespadelus baverstocki*), Jewelled Gecko (*Diplodactylus elderi*), Little Eagle (*Hieraaetus morphnoides*), Little Pied Bat (*Chalinolobus picatus*), Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Malleefowl (EPBC Act listed) (*Leipoa ocellata*), Pied Honeyeater (possible detection only) (*Certhionyx variegatus*), Plains-wanderer(*Pedionomus torquatus*) (EPBC Act listed - possible detection only), Redthroat (*Pyrrholaemus brunneus*), Regent Parrot (P*olytelis anthopeplus monarchoides*) (EPBC Act listed), Southern Ningaui (*Ningaui yvonneae*),Spotted Harrier (*Circus assimilis*), Varied Sittella (*Daphoenositta chrysoptera*), Western Blue-

tongue (*Tiliqua occipitalis*),White-fronted Chat (*Epthianura albifrons*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) .

In addition to the 20 threatened species detected during field surveys, six species of threatened fauna were determined to be affected species based on presence within the locality and the suitability of habitat within the project area. The six additional affected threatened species are: Southern Bell Frog (*Litoria raniformis*) (EPBC Act listed), Gilbert's Whistler (*Pachycephala inornata*), Bolam's Mouse (*Pseudomys bolam*), Western Pygmy Possum (Cercartetus concinnus), Bardick (*Echiopsis curta*) and Mallee Worm-lizard (*Aprasia inaurita*) (hereafter referred to by common name).

Impact assessment

Development of the Balranald Project will result in vegetation clearing and loss of flora and fauna habitat. Vegetation clearing extents for the various project elements are shown below.

BioMetric Vegetation Type abbreviation for this ecological assessment	Extent of Vegetation Community within disturbance area(hectares)[1]								
	Nepean mine	Nepean access road	West Balranald mine	West Balranald access road	Injection Borefield	Water Supply Pipeline	Accommodation facility	Gravel extraction area	Total
1. Spinifex Dune Mallee Woodland (LM130)	187.2	8.6	311.6	7	8.1	0	0	13.9	536.4
2.Chenopod Sandplain/Swale Mallee Woodland (LM116)	248.4	28	1392.2	14.4	366.2	2.3	0	0	2051.5
3.Black Bluebush Low Open Shrubland (LM102)	0	30	85.6	0	169.3	0	0	0	284.9
4.Pearl Bluebush Low Open Shrubland (LM138)	0	8	1032.5	0	23.9	0	0	7.7	1072.1
5.Bladder Saltbush Low Open Shrubland (LM110)	0	40	0	0	518	0	0	0	558.0
6.Old Man Saltbush Shrubland (LM137)	0	0	19.3	0	0.5	0	0	0	19.8
7.Belah – Pearl Bluebush Woodland (LM107)	0	5.3	105.8	0	3.7	0	0	0	114.8
8.Belah – Chenopod Woodland (LM108)	368.3	8	0	0	62.4	0	0	0	438.7

[1] Vegetation calculations have been rounded to one decimal place.

BioMetric Vegetation Type abbreviation for this ecological assessment	Extent of Vegetation Community within disturbance area(hectares)[1]								
	Nepean mine	Nepean access road	West Balranald mine	West Balranald access road	Injection Borefield	Water Supply Pipeline	Accommodation facility	Gravel extraction area	Total
9.Black Box – Grassy Chenopod Open Woodland (LM105)	0	0.2	1.4	0	4.3	1	0	0	6.9
10.River Red Gum Woodland (LM143)	0	0	0	0	0	3.8	0	0	3.8
11.Flat Open Claypan / Derived Sparse Shrubland /Grassland(LM124)	0	1.7	50.9	0	21	0	0	0	73.6
12.Cultivated Grain Crops / Cleared Weedy Fallow / Developed	1.2	27.5	59.4	30.5	36.3	3.8	7.1	20.3	186.1
TOTAL	805.1	157.3	3058.7	51.9	1213.7	10.9	7.1	41.9	5346.6

Potential indirect impacts include dust, noise, sedimentation or erosion in adjacent bushland and weed invasion. These indirect impacts would be ameliorated by a series of mitigation measures.

A total of 33 threatened species, comprising 7 flora species and 26 fauna species have the potential to be impacted by the Balranald Project (affected species).All of the affected species are listed under the NSW TSC Act while nine species are also listed under the Commonwealth EPBC Act.

The potentially affected species include:

- **threatened flora:** *Brachyscome papillosa, Lepidium monoplocoides, Maireana cheelii* (Chariot Wheels)*, Pterostylis cobarensis, Santalum murrayanum, Swainsona murrayana,* and *Swainsona pyrophila*

- ***threatened fauna*:** Southern Bell Frog, Chestnut Quail-thrush, Gilbert's Whistler, Grey-crowned Babbler, Hooded Robin (south-eastern form), Little Eagle, Major Mitchell's Cockatoo, Malleefowl, Pied Honeyeater, Plains-wanderer, Redthroat, Regent Parrot, Spotted Harrier, Varied Sittella, White-fronted Chat, Bolam's Mouse, Corben's Long-eared Bat, Inland forest Bat, Little Pied Bat, Southern Ningaui, Yellow-bellied Sheathtail-bat, Western Pygmy Possum, Bardick, Jewelled Gecko, Mallee Worm-lizard, Western Blue-tongued Lizard.

The *Assessment of Significance* under the TSC Act, applied to each of the 33 potentially affected threatened species (above), highlighted that six threatened species (all fauna) either could be, or are likely to be, significantly impacted such that a viable local population could be placed at risk of extinction. All significantly impacted species are tabled below with their listing status.

Significantly impacted threatened species from the Balranald Mineral Sands Project

Scientific name	Common name	TSC Act	EPBC Act
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-
Leipoa ocellata	Malleefowl	E	V
Chalinolobus picatus	Little Pied Bat	V	-
Diplodactylus elderi	Jewelled Gecko	V	-
Aprasia inaurita	Mallee Worm-lizard	E	-
Tiliqua occipitalis	Western Blue-tongued Lizard	V	-

V= vulnerable E= endangered

The *significant impact criteria* under the EPBC Act were addressed for each of eleven affected threatened and migratory species listed under the EPBC Act, and highlighted that one threatened species (the Malleefowl) would be significantly impacted. No migratory species would be significantly impacted.

Biodiversity offsetting

A Biodiversity Offset Strategy for the Balranald Project has been developed in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the Commonwealth EPBC Act 1999 Environmental Offsets and is outlined in section 7 of this report. The offset strategy primarily relies upon securing suitable lands through conservation mechanisms which are then managed for conservation in perpetuity.

Biodiversity credits required to compensate for the Balranald Project's impacts in accordance with the NSW requirements have been assessed using the BioBanking calculator with additional offset requirements added for impacts to Southern Mallee Conservation Areas.

The offset area required for MNES species significantly impacted by the Balranald Project (Malleefowl and Corben's Long-eared Bat) has been calculated using the EPBC Act offsets assessment guide. While this assessment does not conclude that Corben's Long-eared Bat will be significantly impacted, it is DoE's view that it will and therefore offsets have been calculated and provided for this species.

Initial investigation into numerous candidate offset properties has occurred and one specific site (the subject offset site) has been investigated in detail to satisfy the Commonwealth offset requirement for significant impacts to Malleefowl and Corben's Long-eared Bat via a 100% direct offset. The subject offset site will also contribute significantly towards the NSW offset requirement but additional offset measures will be needed to fulfil this requirement.

Both the NSW and Commonwealth offset requirements acknowledge the staging of the Balranald Project and allowance is made to enact the required offset measures coincidently with the two mining stages (West Balranald and Nepean mines) to reflect the timing of impacts on biodiversity. In addition, the NSW offset requirement for the West Balranald mine (stage one) is deferrable until three years after the commencement of any clearing associated with mining activities. This acknowledges impending changes to offset policy in NSW. Conversely, Commonwealth offset measures (offsets for impacts to Malleefowl and Corben's Long-eared Bat) must be in place prior to the commencement of any mining activities for the West Balranald mine.

Works undertaken to date have identified that suitable offsets exist, both in quantum and type, within the vicinity of the Balranald Project to satisfactorily cover the remaining offset requirement after securing of the subject offset site.

Mitigation and management

Management and mitigation measures associated with each stage of the Balranald Project are detailed in section 6 of this report, aligning with the requirements of development consent under the EP&A Act. The management and mitigation measures are associated with the four broad stages of the Balranald Project: project design, construction, operation, rehabilitation and closure.

A summary of the key mitigation measures include the following:

- Pre-clearing surveys for Malleefowl, which are known to use specific mound sites for breeding and will therefore benefit from further investigations identifying such sites. The surveys will be undertaken prior to clearing to identify areas where temporal clearing controls should be implemented.
- Timing of clearing: clearing window restrictions should be informed by important lifecycle events of the threatened species that would genuinely benefit from it (i.e. the threatened species known or likely to occur within the project area which are likely to be significantly impacted by the Balranald Project).
- The Closure and Rehabilitation Plan for the Balranald Project (EMM 2015) outlines the clearing method (s) that will be employed. In areas where vegetation clearing will be followed by topsoil removal clearing using a dozer is proposed with the cleared vegetation to be used immediately elsewhere in Balranald Project for progressive rehabilitation (see below).
- Where vegetation clearing will not be followed by topsoil removal, for example where vegetation removal is proposed to facilitate temporary access for the construction of the injection borefields, Iluka intends to use the trittering or mulching method of vegetation removal where possible. The use in the trittering method will assist with rehabilitation as the root ball of the plant will remain in the ground.
- Prior to carrying out any development on site, a Biodiversity Management Plan (BMP) would be prepared to inform and manage various activities throughout the life of the Balranald Project in order to protect and manage important biodiversity values. Key commitments to be covered by the BMP include threatened species management (including specific provisions for Malleefowl and Corben's Long-eared Bat), pest and weed management, fire management and site hygiene practices. The BMP will include specific protocols dealing with any potential interaction between Balranald Project activities and threatened flora or fauna species during the life of the Balranald Project. The plan will include directions for survey, monitoring and management of key threatened species known or considered to be potentially impacted by the Balranald Project (in particular Malleefowl) and protocols for reporting and managing any unforeseen threatened species occurrences within the project area. Measures designed to mitigate impacts on threatened species would be monitored for success.
- Malleefowl and Corbens Long-eared Bat management: as prominent threatened species known to occur within the project area, a specific Malleefowl and Corben's Long-eared Bat management and monitoring plan will be developed, and include the following:
    - monitoring the status and use of active and recently active mounds leading up to the commencement and throughout the life of the Balranald Project prior to clearing events as per clearing specifications
    - identification of previously unidentified Malleefowl mounds through foot surveys and/or aerial surveys using LIDAR (if available) or stereoscopy over the project area at least within areas identified as moderate to very high potential habitat for the species
    - in areas where known active or recently active mounds occur vegetation clearing protocols will follow those described in Section 6.2.1
    - communications protocols to inform staff and contractors of the presence and importance of Malleefowl and Corbens Long-eared Bat and controls in place for impact minimisation
    - planning to minimise road-strike for Malleefowl by limiting truck speeds and provision of appropriately sized signage along access roads, particularly areas close to active or recently active mounds
    - establishment of a protocol to identify and clean up potential spillages on roads so that Malleefowl and other species are not attracted to the roadside environment

- development of methods and communication tools to monitor road-strike and mortality of Malleefowl and disseminate such information to the public and appropriate state and local authorities/interest groups
- establishing a rapid response protocol to control bushfires, particularly those affecting mallee habitat, within or adjacent to the project area (this will form part of Iluka's Emergency Management Plan)
- management of feral species, incorporating predator control programs including fox and cat baiting
- management of noxious or environmental weeds
- dust, noise and light minimisation, especially where mounds occur within 200 m disturbance source

1. Introduction

1.1 Overview

Iluka Resources Limited (Iluka) proposes to develop a mineral sands mine in south-western New South Wales (NSW), known as the Balranald Mineral Sands Project (the Balranald Project). The Balranald Project includes construction, mining and rehabilitation of two linear mineral sand deposits, known as West Balranald and Nepean. These mineral sands deposits are located approximately 12 km and 66 km north-west of the town of Balranald (Figure 1 and Figure 2).

- Iluka received development consent under Part 4 of the EP&A Act for the Balranald Project on the 5th April 2016 and is continuing to seek Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999* for the Balranald Project, broadly comprising: open cut mining of the West Balranald and Nepean deposits, referred to as the West Balranald and Nepean mines, including progressive rehabilitation
- processing of extracted ore to produce heavy mineral concentrate (HMC) and ilmenite
- road transport of HMC and ilmenite to Victoria
- backfilling of the mine voids with overburden and tailings, including transport of by-products from the processing of HMC in Victoria for backfilling in the mine voids
- return of hypersaline groundwater extracted prior to mining to its original aquifer by a network of injection borefields
- an accommodation facility for the construction and operational workforce
- gravel extraction from local sources for construction requirements
- a water supply pipeline from the Murrumbidgee River to provide fresh water during construction and operation.

Separate approvals are being sought for:

- the construction of a transmission line to supply power to the Balranald Project
- project components located within Victoria.

1.2 Project setting

The regional geographical, environmental and landscape context is provided below in Table 1. This covers the primary areas of the project area consisting of the West Balranald and Nepean mines.

Table 1. Regional geographic and context

Project area	Description
Bioregion	Murray Darling Depression and Riverina
Botanical subregion	South Far Western Plains
Catchment Management Authority	Lower Murray Darling Catchment Management Authority (CMA) and Murrumbidgee CMA (NSW)
Mitchell Landscape	Lachlan Lakes, Swamps and Lunettes; Lachlan Depression Plains; Mallee Cliffs Sandplains; and Lachlan Channels and Floodplains
Local government area	Balranald Shire (NSW)
Nearby conservation areas	Mungo State Conservation Area, Yanga Nature Reserve, Yanga National Park

Project area	Description
West Balranald mine	
Surrounding land use	Mostly agricultural land consisting of patches of mallee, saltbush plains and grain cropping. The project area contains, and is contiguous with Southern Mallee Conservation Areas (Figure 2). Charcoaling operations are also undertaken in the area and a gypsum mine is located approximately 4km to the east of the southern boundary of the West Balranald mine.
Watercourses, drainage and catchment	The Murrumbidgee River is to the east and south of the project area. The West Balranald mine is part of the catchment for Paika Creek (central) and Box Creek (northern part) (Figure 3). Dry lake beds (Muckee and Tin Tin) occur in the northern half and are currently being cropped (Figure 3).
Geology	The northern third of the project area consists of flat alluvial and lacustrine deposits of gravel, sand, silt and clay. The southern two-thirds of the project area consists of aeolian flat to gently undulating plains and dunes of red and red-brown clayey sands and loams (Soil Conservation Service of NSW 1990).
Fire History	Woodland within the project area is mapped as unburnt since at least 1972 (Figure 4). There was no contradictory evidence to this witnessed during field surveys although localised fire may have occurred in some areas.
Elevation	Approximately 60 – 75m
Prominent ecological features	The West Balranald mine passes through an area of the Southern Mallee Conservation Area which is fenced and set aside as an offset for clearing mallee remnants for agriculture. Special conditions have been attached to the Western Lands Lease No.1849 with regards to management issues such as fencing, grazing, vegetation removal and using best management practices specified in a document 'Southern Mallee Regional Guidelines for the Development of Land Use Agreements' (Maloney Field Services, 2011).
Local Government Areas	Balranald Shire (NSW)
Nepean mine	
Surrounding land use	Apart from the Southern Mallee Conservation Area (Figure 3), the project area is currently used for agricultural purposes, particularly sheep grazing. All areas are grazed by feral goats, which has resulted in a reduced shrub and ground layer within the mallee. Outside of the conservation area, some clearing of mallee remnants has taken place in the far south of the project area.
Watercourses, drainage and catchment	The project area is part of the catchment for Box Creek. Dry lake beds occur to the east and south of the project area (Figure 3).
Geology	The project area consists of tertiary marine and non-marine sediments (silty sands, course sand and gravels and fine-medium quartz sand) overlain with Quaternary aeolian fluvial and lacustrine deposits of sand, silt and clay.
Fire History	The vast majority of woodland within the project area is mapped as unburnt since at least 1972 (Figure 4). Two small areas are mapped as having being burnt between 2004-2005 and between 2005 -2007. There was no contradictory evidence to this witnessed during field surveys although localised fire may have occurred in some areas.
Elevation	Approximately 55 – 105m
Prominent ecological features	The Nepean mine occurs within a large area of linear Dune Mallee with approximately 60% being within the Wampo Southern Mallee Conservation Area. This conservation area contains known habitat for the listed endangered

Project area	Description
	species, Malleefowl and western pygmy possum and several listed vulnerable species e. g. southern ningaui, Major Mitchell's cockatoo, chestnut quail-thrush and inland forest bat (James Val OEH pers. comm.). Several threatened reptile species dependant on spinifex mallee could also occur. The conservation status and ecology of all these species is discussed in subsequent sections of this report.
Local Government Areas	Balranald Shire (NSW)

1.3 Project schedule

The Balranald Project will have a life of approximately 15 years, including construction, mining, backfilling of overburden material, rehabilitation and closure.

Construction of the Balranald Project will commence at the West Balranald mine, and is expected to take about 2.5 years. Operations will commence at the West Balranald mine in Year 1 of the operational phase, which will overlap with approximately the last six months of the construction. The operational phase would include mining and associated ore extraction, processing and transport activities, and would be approximately nine years in duration. This would include completion of backfilling overburden into the pits at both the West Balranald and Nepean mines. Construction of infrastructure at the Nepean mine will commence in approximately Year 5 of the operational phase, with mining of ore starting in Year 6, and being complete by approximately Year 8.

Rehabilitation and decommissioning is expected to take a further two to five years following Year 9 of the operational phase.

1.4 Project area

All development for the Balranald Project that is the subject of the application is within the project area (Figure 2). The project area is approximately 9,964 ha, and includes the following key project elements, described in subsequent sections:

- West Balranald and Nepean mines
- West Balranald access road
- Nepean access road
- Injection borefields
- Gravel extraction
- Water supply pipeline (from the Murrumbidgee River)
- Accommodation facility.

Within the project area, the land directly disturbed for the Balranald Project is referred to as the disturbance area. For some project elements in the project area, a larger area has been surveyed than would actually be disturbed. This enables some flexibility to account for changes that may occur during detailed design and operation. The project area and disturbance area for each project element is provided in Table 2.

Table 2. Project area and disturbance area components for the Balranald Project

Project element	Project area (ha)	Disturbance area (ha)
West Balranald mine	3,059	3,059
Nepean mine	805	805
West Balranald access road	128	52 [1]
Nepean access road	173	156[2]
Injection borefields	5,721	1,214 [3]
Gravel extraction	42	42
Water supply pipeline	29	11 [4]
Accommodation facility	7	7
Total	**9,964**	**5,346**

Notes: 1. 60 m wide corridor within project area; 2. 40-50 m wide corridor within project area; 3. 100 m wide corridors within project area; and 4. 15 m wide corridor within project area

1.4.1 West Balranald and Nepean mines

The West Balranald and Nepean mines include:

- open cut mining areas (i.e. pit/mine void) that would be developed using conventional dry mining methods to extract the ore
- soil and overburden stockpiles
- ore stockpiles and mining unit plant (MUP) locations
- a processing area (at the West Balranald mine), including a mineral processing plant, tailings storage facility (TSF), maintenance areas and workshops, product stockpiles, truck load-out area, administration offices and amenities
- groundwater management infrastructure, including dewatering, injection and monitoring bores and associated pumps and pipelines
- surface water management infrastructure
- services and utilities infrastructure (e.g. electricity infrastructure)
- haul roads for heavy machinery and service roads for light vehicles
- other ancillary equipment and infrastructure.

The location of infrastructure at the West Balranald and Nepean mines would vary over the life of the Balranald Project according to the stage of mining.

1.4.2 Injection borefields

The Balranald Project requires a network of injection borefields in the Balranald Project for the return of hypersaline groundwater to the Loxton Parilla Sands aquifer. Within each borefield, infrastructure is generally located in two 50 m wide corridors (approximately 350-400 m apart) and typically comprises:

- a network of pipelines with a graded windrow on either side
- access roads for vehicle access during construction and operation
- rows of injection wells, with wells spaced at approximately 100 m intervals
- a series of water storage dams to store water during well development.

1.4.3 Access roads

There are two primary access roads within theproject area to provide access to the Balranald Project:

- West Balranald access road – a private access road to be constructed from the Balranald Ivanhoe Road to the West Balranald mine
- Nepean access road – a route comprising private access roads and existing public roads. A private access road would be constructed from the southern end of the West Balranald mine to the Burke and Wills Road. The middle section of the route would be two public roads, Burke and Wills Road and Arumpo Road. A private access road would be constructed from Arumpo Road to the Nepean mine.

The West Balranald access road would be the primary access point to the project area, and would be used by heavy vehicles transporting HMC and ilmenite. The Nepean access road would primarily be used by heavy vehicles transporting ore mined at the Nepean mine to the processing area at the West Balranald mine.

During the initial construction phase, existing access tracks through the project area from the local road network may also be used temporarily until the West Balranald and Nepean access roads and internal access roads within the Balranald Project are established.

1.4.4 Accommodation facility

An accommodation facility would be constructed for the Balranald Project workforce. It would operate throughout the construction and operation phases of the Balranald Project. It would be located adjacent to the West Balranald mine near the intersection of the West Balranald access road with the Balranald Ivanhoe Road.

1.4.5 Water supply pipeline

A water supply pipeline would be constructed to supply water from the Murrumbidgee River for operation of the Balranald Project.

1.4.6 Gravel extraction

Gravel would be required during the construction and operational phases of the Balranald Project. Local sources of gravel (borrow pits) have been included in the project area to provide gravel during the construction phase. During the construction phase, gravel would be required for the construction of the West Balranald access road, internal haul roads and service roads, and hardstand areas for infrastructure. Processing operations, such as crushing and screening activities (if required) would also be undertaken at the borrow pits. Additional gravel required during construction and operations would be obtained from external sources.

1.5 Approval process

In NSW, the Balranald Project has been granted consent under Part 4, Division 4.1 of the EP&A Act. Part 4 of the EP&A Act relates to development assessment. Division 4.1 specifically relates to the assessment of development deemed to be SSD. The Balranald Project is a mineral sands mining development which meets the requirements for SSD.

The application for SSD was accompanied by an environmental impact statement (EIS), prepared in accordance with the NSW *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

An approval under the Commonwealth EPBC Act is required for the Balranald Project (with the exception of the transmission line which will be subject to a separate EPBC Act referral process). A separate EIS (this EIS) is required to support an application in accordance with the requirements of Part 8 of the EPBC Act.

1.5.1 Secretary's environmental assessment requirements

This biodiversity assessment was prepared to address specific requirements provided in the Secretary's environmental assessment requirements (SEARs) for the SSD application, issued on 2 December 2014. Table 3 below cross-references this report and the relevant SEARs.

Table 3. Relevant SEARs for this assessment

Requirement	Section addressed in report
A description of the existing environment likely to be affected by the development, using sufficient baseline data	Sections 2, 3 and 4
An assessment of the potential impacts of all stages on the development, including any cumulative impacts taking into consideration relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practise	Section 5
A description of the measures that would be implemented to mitigate and/or offset the potential impacts of the development, and an assessment of Whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented	Sections 6 and 7
The likely effectiveness of these measures	Sections 6 and 7
Whether contingency plans would be necessary to manage any residual risks	Sections 6 and 7
A description of the measures that would be implemented to monitor and report on the environmental performance of the development if it is approved	Sections 6 and 7
An assessment of the likely biodiversity impacts of the development, having regard to the principles and strategies in the draft NSW Biodiversity Offsets Policy for Major Projects and the requirements of OEH	Sections 5, 6 and 7
Measures taken to avoid, reduce or mitigate impacts on biodiversity	Sections 6 and 7
Accurate estimates of proposed vegetation clearing	Sections 5, 6 and 7
A comprehensive offset strategy to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term.	Section 7

1.5.2 Controlling provisions for the Controlled Action

This biodiversity assessment has been prepared to address the relevant controlling provisions as outlined in the Referral Decision and Designated Proponent – Controlled Action – Decision on Assessment Approach notification. Table below cross-references this report and the relevant controlling provisions.

Table 4. Relevant controlling provisions for the controlled action under the EPBC Act

Relevant controlling action	Section addressed in report
World Heritage properties	Not addressed in this report
National Heritage places	Not addressed in this report
Listed threatened species and communities	Section 4 and 5, 7 (offsets) and Appendices1, 2, 3, 7 and 8
Listed migratory species	Section 4 and 5, 7 (offsets) and Appendices 1 and 2.

1.6 Consultation

A core requirement of the SEARs was to undertake consultation with relevant agencies and provide evidence that development and environmental assessment addresses the considerations of various agencies.

Table 5 below summarises they key issues covered during correspondence with various agencies including the OEH, Department of Environment (DoE) and the Department of Primary Industries (DPI). Several meetings took place with key stakeholders specifically to present information on the Balranald Project in regard to ecology and to seek advice regarding survey, impact assessment and offsetting requirements.

Table 5. Address of issues which arose during consultation

Dates of consultation	Relevant key issues/discussion points	How are the issues addressed in this report?
5 June 2012, OEH office, Buronga, Iluka Resources, OEH and EMM	Meeting between OEH, Iluka and EMM representatives to discuss approach to offsetting. The following offsetting mechanisms, options/mechanisms for securing offsets include: • BioBanking – this mechanism is strongly supported by OEH and has prescribed reporting mechanisms. OEH noted that this option has not been popular in NSW. • Handover to National Parks and Wildlife Service (NPWS) - This mechanism is strongly supported by OEH if appropriate/suitable offset areas which provide a connection with existing NPWS land (such as state conservation areas or National Parks). • Voluntary Conservation Agreement (VCA) – an agreement with OEH (specifically the Minister for the Environment). Could form part of a wider offset management package. Would be developed in consultation with OEH. It would include monitoring requirements for vegetation quality and feral animal control. • Conservation property vegetation plan (PVP) – implemented through the Catchment Management Authority (CMA). Could form part of a wider offset package. • Existing PVPs – existing PVPs which are due to expire in the next 5-10 years could be secured in perpetuity by Iluka. Could form part of a wider offset package. • Indirect offset – such as provision of funding or other indirect means of offsetting in lieu of provision of physical offsets. This option is only supported by OEH where all other offsetting options have been fully exhausted. • OEH indicated a preference for smaller, higher quality offsets and good ongoing management, as opposed to strict adherence to a ratio of the cleared vegetation. Like for like vegetation as offsets is preferable. Southern Mallee Conservation Areas • OEH's expectation would be that existing Southern Mallee Conservation Areas are offset in accordance the quantum determined in the offset plan, plus an additional area would be offset at the same ratio as the original conservation area. • Iluka would need to obtain original conservation agreements/leases to determine the original offset ratio of existing Southern Mallee Conservation Areas. • OEH noted that a sounder conservation outcome could be achieved if these areas were subject to further management as part of an offset strategy in perpetuity. Offset strategy development and EIS requirements • An assessment of the mechanisms and their suitability for Balranald Project should be discussed. • If known, proposed offset sites could be presented in the EIS, but this is not mandatory. • OEH indicated that a biodiversity offset strategy would need to be in place prior to any clearing for Balranald Project (i.e. not necessarily prior to approval).	The options available for offsetting are discussed in section 7. SMCAs and how they have been applied in the offset strategy are addressed in section 7.
18 December 2012 meeting with DoE	Meeting between Iluka and DoE discussing the adequacy of the Balranald Project environmental impact statement (EIS) ecological field survey. Iluka agreed to provide further information on the process, methodology and effort for ecological field surveys.	Details of the field survey are provided in section 3.
19 April 2013 Email from DoE outlining	Email outlining survey effort and impact for the threatened flora *Pterostylis cobarensis*, *Lepidium monoplocoides* and *Brachyscome papillosa* and threatened fauna Malleefowl and Regent Parrot.	Details of the field survey are provided in section 3.

Dates of consultation	Relevant key issues/discussion points	How are the issues addressed in this report?
remaining concerns		
21 June 2013 Meeting between DoE, Iluka, EMM and Ecotone	A phone conference was held between DoE, Iluka, EMM and Ecotone Ecological Consultants on 21 June 2013 to discuss survey effort, in particular threatened fauna, Malleefowl and Regent Parrot.	
9 July 2013 DoE – further clarifications ecological field survey effort	Correspondence received from DoE indicated the following concerns remained: • Threatened plants - It is not clear how much survey effort was employed targeting threatened plant species on the site, and whether this was in proportion to the likelihood of the species occurring on the site. It is noted that three species of threatened plants have been recorded immediately to the north of the site in similar habitats to those which occur on the site (Cobar Greenhood, Winged Peppercress and Mossgiel Daisy). • Regent Parrot - Surveys undertaken for the Regent Parrot were not sufficient to determine the likelihood that mallee habitats on the site, particularly those associated with the West Balranald deposit, represent important habitat for this species. This is based on the large area of potential Regent Parrot habitat present and its proximity to potential breeding habitat along the Murrumbidgee River. • Malleefowl -the number of hours of survey effort (48 hours of transect searches) employed for the Leipoa ocellata Malleefowl seems to be consistent with the department's survey effort guide for this species; being 30 hours per 5000 ha. However, the guide also recommends transects are located about 1 km apart, to ensure reasonable coverage of the survey area. Based on the information provided, large areas of mallee on the site were not surveyed for Leipoa ocellata Malleefowl, particularly within the West Balranald deposit. • Hence, it is not clear whether the surveys were sufficient to provide a confident estimate of the number of Malleefowl likely to be impacted by the proposal, including in habitats adjacent to the site, which may limit the ability to consider impacts on the broader population of the species.	Details of the field survey are provided in section 3. Hours of survey are sufficient when compared to those specified in guidelines used throughout this report.
16 July 2013 Letter from DoE to EMM,EPBC Ref 2012:6509	The letter from DoE stated that, based on the additional information provided to DoE, the ecological survey effort appears to be adequate to enable assessment of the proposal. However, in the absence of sufficient confidence in the presence or absence of threatened species and their extent of occurrence on the site, DoE would assume that those species could be present within suitable habitat on the site for the purposes of the assessment.	Details of the field survey are provided in section 3. Species not recorded during field survey were deemed affected species if potential habitat occurs within the disturbance area.
5June 2014 Meeting between OEH, Iluka, EMM and Niche	Meeting between OEH, Iluka, Niche and EMM representatives to discuss findings and key issues from ecological and heritage surveys.	Details of the field survey are provided in section 3.
17June 2014 Meeting between DoE, Iluka, EMM and Niche	Meeting between DoE, Iluka, Niche and EMM representatives to discuss findings and key issues from ecological surveys and to ascertain the preferred approach to assessment of the Balranald Project via separate referrals.	Details of the field survey are provided in section 3.
5 June 2014 Meeting with Iluka, EMMA and OEH	Meeting to discuss cultural heritage and ecology issues and approvals Key notes from the meeting include the following: • OEH was not too concerned regarding mallee rehabilitation at West Balranald, but would want to see mallee considered in the rehabilitation at Nepean. • OEH stated that he is cognisant that West Balranald is fragmented in terms of connectivity with other large stands of native vegetation. In terms of	Direct and indirect impacted discussed in section, including connectivity, fragmentation and feral pests. An offset strategy has

Dates of consultation	Relevant key issues/discussion points	How are the issues addressed in this report?
	West Balranald OEH is happy to look at a mosaic of cropping and native vegetation. • Agreement that feral goats were having a significant impact on habitat value in the area due to grazing of groundcover and shrubs etc. • OEH noted that they would be surprised if pygmy possums would be in the area due to habitat quality. • OEH recommended that Niche adopt and achieve national guidelines in demonstrating effectiveness of survey effort for Malleefowl. • OEH agreed that it is unlikely that Bitter Quandong is likely to occur in the disturbance area. • OEH noted that Regent Parrot not know to breed as far east as Balranald. • OEH noted that the Balranald Project is likely to have a significant impact on Malleefowl (in terms of section 5A assessment), but noted that there is likely to be other fauna species where there may be a significant impact. • OEH noted that in considering offsets, Iluka could consider the link with Mungo and the offset that Cristal is providing. Notwithstanding this, OEH stated that consideration of the sites to the west and adding to existing national parks is a good idea and one that OEH would support. • OEH stated that Mallee Cliffs area has highest density of Malleefowl in NSW. Adding offset areas to this will increase possible habit for this species and is a good idea. • OEH was happy to consider Iluka staging offsets.	been provided in section. The offset package will be further refined through consultation with OEH and DoE. Bitter Quandong was not recorded during the survey within the disturbance area. It is a relatively non-cryptic species and would likely to remain undetected during the survey.
2 September 2014 Meeting between OEH, NPWS, Iluka, Niche and EMM	Meeting between OEH, NPWS, Iluka, Niche and EMM representatives to discuss results of offset investigations and seek clarification in regard to offsets via handover of lands to National Parks and BioBanking. SMCAs: • Conservation originally intended to be in perpetuity, however noted that they were not overly secure. • SMCAs should be treated as if already existing offsets - unless a clear expiration date can be identified. • There is an opportunity to improve management outcomes on existing SMCAs. Suitability of proposed offset property groupings: • OEH offered opinion on proposed offset properties. • Chenopod communities - OEH noted that chenopod communities are generally less well reserved, and generally impacted by grazing, and that there are opportunities for good conservation outcomes, even if at lower ratios.	The options available for offsetting are discussed in section 7. SMCAs and how they have been applied in the offset strategy are addressed in section 7. Proposed offsets are not discussed. Proposed offsets will be discussed in the Offset Package.
6 February 2015 Meeting with OEH, DoE, EMM, Iluka and Niche	• OEH reiterated the opportunity to improve management outcomes for existing SMCAs. • OEH reiterated that additional offsets would be required for impacts to SMCAs. • OEH noted that the older mallee communities were better habitat than the young mallee. • DoE noted that the number of quadrats looked low on actual mine footprint. • OEH noted that showing the vegetation mapping past the disturbance area would be beneficial.	The management of SMCAs are discussed in section 5.7 The offsets regarding SMCAs are discussed in section 5.7. Habitat of mallee is discussed in section 4. The number and location of quadrats was sufficient for this assessment. The location provides a representation of the disturbance area. Mapping of vegetation throughout the locality

Dates of consultation	Relevant key issues/discussion points	How are the issues addressed in this report?
		was done via a desktop assessment in section 5.3.1.
19 August 2015, site visit, Iluka, DoE and EMM	Site visit which included Iluka, DoE and EMM representatives. The site visit included the West Balranald and Nepean mines and part of the potential route of the transmission line. Some key outcomes of the site visit included: • An agreement that the draft EIS would not be required to be accompanied by management plans as recommended within DoE's comments on the draft EIS. Notwithstanding this it was recognised that additional mitigation measures would be required for Malleefowl and Corben's Long-eared Bat. • An acknowledgment that the draft EIS would not be required to include location details on the offset site due to negotiations being undertaken between Iluka and property owners. Location details would be provided separate to the draft EIS in commercial confidence.	More mitigation measures have been detailed in this report for Malleefowl and Corben's Long-eared Bat. While details of the proposed offset site for MNES have been provided in this report, details on the location of the offsite site have been excluded.
15 September 2015. Iluka letter to DoE	Response to submissions from DoE indicating intention and approach to address various matters raised in submissions.	Updated content in the final biodiversity assessment.
22 October 2015. Meeting between Iluka, EMM, DoE and Niche representatives	Consultation in regard to DoE submissions to the draft biodiversity assessment and finalisation of reporting for submission of the final biodiversity assessment and EIS for the project.	Updated content in the final biodiversity assessment.
11 November 2015. Phone conference between Niche and DoE representative	Further consultation in regard to potential impacts and survey effort for selected MNES species, along with content of the submitted draft Assessments of Significance.	Updated Assessments of Significance for selected MNES.
7 January 2016. Meeting between Iluka, EMM, DoE and Niche	Meeting to discuss finalisation of draft EIS for exhibition, following DoE's review of draft EIS provided on 21 December 2015. Key issues discussed included: • exhibition requirements of draft EIS; • DoE's review of updated Assessments of Significance for selected MNES; • details required to be provided on exhibition; and • DoE's assessment process following exhibition of draft EIS. DoE stated at the meeting that they agreed with updated Assessments of Significance in relation to the Plains Wanderer and Regent Parrot. However they also stated that they would likely take a precautionary approach to the assessment of significance on Corben's Long-eared Bat.	Minor changes and updates to Assessments of Significance for selected MNES.
11 April 2016. Meeting between Iluka, EMM, DoE and Niche	Meeting to discuss issues raised in submissions and assessment of offsets. Discussions were also held on the underlying assumptions made in relation to calculating offset values of the offset site, including assumptions made by DoE and Niche.	Updated section 7 of this report and Biodiversity Offset Package addendum (Niche 2016).

1.7 Purpose of this report

Niche Environment and Heritage was commissioned to undertake a biodiversity assessment for the Balranald Project. The assessment has been carried out accordance with the SEARs and controlling provisions for the EPBC Act with reference to the following standards, guidelines and policies:

- NSW Biodiversity Offset Policy for Major Projects (OEH 2014)

- Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECCW 2009)
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DECC 2004)[2]
- Threatened Species Assessment Guidelines: the Assessment of Significance (DECC 2007)
- Guidelines for Threatened Species Assessment (DoE 2005)
- Environmental Offsets Policy (Commonwealth DoE 2012)
- BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECCW 2008)
- NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002)
- Risk Assessment Guidelines for Groundwater Dependant Ecosystems (NOW 2012)
- Policy & Guidelines - Aquatic Habitat Management and Fish Conservation (NSW Fisheries 2013)
- Policy & Guidelines - Fish Friendly Waterway Crossings (NSW Fisheries 2003)
- State Environmental Planning Policy No. 44 – Koala Habitat Protection.

The primary objective of this report was to describe and assess the ecological values within the project area and surrounds and determine whether the Balranald Project is likely to have a significant impact on threatened biodiversity listed on the NSW TSC Act and Commonwealth EPBC Act. The report also defines mitigation and offset measures that will reduce and manage ecological impacts from the Balranald Project.

The approach of this assessment includes the following:

1. undertake a background review of relevant literature, mapping and databases
2. conduct a field survey using recognised methods to assess the ecological values of the site and address identified data gaps
3. describe the ecological values of the site in regard to flora, fauna and vegetation communities
4. describe the potential ecological impacts of the Balranald Project
5. assess impacts of the Balranald Project on threatened biodiversity as listed on the TSC Act and EPBC Act
6. outline mitigation measures to reduce ecological impacts
7. provide an offset strategy that meets the requirements specified in the SEARs.

[2]Departure from survey techniques identified in the 2004 Threatened Biodiversity Survey and Assessment Guidelines have been noted in the field survey methodology described in this report

2. Literature Review

In completing this biodiversity assessment, a number of threatened species databases and previous documents relevant to the Balranald Project have been reviewed. In addition, a recent publication describing fauna surveys carried out in 2007 in the south-western corner of NSW (Val et al. 2012) was also referenced. Duplicate records may have been extracted during the database searches or the document review.

2.1 Atlas of NSW Wildlife Database

A review of the documented records of the locations of threatened flora and fauna species within the study locality has been undertaken using the Atlas of NSW Wildlife (accessed throughout the life of the Balranald Project but the inclusion of data in this assessment is from the searches undertaken finally in November 2014).Due to the large size of the project area and the general scarcity of threatened species records in south-western NSW, threatened species records were reviewed from the OEH Atlas of NSW Wildlife Database for six 1:100 000 map sheets: Weimby (7528), Bidura (7529), Turlee (7530), Balranald (7628), Paika (7629), Hatfield (7630) (October 2014). All threatened species records for the six map sheets as well as the number of records occurring within a 50km radius from the centre of the West Balranald and Nepean mines, were tabulated (Table 6 and Table 7). Threatened flora and fauna records from a 20 km radius search of the project area (Balranald Project locality) are presented in Figure 5 and Figure 6. Threatened species are provided in Table 7.

2.2 Review of Threatened Species known or predicted to occur within the relevant NSW Catchment Management Authority (CMA) Subregions

A search of threatened species, populations, communities and key threatening processes known or predicted to occur within the relevant CMA was undertaken using the Threatened Species Profile Search tool from the NSW OEH website in November 2014. Those species generated by the search are provided in Table 6 and Table 7. Threatened aquatic species are provided in Table 8. However it should be noted that species are predicted to occur within the CMA regardless of whether suitable habitat exists within the project area.

2.3 EPBC Act Protected Matters Search

A Protected Matters Search was carried out for a 50 km area around the project area. The search list for the database searches are detailed in Table 6 and Table 7. Protected Matters were specifically addressed in a Referral submitted to Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC) (now DoE) (2012). DoE subsequently prepared the Guidelines for the Content of a Draft Environmental Impact Statement for the Balranald Mineral Sands Project (Reference: 2012/6509) which identified species that may be impacted by the Balranald Project. The identified threatened species and ecological communities plus other listed species that could potentially be impacted by the Balranald Project (as determined by a refined 50 km search of the Protected Matters Search Tool in January 2015) have been identified in section 2.6.

2.4 FM Act DPI Records Viewer

The DPI website http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current was consulted to determine potential threatened aquatic species, populations and communities listed on the *NSW Fisheries Management Act* 1994 (FM Act) and their likely presence near the project area. The DPI records viewer was used to establish known threatened aquatic species records in the Murrumbidgee CMA.

These records were cross referenced with Bionet and Atlas of Living Australia. Threatened aquatic species are provided in Table 8.

2.5 Review of Relevant Previous Reports

The following reports or surveys, that contain ecological information potentially relevant to the project area, were reviewed:

- Review of Environmental Factors - Nepean Deposit (Currie 2009)
- Review of Environmental Factors - West Balranald Deposit (Overall 2011)
- Part 5A Assessment of Significance for Iluka's Proposed Drilling Program at Nepean Mineral Sands Prospect - Northwest Balranald (Ogyris 2007)
- CMA/OEH surveys for Southern Mallee Conservation Areas (not published – Atlas of NSW Wildlife records)
- National Recovery Plan for Malleefowl Leipoa ocellata (Benshemesh 2007)
- Malleefowl in New South Wales: Review of Past and Future Actions (DECC 2007)
- Biodiversity Summary for Natural Resource Management Regions (DoE 2011)
- The reptile, bird and small mammal fauna of Dune Mallee Woodlands in south-western New South Wales (Val et al. 2012)
- Atlas-Campaspe Mineral Sands Project – Environmental Impact Statement (Resource Strategies 2013)
- Sustainable River Audit 2008-2010 (Murray Darling Basin Authority MDBA 2012).

A summary of the ecological information of relevance from these reports or surveys is provided below.

2.5.1 Review of Environmental Factors - Nepean Deposit (Currie 2009)

This Review of Environmental Factors (REF) was prepared to comply with requirements under the EP&A Act and covered the test drilling phase at the Nepean mine within the Wampo SMCA.

The REF reviewed relevant ecological information and made recommendations for mitigation of environmental impacts due to the drilling activities, including access arrangements.

Most of the ecological information relating to potentially occurring threatened flora and fauna, and threatened ecological communities, was obtained from a desktop study and site visit carried out by specialist consultancy firm Ogyris Ecological Research in 2006.

The study identified and mapped the following predominant vegetation types:

- East West Dune Mallee
- Chenopod Mallee
- Belah Rosewood Community
- Chenopod Shrub.

Whilst no species listed under the TSC Act or the EPBC Act were identified during the study, a number of threatened species were considered to have potential to occur. The REF in particular identified the likelihood of Malleefowl presence the Balranald Project.

Threatened species considered most likely to occur included:

<u>Flora</u>

- *Santalum murrayanum*– Endangered (TSC Act)
- *Swainsona pyrophila*– Vulnerable (TSC Act and EPBC Act).

Fauna

- Southern Ningaui – Vulnerable (TSC Act)
- Little Pied Bat – Vulnerable (TSC Act)
- Corben's Long-eared Bat – Vulnerable (TSC Act and EPBC Act)
- Inland Forest Bat – Vulnerable (TSC Act)
- Chestnut Quail-thrush – Vulnerable (TSC Act)
- Malleefowl – Endangered (TSC Act) Vulnerable (TSC EPBC Act)
- Shy Heathwren – Vulnerable (TSC Act)
- Jewelled Gecko – Vulnerable (TSC Act)
- Mallee Worm Lizard – Endangered (TSC Act)
- Mallee Slender Blue-tongue Lizard – Endangered (TSC Act)
- Western Blue-tongue Lizard – Vulnerable (TSC Act)
- Yellow-tailed Plains Slider – Vulnerable (TSC Act).

No threatened ecological communities (TSC Act or EPBC Act) were identified as occurring.

2.5.2 Review of Environmental Factors - West Balranald Deposit (Overall 2011)

This REF was prepared to comply with requirements under the EP&A Act and covered the test drilling phase in the vicinity of the West Balranald mine. The REF reviewed relevant ecological information and made recommendations for mitigation of environmental impacts due to the drilling activities, including access arrangements.

Most of the ecological information relating to potentially occurring threatened flora and fauna, and threatened ecological communities, was obtained from a desktop study and site visit carried out by specialist consultancy firm Ogyris Ecological Research in 2006.

The study identified and mapped the following predominant vegetation types within the Balranald Project area:

- East West Dune Mallee
- Chenopod Mallee
- Belah Rosewood Community
- Chenopod Shrubland.

No species listed under the TSC Act or the EPBC Act were recorded, however a number of threatened species were considered to have potential to occur. The REF in particular identified the likelihood of Malleefowl presence within the Balranald Project site, and recommended appropriate buffers from any Malleefowl nests encountered and other mitigation measures during selection of drill sites and subsequent drilling activities.

Threatened species considered most likely to occur included:

Flora

- *Santalum murrayanum* – Endangered (TSC Act)
- *Swainsona pyrophila*– Vulnerable (TSC Act and EPBC Act)

Fauna

- Southern Ningaui – Vulnerable (TSC Act)

- Little Pied Bat – Vulnerable (TSC Act)
- Corben's Long-eared Bat – Vulnerable (TSC Act and EPBC Act)
- Inland Forest Bat – Vulnerable (TSC Act)
- Chestnut Quail-thrush – Vulnerable (TSC Act)
- Malleefowl – Endangered (TSC Act) Vulnerable (EPBC Act)
- Shy Heathwren – Vulnerable (TSC Act)
- Jewelled Gecko – Vulnerable (TSC Act)
- Mallee Worm-lizard – Endangered (TSC Act)
- Mallee Slender Blue-tongue Lizard – Endangered (TSC Act)
- Western Blue-tongue Lizard – Vulnerable (TSC Act)
- Yellow-tailed Plains Slider – Vulnerable (TSC Act).

No threatened ecological communities (TSC Act or EPBC Act) were identified.

2.5.3 Part 5A Assessment of Significance for Iluka's Proposed Drilling Program at Nepean Mineral Sands Prospect - Northwest Balranald (Ogyris 2007)

This Part 5A Assessment of Significance under the EP&A Act was carried out for the proposed drilling works in the vicinity of the Nepean mine.

The study noted that the site exists entirely within the Arumpo Land System which consists of mostly east to west parallel sand dunes. Three vegetation types were identified as occurring within the area:

- Mallee / Porcupine Grass (Spinifex) on sandy dunes
- Mallee / Chenopod on calcareous interdune swales and plains
- Belah-Rosewood on calcareous earths.

The authors drew on a large body of ecological and edaphic information collected from Prungle Station and surrounds for Murray Basin Titanium P/L (now Crystal Mining). This is a similar, proximal site which also occurs on the Arumpo Land System with similar vegetation types.

A number of threatened flora and fauna species were considered to be 'possibly present within the project area', but those 'known' to be present due to records near the Nepean project area are:

Flora

- *Santalum murrayanum*– Endangered (TSC Act): known to be present nearby on the Arumpo Road
- *Swainsona pyrophila*– Vulnerable (TSC Act and EPBC Act): known to be present at scattered sites in mallee lands 30-50km to the west and south-west of the project area.

Fauna

The same species as listed in Overall (2011) (see above) were considered for the Nepean Assessment report.

2.5.4 CMA/OEH surveys for Southern Mallee Conservation Areas (not published in Atlas of NSW Wildlife records)

Fauna and flora surveys within the SMCAs within the West Balranald and Nepean mine areas were first conducted in 1999. Whilst the results have not been published, a report on more recent surveys carried out in dune mallee woodlands of south west NSW (2007/8) was published in 2012 (James Val, OEH pers. com.

and see review below). The species recorded in the 1999-2001 surveys have been lodged in the OEH NSW Wildlife Atlas. The threatened species recorded were as follows:

Flora

- Nil

Fauna

- Major Mitchell's Cockatoo – Vulnerable (TSC Act)
- Chestnut Quail-thrush – Vulnerable (TSC Act)
- Varied Sittella – Vulnerable (TSC Act), WB only
- Malleefowl – Endangered (TSC Act) Vulnerable (EPBC Act)
- Freckled Duck – Vulnerable (TSC Act), West Balranald only
- Little Eagle – Vulnerable (TSC Act), Nepean only
- Western Pygmy-possum – Endangered (TSC Act), Nepean only
- Inland Forest Bat – Vulnerable (TSC Act), Nepean only.

2.5.5 National Recovery Plan for Malleefowl *Leipoa ocellata* (Benshemesh 2007)

This recovery plan takes into account Malleefowl populations across Australia. The primary objectives of the plan are to secure existing populations across the species' range and achieve de-listing of Malleefowl under the EPBC Act within 20 years.

The specific objectives in the recovery plan for managing populations are:

1. reduce permanent habitat loss
2. reduce the threat of grazing pressure on Malleefowl populations
3. reduce fire threat
4. reduce predation
5. reduce isolation of fragmented populations
6. promote Malleefowl-friendly agricultural practices
7. Reduce Malleefowl mortality on roads.

Another eleven objectives involving planning, research, monitoring, community involvement and project coordination are listed in the recovery plan.

2.5.6 Biodiversity Summary for Natural Resource Management Regions (DSEWPaC 2011)

Species List for the Lower Murray Darling Region, NSW

This species list has been produced by DOE for the Natural Resources Management Spatial Information System. It was created by using the Australian Natural Heritage Assessment Tool (ANHAT) by accessing all available database sources.

A total of 52 flora families and 820 species have been recorded for the region. Nine species are listed as threatened on the EPBC Act and six of these, listed below, have not been listed for the greater study locality (four 1:100,000 map sheets) in the NSW Wildlife Atlas.

- *Acacia carneorum* (Purple Wood Wattle / Needle Wattle) - Vulnerable (EPBC Act)
- *Atriplex infrequens* (a saltbush) - Vulnerable (TSC Act and EPBC Act)

- *Austrostipa nullanulla* - Endangered (TSC Act)
- *Calotis moorei* (a native daisy) - Endangered (TSC Act and EPBC Act)
- *Pterostylis xerophila* (Desert Greenhood) - Vulnerable (EPBC Act)
- *Senecio behrianus* (Stiff Groundsel) - Presumed Extinct (TSC Act); Endangered (EPBC Act).

From this species list the total number of fauna species recorded for the whole of the Lower Murray Darling region is 20 frogs, 96 reptiles, 286 birds and 56 mammals. Note that the number of species occurring within the project area would be considerably less than this, as not all of the habitats in this region are available in the project area. A total of 17 threatened species listed in the EPBC Act have been recorded in the Lower Murray Darling Region of NSW. Of these, eight species are regionally extinct, although populations of the Bridled Nail-tail Wallaby, Numbat, Burrowing Bettong and Bilby occur in predator proof enclosures at Scotia Sanctuary, which is located approximately 200 km north-west of the project area, near the South Australia border. Other regionally extinct species are the Western Quoll (*Dasyurus geoffroyii*), Greater Stick-nest Rat (*Leporillus conditor*), Western Barred Bandicoot (*Perameles bougainville*) and Northern Hairy-nosed Wombat (*Lasiorhinus krefftii*). Two additional threatened fauna species not listed for the greater study locality (six 1:100,000 map sheets) in the NSW Wildlife Atlas are:

- Mallee Emu-wren (*Stipiturus mallee)*- Vulnerable (EPBC Act)
- Red-lored Whistler (*Pachycephala rufogularis*) - Endangered (TSC Act) Vulnerable (EPBC Act).

2.5.7 The reptile, bird and small mammal fauna of Dune Mallee Woodlands in south-western New South Wales (Val et al. 2012)

Baseline surveys of reptiles, birds and small mammals that occur in Dune Mallee Woodlands in the Lower Murray Darling catchment of south-western NSW were conducted at 60 sites between October 2007 and March 2008. These surveys comprise the first round of a catchment wide monitoring program to obtain a measure of the distribution and abundance of 21 priority threatened fauna species that inhabit Dune Mallee Woodlands. A total of 127 fauna species were recorded, which included 19 of the possible 21 threatened fauna species. The 127 species comprised 37 reptile species, 15 bat species, three small mammal species and 72 bird species. The mean species richness recorded at each 3ha survey site for birds was 14.7, reptiles 7.1, small ground dwelling mammals 0.5 and bats 3.0.

Six survey sites were located within the Turlee 1:100,000 map sheet nearest to Nepean mine and six sites were within the Weimby map sheet near the West Balranald mine. At the Turlee sites 20 reptile, 9 mammal and 32 bird species were recorded; and at the Weimby sites 13 reptile, 6 mammal and 16 bird species were recorded. Threatened species listed on the TSC Act and recorded in the Turlee and Weimby map sheets were:

- Mallee Worm-lizard – Weimby Map Sheet
- Chestnut Quail-thrush – Turlee and Weimby Map Sheets
- Southern Ningaui – Turlee Map Sheet
- Little Pied Bat – Turlee Map Sheet
- Yellow-bellied Sheathtail-bat – Weimby Map Sheet
- Inland Forest Bat – possible record Turlee Map Sheet.

2.5.8 Atlas-Campaspe Mineral Sands Project – Environmental Impact Statement (Resource Strategies 2013)

The Atlas-Campaspe Mineral Sands Project is located about 20km north of the proposed Nepean mine project area. A number of threatened flora and fauna species were recorded during surveys undertaken for the environmental impact statement. Surveys were undertaken by Australian Museum Business Services.

The following state (TSC Act) and federally (EPBC Act) listed threatened and migratory species and endangered ecological communities were recorded (AMBS 2013):

Flora

- *Brachyscome papillosa* (TSC Act and EPBC Act): a large population comprising >1000 individuals was recorded at a single location on both sides of Magenta Road, over a distance of 1.5km. The population occurs within chenopod shrubland habitat, over an area of approximately 142ha. The population is located approximately 25km east-north-east of the northern end of the proposed Nepean mine.
- *Lepidium monoplocoides* (TSC Act and EPBC Act): the species was recorded at six locations, the closest within 20km north of the northern end of the proposed Nepean mine. Numbers at each location ranged from one to 188 plants, but only two of the locations (containing a single plant each) occurred within the proposed disturbance area. A total of 301 plants were recorded at the six locations.
- *Pterostylis cobarensis* (TSC Act): the species was recorded at five sites, with a total of 18 plants. Due to the lifecycle of the species and distributions of the sites, the EIS found that these five sites constituted two populations: one population comprised of one individual, the other comprised of 17 individuals. A total of seven individuals were located within the footprint, with 11 proposed for retention. For this reason, the EIS found that the Balranald Project would have a significant impact on the populations of this species at this location.

Fauna

- Malleefowl (TSC Act and EPBC Act): this species was recorded (mounds, sightings or footprints) in a number of locations around the Atlas-Campaspe project area.
- Freckled Duck (TSC Act): up to 30 individuals were recorded at three locations within the Atlas-Campaspe project area.
- Spotted Harrier (TSC Act): was recorded in one location within the Atlas-Campaspe project area.
- Little Eagle (TSC Act): was recorded in one location within the Atlas mine footprint and two locations within the proposed offset areas.
- Bush Stone-curlew (TSC Act): one individual was detected during call playback surveys within the Atlas mine footprint.
- Australian Painted Snipe (TSC Act): 10 individuals were recorded from one location within the Atlas-Campaspe project area.
- Major Mitchell's Cockatoo (TSC Act): was recorded at 10 locations from within the footprint and a further 15 locations within the proposed offset areas.
- Regent Parrot (EPBC and TSC): this species was recorded at one location within the Atlas-Campaspe project area.
- Redthroat (TSC Act): was recorded at five locations within the Atlas-Campaspe project area, adjacent to the proposed footprint of the road infrastructure.
- Pied Honeyeater (TSC Act): this species was recorded at one location within the Atlas mine footprint and one location within the Atlas-Campaspe project's offset areas.
- White-fronted Chat (TSC Act): was recorded at four locations within the proposed Atlas-Campaspe offset areas and one location adjacent to proposed road infrastructure.
- Hooded Robin (TSC Act): Hooded Robin was recorded at 12 locations – six within the Balranald Project footprint and six within the proposed Atlas-Campaspe offset sites.

- Chestnut-backed Quail-thrush (TSC Act): Recorded at 14 locations within the Balranald Project footprint and a further 36 locations in the proposed Atlas-Campaspe offset area.
- Varied Sittella (TSC Act): recorded at three locations: two within the mine footprint and one within the proposed Atlas-Campaspe offset area.
- Gilbert's Whistler (TSC Act): recorded at one location within the proposed Atlas-Campaspe offset areas and two locations outside of the mine footprint.
- Southern Ningaui (TSC Act): located at five locations – three within Atlas-Campaspe mine footprint and two within the proposed offset area.
- Western Pygmy-possum (TSC Act): three probable records were located within the mine footprint
- Yellow-bellied Sheathtail-bat (TSC Act): was recorded at five locations within the Atlas-Campaspe Mine footprint and in up to eight locations within the proposed offset area.
- Corben's Long-eared Bat (TSC Act): This species was recorded in eight locations within the Atlas-Campaspe mine footprint and nine locations within the proposed offset area.
- Little Pied Bat (TSC Act): Located at 21 locations within the Atlas-Campaspe footprint and 12 locations in the proposed offset area.
- Inland Forest Bat (TSC Act): this species was recorded at 10 locations within the Atlas-Campaspe mine footprint and nine locations within the proposed Atlas-Campaspe offset area.
- Bardick (TSC Act): Individuals were recorded in two locations – one within the mine lease area and one further to the north.
- Jewelled Gecko (TSC Act): species recorded at one location within the Campaspe footprint and eight locations within the proposed offset areas.
- Mallee Worm-lizard (TSC Act): this species was recorded at one location in the proposed Atlas-Campaspe offset area.
- Spinifex Slender Blue-tongue (TSC Act): recorded from one location within the proposed Atlas-Campaspe offset area.

Migratory Species (EPBC Act)

- Rainbow Bee-eater– no details are provided of sites where this species was recorded.
- Australian Painted Snipe– this species was recorded at one location within the Atlas-Campaspe project area.
- Great Egret– this species was recorded at one location within the Atlas-Campaspe project area.

Endangered Ecological Communities

- *Acacia melvillei* Shrubland in the Riverina and Murray Darling Depression Bioregions (TSC Act): a total of 1,306ha of *Acacia melvillei* shrubland TECTEC was identified as part of the Balranald Project and was generally in moderate to poor condition having been subject to extensive previous disturbance.
- Sandhill Pine Woodland in the Riverina and Murray-Darling Depression and NSW South Western Slopes Bioregion (TSC Act): The Sandhill Pine Woodland TEC was recorded in 7 locations within the Atlas-Campaspe project area, comprising a total of 21ha.

2.5.9 Sustainable River Audit (2008-2010)

The Sustainable Rivers Audit (SRA) is a systematic assessment of the health of river ecosystems in the Murray–Darling Basin. It is based on data collected and analysed by a multi-jurisdictional team from state and federal governments. The second full SRA assessment report provides assessments of ecosystem health for each of 23 major river valleys of the Basin, using data gathered in 2008–2010, on the condition of five key ecological components: fish, benthic macroinvertebrates, riverine vegetation, physical form and

hydrology. The audit made the following assessments of the lower Murrumbidgee near Balranald: The overall health rating for the lowland Murrumbidgee fish was very poor and dominated by exotic species.

- the overall health rating for lowland Murrumbidgee macroinvertebrates was poor
- the overall health rating for lowland Murrumbidgee vegetation was good
- the overall health rating for lowland Murrumbidgee physical form was good
- the overall health rating for lowland Murrumbidgee hydrology was very poor.

Threatened species

The audit found that threatened species Murray Cod (*Maccullochella peelii*) and Silver Perch (*Bidyanus bidyanus*) in the lowland Murrumbidgee. Macquarie Perch (*Macquaria australasica*), Trout Cod (*Maccullochella macquariensis*), Freshwater Catfish (*Tandanus tandanus*), Murray Hardy Head (*Craterocephalus fluviatili*), Southern Pygmy Perch (*Nannoperca australis*), Olive Perchlet (*Ambassis agassizii*) and Purple Spotted Gudgeon (*Mogurnda adspersa*) were not observed.

2.6 Threatened biodiversity from literature review

2.6.1 Threatened Ecological Communities

The following TECs are known to or could occur within 50km of the two proposed mining areas:

Endangered Ecological Communities **(TSC Act):**

- *Halosarcia lylei* low open-shrubland in the Murray Darling Depression Bioregion
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions
- *Allocasuarina luehmannii* Woodland in the Riverina and Murray-Darling Depression Bioregions
- *Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions
- *Acacia loderi* shrublands
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions
- Lowland Murray River aquatic ecological community – including the Murrumbidgee River downstream of Burrinjuck Dam.

Endangered Ecological Communities **(EPBC Act):**

- Buloke Woodlands of the Riverina and Murray- Darling Depression Bioregions
- Grey Box Grassy Woodlands and Derived Native Grasslands of South-eastern Australia
- Weeping Myall Woodlands.

Discussions regarding the potential for these TECs to occur within the project area are provided in section 4.2.

2.6.2 Threatened flora species

Based on the results of the data review, 34 threatened flora species have been previously recorded within the area bounded by the six map sheets, or within 50 km from the centre of the proposed project area (Table 6).The identified threatened flora are comprised of:

- Two species listed as Critically Endangered under TSC Act

- Nineteen species listed as Endangered under the TSC Act and five under the EPBC Act
- Twelve species listed as Vulnerable under the TSC Act and nine under the EPBC Act.

The potential for these species to occur within the project area is discussed in section 4.3.

Table 6. Threatened flora species previously recorded or with potential habitat within 50km of the project area or within the six 1:100,000 mapsheets, or predicted to occur within the CMA subregion via the Biobanking Tool

Scientific Name	Legal Status			Number of Records			Presence (X)	
	TSC Act	EPBC Act	Earliest / Latest Record	Within 7528; 7529; 7530 7628; 7629; 7630 mapsheets	Within 50km of West Balranald mine	Within 50km of Nepean mine	EPBC Act Search within 50kms	BioBanking Tool (CMA)
Acacia acanthoclada	E	-	1997-2006	16	0	2	-	X
Acacia carneorum	V	V	-	0	0	0	X	-
Acacia rivalis	V	-	-	0	0	0	-	X
Atriplex infrequens	V	V	-	0	0	0	-	X
Austrostipa metatoris	V	V	1980-2000	9	0	0	X	X
Austrostipa nullanulla	E	-		0	0	0	-	X
Austrostipa wakoolica	E	E	-	0	0	0	-	X
Brachyscome papillosa	V	V	1952-2012	16	3	1	X	X
Caladenia tensa	-	E	-	0	0	0	X	-
Callitriche cyclocarpa	V	V	-	0	0	0	X	-
Calotis moorei	E	E	-	0	0	0	-	X
Casuarina obesa	E	-	1999-2008	4	0	0	-	-
Convolvulus tedmoorei	E	-	-	0	0	0	-	X
Cratystylis conocephala	E	-	-	0	0	0	-	X
Dodonaea stenozyga	CE	-	-	0	0	0	-	X
Erodiophyllum elderi	E	-	-	0	0	0	-	X
Eucalyptus leucoxylon subsp. pruinosa	V	-	2002-2003	5	0	0	-	-
Kippistia suaedifolia	E	-	-	0	0	0	-	X
Lasiopetalum behrii	CE	-	1997-1997	2	0	0	-	X
Lepidium monoplocoides	E	E	1997-2011	6	2	2	X	-
Leptorhynchos waitzia	E	-	1984-1985	1	0	0	-	X
Leucochrysum albicans var. tricolor	E	E	2008	1	1	0	-	-
Maireana cheelii	V	V	1952-2001	10	0	0	X	-

Phyllanthus maderaspatensis	E	-	-	0	0	0	-	X
Pimelea serpyllifolia subsp. serpyllifolia	E	-	-	0	0	0	-	X
Santalum murrayanum	E	-	1998-2008	41	17	3	-	X
Solanum karsense	V	V	1985-2000	6	13	0	-	X
Swainsona adenophylla	E	-	-	0	0	0	-	-
Swainsona colutoides	E	-	-	0	0	0	-	X
Swainsona flavicarinata	E	-	-	0	0	0	-	-
Swainsona murrayana	V	V	1990	2	1	0	X	-
Swainsona pyrophila	V	V	1998-2003	5	0	0	X	-
Swainsona sericea	V	-	1995-1997	6	0	0	-	-
Swainsona viridis	E	-	-	0	0	0	-	X

E: Endangered, V: Vulnerable

2.6.3 Critical Flora Habitat

No Critical Habitat for flora declared under NSW legislation to date occurs within the project area. Critical habitats are defined under the TSC Act as areas of land that are crucial to the survival of particular threatened species, populations and ecological communities.

2.6.4 Endangered Populations of Plants

There are no listed endangered populations of flora likely to occur within the project area under the TSC Act.

2.6.5 Threatened Fauna

Based on the results of the data review, 81 threatened fauna species have been previously recorded within the area bounded by the six map sheets, or have potential habitat within 50 kms of the centre of the West Balranald mine or centre of the Nepean mine (Table 7).The list includes: two amphibians; 58 birds; 12 mammals; and nine reptiles.

The identified threatened fauna are comprised of:

- Two species listed as Critically Endangered under TSC Act
- Twenty-one species listed as Endangered under the TSC Act and six under the EPBC Act
- Forty-nine species listed as Vulnerable under the TSC Act and 10 under the EPBC Act
- Nine species listed as Migratory under the EPBC Act.

The potential for these species to occur within the project area is discussed in section 4.4.

Table 7. Threatened fauna species previously recorded or with potential habitat within 50km of the West Balranald and Nepean mines and/or within the six 1:100,000 mapsheets, or predicted to occur within the CMA subregion via the Biobanking Tool

Scientific Name	Common Name	Legal Status		Earliest /latest record	No of records within 7528; 7529; 7530; 7628; 7629; 7630; mapsheets	No of records within 50km of the Project Area	Number of records within 50km of the West Balranald Mine	EPBC Act Search (50km) (x)	BioBanking tool (CMA) (x)
		TSC Act	EPBC Act						
Frogs									
Litoria raniformis	Southern Bell Frog	E	V	1989-2013	115	106	0	X	X
Neobatrachus pictus	Painted Burrowing Frog	E	-	-	0	0	0	-	X
Birds									
Amytornis striatus	Striated Grasswren	V	-	-	0	0	0	-	X
Amytornis textilis modestus	Thick-billed Grasswren	CE	V	-	0	0	0	-	X
Anseranas semipalmata	Magpie Goose	V	-	-	0	0	0	-	X
Antechinomys laniger	Kultarr	E	-	-	0	0	0	-	X
Apus pacificus	Fork-tailed Swift	-	M	-	0	0	0	X	-
Ardea alba	Great Egret	-	M	-	0	0	0	X	-
Ardea ibis	Cattle Egret	-	M	-	0	0	0	X	-
Ardeotis australis	Australian Bustard	E	-	1982-2000	2	0	1	-	X
Botaurus poiciloptilus	Australasian Bittern	E	E	1986-2010	24	6	0	X	X
Burhinus grallarius	Bush Stone-curlew	E	-	1994-1995	4	1	0	-	X
Cacatua leadbeateri	Major Mitchell's Cockatoo	V	-	1981-2010	81	70	88	-	X
Calamanthus campestris	Rufous Fieldwren	V	-	-	0	0	0	-	X
Calidris alba	Sanderling	V	-	-	0	0	0	-	X
Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland	-	E	1994	1	0	0	-	X

Scientific Name	Common Name	Legal Status		Earliest /latest record	No of records within 7528; 7529; 7530; 7628; 7629; 7630; mapsheets	No of records within 50km of the Project Area	Number of records within 50km of the West Balranald Mine	EPBC Act Search (50km) (x)	BioBanking tool (CMA) (x)
		TSC Act	EPBC Act						
	subspecies)								
Certhionyx variegatus	Pied Honeyeater	V	-	1994-2012	8	2	6	-	X
Charadrius mongolus	Lesser Sand-plover	V	-	-	0	0	0	-	X
Chthonicola sagittata	Speckled Warbler	V	-	1994-1995	4	0	0	-	-
Cinclosoma castanotus	Chestnut Quail-thrush	V	-	1984-2008	200	57	56	-	X
Circus assimilis	Spotted Harrier	V	-	1981-2011	21	8	6	-	X
Climacteris picumnus	Brown TrTECreeper	V	-	1981-2012	0	57	33	-	-
Daphoenositta chrysoptera	Varied Sittella	V	-	1981-2008	35	7	15	-	-
Drymodes brunneopygia	Southern Scrub-robin	V	-	2006-2008	14	0	0	-	X
Epthianura albifrons	White-fronted Chat	V	-	1980-2009	46	16	20	-	-
Falco hypoleucos	Grey Falcon	E	-	-	0	0	0	-	X
Falco subniger	Black Falcon	V	-	1982-2012	15	0	1	-	-
Gallinago hardwickii	Latham's Snipe	-	M	-	0	0	0	X	-
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V	-	1998	2	0	1	-	X
Grantiella picta	Painted Honeyeater	V	-	1989	1	1	0	-	-
Grus rubicunda	Brolga	V	-	-	0	0	0	-	X
Haliaeetus leucogaster	White-bellied Sea-Eage	-	M	-	0	0	0	X	-
Hamirostra melanosternon	Black-breasted Buzzard	V	-	1994	2		1	-	X
Hieraaetus morphnoides	Little Eagle	V	-	1989-2002	29	13	6	-	X
Hylacola cautus	Shy Heathwren	V	-	1985-2008	33	0	0	-	X

Scientific Name	Common Name	Legal Status		Earliest /latest record	No of records within 7528; 7529; 7530; 7628; 7629; 7630; mapsheets	No of records within 50km of the Project Area	Number of records within 50km of the West Balranald Mine	EPBC Act Search (50km) (x)	BioBanking tool (CMA) (x)
		TSC Act	EPBC Act						
Lathamus discolor	Swift Parrot	E	E	2006	1	-	0	X	X
Leipoa ocellata	Malleefowl	E	V, M	1975-2008	149	72	53	X	X
Lichenostomus cratitius	Purple-gaped Honeyeater	V	-	1985-2008	4	1	2	-	X
Limosa limosa	Black-tailed Godwit	V	M	1989	1	1	0	-	X
Lophoictinia isura	Square-tailed Kite	V	-	1989	1	1	1	-	X
Manorina melanotis	Black-eared Miner	E	E	1998	0	0	0	X	X
Melanodryas cucullata	Hooded Robin	V	-	1981-2008	44	4	16	-	X
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	1985	1	0	0	-	X
Merops ornatus	Rainbow Bee-eater	-	M	-	0	0	0	X	-
Myiagra cyanoleuca	Satin Flycatcher	-	M	-	0	0	0	X	-
Neophema splendida	Scarlet-chested Parrot	V	-	-	0	0	0	-	X
Ninox connivens	Barking Owl	V	-	1998	1	0	0	-	X
Oxyura australis	Blue-billed Duck	V	-	1987-2013	34	18	4	-	X
Pachycephala inornata	Gilbert's Whistler	V	-	1981-2008	73	29	16	-	X
Pachycephala rufogularis	*Red-lored Whistler*	CE	V	-	0	0	0	X	X
Pedionomus torquatus	Plains-wanderer	E	V	1982-1995	2	0	0	X	X
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	E	V	1983-2008	434	167	0	X	X
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	1989-2013	41	20	4	-	X

Scientific Name	Common Name	Legal Status		Earliest /latest record	No of records within 7528; 7529; 7530; 7628; 7629; 7630; mapsheets	No of records within 50km of the Project Area	Number of records within 50km of the West Balranald Mine	EPBC Act Search (50km) (x)	BioBanking tool (CMA) (x)
		TSC Act	EPBC Act						
Pyrrholaemus brunneus	Redthroat	V	-	1984-2008	25	23	21	-	X
Rostratula australis	Australian Painted Snipe	E	E	1990-2012	2	1	1	X	X
Pyrrholaemus saggitatus	Speckled Warbler	V	-	1994-1995	1	1	21	-	-
Sminthopsis macroura	Stripe-faced Dunnart	V	-	-	0	0	0	0	X
Stagonopleura guttata	Diamond Firetail	V	-	2013	1	1	1	-	X
Stictonetta naevosa	Freckled Duck	V	-	1984-2012	42	32	8	-	X
Tyto capensis	Grass Owl	V	-	-	0	0	0	0	X
Non-flying Mammals									
Cercartetus concinnus	Western Pygmy Possum	E	-	1996-2008	281	55	110	-	X
Dasyurus maculatus	Spotted-tailed Quoll	V	E	1975-2004	2	1	0	-	-
Lasiorhinus latifrons	Southern Hairy-nosed Wombat	E	-	-	0	0	0	0	X
Ningaui yvonneae	Southern Ningaui	V	-	1984-2009	338	9	76	-	X
Phascolarctos cinereus	Koala	V	V	2004-2013	4	0	0	X	-
Pseudomys bolami	Bolam's Mouse	E	-	2000	4	1	4	-	X
Flying Mammals									
Chalinolobus picatus	Little Pied Bat	V	-	1974-2008	36	1	19	-	X
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	2004-2005	21	0	0	-	-
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	1984-2008	52	22	44	X	-
Nyctophilus timoriensis	Greater Long-eared Bat (south	V	V	-	0	0	0	-	X

Scientific Name	Common Name	Legal Status		Earliest /latest record	No of records within 7528; 7529; 7530; 7628; 7629; 7630; mapsheets	No of records within 50km of the Project Area	Number of records within 50km of the West Balranald Mine	EPBC Act Search (50km) (x)	BioBanking tool (CMA) (x)
		TSC Act	EPBC Act						
	eastern form)								
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	V	-	0	0	0	-	X
Vespadelus baverstocki	Inland Forest Bat	V	-	1984-2008	67	22	48	-	-
Reptiles									
Aprasia inaurita	Mallee Worm-lizard	E	-	1998-2014	40	3	3	-	X
Cyclodomorphus melanops elongatus	Mallee Slender Blue-tongue Lizard	E	-	1999-2006	2	0	0	-	X
Delma australis	Marble-faced Delma	E	-	2008	1	0	0	-	X
Diplodactylus elderi	Jewelled Gecko	V	-	1984-2014	45	0	0	-	X
Diplodactylus stenodactylus	Crowned Gecko	V		-	0	0	0	-	X
Echiopsis curta	Bardick	E	-	1983-2006	2	1	1	-	X
Lerista xanthura	Yellow-tailed Plain Slider	V	-	2003-2004	7	-	-	-	-
Pseudonaja modesta	Ringed Brown Snake	E	-	-	0	0	0	-	X
Tiliqua occipitalis	Western Blue-tongue Lizard	V	-	1994-2001	6	2	0	-	X

E = Endangered, V = Vulnerable, M = Migratory

2.6.6 Threatened aquatic fauna

Based on the results of the data review, twelve threatened aquatic fauna species have been previously recorded in the Murrumbidgee River (Table 8).

The identified threatened fauna are comprised of:

- Two species listed as Critically Endangered under FM Act and one under the EPBC Act
- Five species listed as Endangered under the FM Act and three under the EPBC Act
- Two species listed as Vulnerable under the FM Act and one under the EPBC Act.

The potential for these species to occur within the project area or be impacted by the Balranald Project is discussed in section 4.4.

Endangered aquatic fauna populations include the Murray-Darling Basin population of Eel Tailed Catfish (*Tandanus tandanus*) and Western population of Olive Perchlet (*Ambassis agassizii*) listed under the FM Act.

Table 8. Threatened aquatic fauna species list derived from the threatened species searches and literature review.

		Legal status		Records
Scientific name	**Common name**	**FM Act**	**EPBC Act**	
Fish				
Ambassis agassizii	Olive Perchlet	EP	-	1881 Murrumbidgee down stream of Balranald (ALA)
Bidyanus bidyanus	Silver Perch	V	CE	Records upstream of Balranald (2009)(ALA)
Craterocephalus fluviatilis	Murray Hardyhead	CE	E	1995 Naranderra - Bundigeree Creek (DPI)
Galaxias rostratu	Flathead Galaxias	CE	-	1995 at Hay on the Murrumbidgee River (DPI)
Macquaria australasica	Macquarie Perch	E	E	No records close to survey area
Maccullochella macquariensis	Trout Cod	E	E	2006 Murrumbidgee at Leeton (DPI)
Maccullochella peelii	Murray Cod	-	V	2007 Murrumbidgee River near Balranald(DPI)
Mogurnda adspersa	Purple spotted Gudgeon	E	-	1910 Murrumbidgee

Scientific name	Common name	Legal status		Records
		FM Act	EPBC Act	
				River at Bringagee (ALA)
Nannoperca australis	Southern Pygmy Perch	E	-	1918 at Murrumbidgee at Bringagee (ALA)
Tandaunus Tandanus	Eel tailed Catfish	EP	-	1963 Murrumbidgee at Naranderra (ALA)
Mulluscs				
Notopala sublineata	River Snail	E	-	2011 Murray at Mildura (ALA)
Crustaceos				
Euastacus armatus	Murray River Cray Fish	V	-	No specific recent database records are available however are now considered rare in the lower Murrumbidgee (DPI).

Records source from DPI – Records Viewer (DPI) and Atlas of Living Australia (ALA). E = Endangered, CE = Critically Endangered V = Vulnerable, EP = Endangered Population

2.6.7 Endangered fauna populations

No endangered populations of terrestrial fauna are listed for the locality.

Endangered aquatic fauna populations known to occur within the Murray-Darling Basin include population of Eel Tailed Catfish and Western population of Olive Perchlet (*Ambassis agassizii*) listed under the FM Act.

2.6.8 Critical Habitat

No Critical Habitat declared under the TSC Act occurs within 50km of the project area. Critical habitats are defined under the TSC Act as areas of land that are crucial to the survival of particular threatened species, populations and ecological communities.

3. Field Survey Methodology

Flora and fauna field survey work was performed broadly in two phases[3]:

- Survey of the West Balranald and Nepean mines and access roads (conducted by Ecotone2011-2013). These surveys were conducted within a footprint that exceeded the current project area to identify constraints, and address impact assessment requirements for the originally proposed mine layout. This area can be seen in Figure 2.
- Survey of proposed additional ancillary infrastructure or amended infrastructure areas (conducted by Niche 2013 - 2014). These surveys took place both outside and within the current project area in response to design amendments and to gather additional information on particular ecological matters after consideration of the Ecotone surveys, the initial round of Niche surveys and agency consultation. This area can be seen in Figure 2. It should be noted that surveys on the potential offset properties have been excluded from the figures for confidentiality reasons.

Elements of the ecological surveys were conducted outside of the current project area (referred to as additional survey areas) as the mine plan was progressively amended in response to mine planning, geotechnical, geological, ecological and heritage constraints. Survey performed outside of the project area was predominantly conducted in contiguous areas within the same vegetation communities and available habitats. Therefore, results from surveys conducted outside of the project area are still considered relevant to this assessment and assisted in predicting the likelihood of threatened biodiversity both within the project area and the locality.

Overall, the completed survey effort represents a comprehensive body of work from October 2011 until December 2014, details of which are provided in the following sections and illustrated in Figure (a-e) and Figure 9 (a-c).

Aquatic fauna survey

No specific aquatic survey was conducted as the disturbance to aquatic ecology by the development is likely to be minimal. The aquatic assessment is based primarily on desktop assessment and as such threatened species likelihood of occurrence is based on previous records in Murrumbidgee near Balranald and relevant threatened species literature.

3.1 Field survey dates

Ecotone Ecological Consultants – West Balranald and Nepean mines and access roads:

- 18 October 2011 – initial site inspection and selection of primary survey sites – Nepean mine
- 19-22 October 2011 – full field surveys – Nepean mine
- 30 October 2011 – initial site inspection and selection of primary survey sites – West Balranald mine
- 31 October – 4 November 2011 – full field surveys (West Balranald mine)
- 6 November – 9 November 2011 – full field surveys (West Balranald mine).
- 7 February 2012 – supplementary field survey (Nepean mine southern end)
- 7-9 February 2012 – Nepean access road options investigations
- 3-7 September 2012 – part field survey for preferred Nepean access road
- 10-15 January 2013 – completion of field survey for preferred Nepean access road
- 10-11 & 15-16 January 2013 – supplementary field survey (Nepean mine northern end).

[3] Note that additional surveys have been performed within the subject offset site for the Balranald Project and these are detailed within an addendum to this report (Niche 2016).

Niche Environment and Heritage – Additional survey areas, injection borefields and West Balranald and Nepean mine areas:

- 14 – 15 October 2013 - initial site inspection and selection of primary survey sites (additional survey areas)
- 31 October – 9 November 2013 – bat and bird surveys (additional survey areas)
- 12 – 14 November 2013 – field survey setup, incidental threatened flora and fauna surveys(additional survey areas)
- 19 – 28 November 2013 – full flora and fauna survey (additional survey areas)
- 9 – 13 December 2013 – full fauna survey (additional survey areas) and targeted Regent Parrot survey (additional survey areas and wider locality)
- 18 – 24 March 2014 – additional survey for Malleefowl (current project area, mine areas and additional survey areas)
- 23 September – 3 October 2014 – full flora and fauna survey and targeted Regent Parrot survey (borehole injection borefields, Murrumbidgee River locality and habitat based survey of water supply pipeline area)
- 2 – 11 December 2014 – full flora and fauna survey (amended injection borefields and water supply pipeline).

Details of the cumulative survey effort for flora and fauna field work are provided in Table 9 and Table 11.

3.2 Vegetation verification and flora survey

The flora survey methodology followed the BBAM (OEH 2014l), which is also consistent with the Framework for Biodiversity Assessment (FBA) (OEH 2014m), with additional information recorded on the basis of current best practice flora survey guidelines for a flora assessment over a large site, particularly OEH's Working Draft Threatened Biodiversity Survey and assessment – Guidelines for Developments and Activities (DEC 2004).

The methodology was applied over the entire project area on the various dates given above. The aim was to adequately sample each of the vegetation community types across the project area using a combination of vegetation quadrats, transects, rapid data points and driving transects or walking meanders according to standard survey requirements. The combination of floristic quadrats and walking meanders, supported by driving transects were ideal for detecting the range of threatened flora with potential to occur within the Project area; walking meanders and transects along with driven transects allowed for significant coverage of the project area while floristic quadrats provide detection advantages for less conspicuous threatened plants. The mixture of survey techniques for threatened plants is consistent with recommended approaches by regulatory authorities (e.g. DEC 2004).The BioBanking plot requirements were calculated using the BBAM/FBA. The number of plots required for each BioMetric Vegetation Types is provided in Table 9.

The BioBanking plots collected (Figure 7(a – e)) the following attributes:

- native species richness (20 x 20 m)
- native over-storey cover (projective foliage cover at 5 m intervals along 50 m transect)
- native mid-storey cover (projective foliage Cover at 5 m intervals along 50 m transect)
- native ground cover (grasses) (frequency tally at 1 m intervals along 50 m transect)
- native ground cover (shrubs) (frequency tally at 1 m intervals along 50 m transect)
- native ground cover (other) (frequency tally at 1 m intervals along 50 m transect)

- exotic cover (as for native over-storey, mid-storey and groundcover)
- over-storey regeneration (proportion of overstorey dominants present as immature recruitment)
- number of trees with hollows (within 50 x 20 m plot)
- total length of fallen logs (within 50 x 20 m plot).

All vascular plant species were recorded within each 20 x 20 m plot used for Native Plant Species Richness score in the BioBanking plots, and were assigned a cover abundance score using a modified six point scale:

1. rare, few individuals (three or less) present and cover <5 %
2. common (consistent throughout plot) and <5 %
3. cover 6-20 %
4. cover 21-50 %
5. cover 51-75 %
6. cover >75 %.

Details of the survey effort are provided in Table. Specifically, the methodology consisted of the following components:

- A total of 207 BioBanking plots/transects located to sample the range of vegetation types within the Survey area. Ninety-four of the207 plots were conducted within the project area, with the majority of the remaining plots (113) conducted within 1,000m from the final project area. Plots and associated targeted plant searches became outside of the project area after disturbance areas were minimised or changes in the project design were made.
- A total of 207BioBanking standard 20 x 20m flora quadrats in the same locations as the BioBanking plots within which all flora species, vegetation structure, extent of modification, disturbance, signs of fire, weed invasion and condition of the vegetation generally were recorded. The combined locations of both the BioBanking plots and the standard flora plots are shown in Figure 6 (a-e).
- Driving transects were conducted throughout all vehicle-accessible parts of the project area. The available tracks provided access to and permitted sampling of a representative cross-section of the project area, encompassing all major vegetation types. These transects were used to record vegetation boundaries, the general condition of vegetation in different parts of the project area and opportunistic flora species not detected in the quadrats.
- Walking meanders were conducted across the project area to access sites for Biobanking plots and to ensure that survey was not skewed significantly towards edge habitats. Walking meanders were conducted within habitat for each targeted threatened species. At a minimum, the combined foot traverses complied with the recommended number and length of traverses per area of stratification unit (vegetation community) according to DEC (2004) survey guidelines. It is estimated that the combined effort for flora meanders and transects is over 400 hours. This figure takes into account all the days' worth of field survey minus travelling times.

Table 9. Vegetation and flora survey effort

BioMetric Vegetation Type OEH(2011)	BioMetric Vegetation Type Abbreviation for Ecological Assessment		Plots conducted per project component						
		Area (ha)[4]	Nepean mine and access road	West Balranald mine (including accommodation facility and gravel extraction area)	Injection borefield	Water supply pipeline	Total plots conducted (project area)	Plots required (NSW FBA)	Additional plots conducted during survey outside of project area boundary
LM130 - Linear Dune Mallee mainly of the Murray-Darling Basin Bioregion	1. Spinifex Dune Mallee Woodland (LM130)	536.4	3	5	1	-	9	7	20
LM116 - Chenopod sandplain mallee woodland/ shrubland of the arid and semi-arid (warm) zones	2.Chenopod Sandplain/Swale Mallee Woodland (LM116)	2,051.50	2	9	17	-	28	8	39
LM102 – Black Bluebush Low Open Shrubland (LM102) of the alluvial plains and sandplains of the arid and semi-arid zones	3.Black Bluebush Low Open Shrubland (LM102)	284.9	3	0	5	-	8	7	3
LM138 – Pearl Bluebush Low Open Shrubland (LM138) of the arid and semi-arid plains	4.Pearl Bluebush Low Open Shrubland (LM138)	1,072	0	4	5	-	9	8	23
LM110 – Bladder Saltbush shrubland on alluvial plains in the semi-arid (warm) zone	5.Bladder Saltbush Low Open Shrubland (LM110)	558	1	0	16	-	17	7	5

[4]Vegetation calculations have been rounded to one decimal place

BioMetric Vegetation Type OEH(2011)	BioMetric Vegetation Type Abbreviation for Ecological Assessment		Plots conducted per project component						
		Area (ha)[4]	Nepean mine and access road	West Balranald mine (including accommodation facility and gravel extraction area)	Injection borefield	Water supply pipeline	Total plots conducted (project area)	Plots required (NSW FBA)	Additional plots conducted during survey outside of project area boundary
LM137 – Old Man Saltbush Shrubland (LM137) mainly of the semi-arid (warm) climate zone (south western NSW)	6.Old Man Saltbush Shrubland (LM137)	19.8	-	5	2		7	3	0
LM107 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	7.Belah – Pearl Bluebush Woodland (LM107)	114.8	-	3	1	-	4	6	2
LM108 – Black Oak – Western Rosewood open woodland on deep sandy loams of Murray-Darling Depression and Riverina Bioregions	8.Belah – Chenopod Woodland (LM108)	438.7	5	-	4	-	9	7	3
LM105 – Black Box open woodland with chenopod understorey mainly on the outer floodplains of the Riverina and Murray-Darling Depression Bioregions	9.Black Box Grassy Chenopod Open Woodland (LM105)	6.9	-	0	1	-	1	3	9
LM143 – River Red Gum – Lignum very tall open forest or woodland on floodplains of semi-arid (warm) climate zone	10.River Red Gum Woodland (LM143)	3.8	-	-	-	1	1	3	5

BioMetric Vegetation Type OEH(2011)	BioMetric Vegetation Type Abbreviation for Ecological Assessment		Plots conducted per project component						
		Area (ha)[4]	Nepean mine and access road	West Balranald mine (including accommodation facility and gravel extraction area)	Injection borefield	Water supply pipeline	Total plots conducted (project area)	Plots required (NSW FBA)	Additional plots conducted during survey outside of project area boundary
LM124 - Disturbed annual saltbush forbland on clay plains and inundation zones of the arid and semi-arid climate zones	11.Flat Open Claypan / Derived Sparse Shrubland/ Grassland [5]	73.6	-	-	-	-	1	5	4
-	12.Cultivated Grain Crops / Cleared Weedy Fallow/ Developed	186.1	-	-	-	-	-	-	0
		5,346.6					94	64	113

[5] Given the extremely sparse nature and highly disturbed element within this vegetation community, minimal plots were conducted. The scores of the BioMetric Vegetation Type are quite low for all attributes and any plot within this community would be within benchmark.

3.3 Targeted threatened flora including MNES species

Flora species listed in Appendix 1 were considered during targeted searches of habitat within the Survey area. Particular attention was given to those species considered to have a moderate or low/moderate chance of occurring within the project area due to the identification of broadly suitable habitat. Those species are tabled below along with an estimate of survey effort (Table 10).

Table 10. Targeted threatened flora with potential habitat in survey area and estimated survey effort

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence	Survey technique/effort
Brachyscome papillosa	Mossgiel Daisy	V	V	Recorded primarily in clay soils on bladder saltbush and leafless bluebush plains, but also in grassland and in inland grey box- cypress pine woodland.	**Moderate**– suitable habitat may be present in the bladder saltbush, black bluebush or derived grassland habitats. Recorded recently within 25 km of Nepean mine (AMBS 2012). However bladder saltbush areas within the project area frequently grazed and disturbed.	Walking meanders within chenopod shrubland areas particularly bladder saltbush, approximately 100 – 150 hours. Flora quadrats (77 in chenopod shrublands within Survey area – approximately 60 hours in addition to meanders).
Lepidium monoplocoides	Winged Peppercress	E	E	Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by bulloak and-or eucalypts, particularly black box or poplar box. The field layer of the surrounding woodland is dominated by tussock grasses.	**Moderate**– potential habitat may be seasonally present in the chenopod mallee, black box, black bluebush, saltbush, claypan or grassland communities, where such areas are lightly grazed. Recorded recently within 20km of Nepean mine (AMBS 2012).	Walking meanders particularly within sparse chenopod mallee, belah and black box communities with some grass cover – approximately 200 hours. Flora quadrats (approximately 95 in possible habitat).
Maireana cheelii	Chariot Wheels	V	V	Usually found on heavier, grey clay soils with bladder saltbush. Soils include heavy brown to red-brown clay-loams, hard cracking red clay, other heavy texture-contrast soils. Tends to grow in shallow depressions, often on eroded or scalded surfaces, and does not extend to the higher soils in the habitat. It has been found on the edges of bare, windswept claypans, in shallow depressions of eroded surfaces where rainwater collects and on a shelf in the crabhole complex of heavy grey soils.	**Low to Moderate**– Suitable habitat including some of the commonly associated species are present on the bladder saltbush plains. Bladder saltbush areas within the project area frequently grazed.	Walking meanders within chenopod shrubland areas particularly bladder saltbush, approximately 100 – 150 hours. Flora quadrats (77 in chenopod shrublands within Survey area – approximately 60 hours in addition to meanders). Opportunistic driving transects.

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence	Survey technique/effort
Pterostylis cobarensis	Greenhood Orchid	V	-	Habitats are eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include *Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna spp.* and *Eremophila* spp. Potential habitat for the species within the project area includes: Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116).	**Low to Moderate**–The species is known to be present at a site approximately 20 kms to the north of the Balranald project area (AMBS 2013).	Walking meanders particularly within mallee and belah communities - approximately 200 hours. Flora quadrats (approximately 114 within potential habitat).
Swainsona murrayana	Slender Darling Pea	V	V	Slender Darling-pea is found in grassland, herbland, and open Black-box woodland, often in depressions. This species grows in heavy grey or brown clay, loam, or red cracking clays. It is often associated with low chenopod shrubs, wallaby-grass and spear grass. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated.	**Moderate**	Walking meanders particularly within sparse chenopod mallee, belah and black box communities with some grass cover – approximately 200 hours. Flora quadrats (approximately 95 in possible habitat).
Swainsona pyrophila	Yellow Swainson-pea	V	V	The Yellow Swainson-pea occurs in mallee vegetation communities on a variety of soil types including well-drained sands, sandy loams and heavier clay loams. The only detailed habitat information is from South Australia, where the species was recorded from mallee woodland with Eucalyptus species including *E. brachycalyx, E. calycogona, E. dumosa, E. gracilis, E. incrassata, E. leptophylla, E. oleosa* and *E. socialis*, sometimes with Broombush *Melaleuca uncinata* tall shrubland. There are some records apparently from riverine vegetation. In NSW, Yellow Swainson-pea has only been recorded a few times, mainly at Mt Hope, Euston and Menindee. In 1988, it was also recorded from Nanya Station (approximately 150 km south of	**Low to Moderate**– potentially suitable habitat is present.	Walking meanders particularly within mallee and communities - approximately 150 hours. Flora quadrats (approximately 96 within potential habitat).

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence	Survey technique/effort
				Broken Hill) (NSW undated). The Yellow Swainson-pea has also been found at Mallee Cliffs and possibly at Tarrawee.		

3.4 Fauna survey

The fauna field surveys incorporated both targeted survey using established survey techniques and broad habitat-based assessment. The project area and additional survey areas were stratified according to the available habitat types identified in section 4.4.1 with survey conducted across each of the stratification units. Survey methods within each stratification unit targeted potentially occurring threatened species within that unit.

A summary of the fauna survey effort performed within and adjacent to the project area is provided in Table 11 and illustrated in Figure 9a-c.

The survey effort for threatened fauna took into considered a number of EPBC Act guidelines including:

- DEWHA (2010) Survey guidelines for Australia's threatened bats Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999
- DEWHA (2010) Survey guidelines for Australia's threatened birds Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999
- DEWHA (2010) Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the EPBC Act
- DEWHA (2011) Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act.

The guidelines presented an issue with the survey design and they do not recommend a survey effort that was suitable for the large Project Area such as the Balranald Project. Most of the guidelines focused on 50 ha sites, with limited details regarding effort for larger areas. To expatiate the 50 ha survey methodology over the Project Area was not feasible. As recommended in the guidelines, consultation with the Department was undertaken to discuss the proposed survey effort (as detailed in Table 5) given the large size. Therefore, the survey effort guidelines provided in DEC (2004) Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft), New South Wales Department of Environment and Conservation, Hurstville, NSW were utilised, with survey methods (trapping technique etc.) recommended in the EPBC Act guidelines (these were similar to those in the OEH guidelines) used where appropriate.

Given the large size of the project area, survey intensity varied across the project area. In the case of the West Balranald Mine, eight primary survey sites were selected within the West Balranald and Nepean mine area (most within the currently proposed project area) in order to sample all of the broad fauna habitats available. Sites 5-8 were sampled over four nights and Sites 1-4 were sampled over three nights as a result of a heavy rainfall event. At the smaller West Balranald Mine, five primary survey sites were established with Sites 1-4 sampled over four nights and Site 5 sampled over three nights. At each of the primary survey sites a combination of the following survey methods were conducted:

- pitfall trapping plus reptile funnel traps and Elliott traps
- micro-bat survey
- diurnal bird census
- diurnal reptile census
- nocturnal survey for mammals, reptiles and frogs
- remote cameras
- call playback
- sand pads (Nepean mine only).

During all survey activity within the project area, opportunistic observations of fauna or faunal activity were recorded, including visual and auditory recognition of fauna species and identification of evidence of faunal activity (e.g. nests, diggings, scratch marks, droppings).

Additional supplementary surveys, mostly targeting specific threatened species, were carried out in February 2012, September 2012, January 2013, December 2014 and November 2014. Surveys carried out included:

- habitat assessment
- Malleefowl mound search transects
- nocturnal and diurnal reptile searches (Jan 2013 only)
- nocturnal and diurnal call playback specifically targeting the Bush-stone Curlew, Redthroat, Rufous Fieldwren, Shy Heathwren, Striated Grasswren and Southern Scrub-robin (Jan 2013 only)
- driven spotlight transects targeting the Plains-wanderer and nocturnal reptiles (2011 and 2013).

3.4.1 Additional targeted survey for Malleefowl and Regent Parrot

To address agency consultation and better understand the distribution of Regent Parrot and Malleefowl within the survey areas (Figure 2) comprehensive additional targeted survey for these species was conducted. Malleefowl survey involved checking the status of known mounds as well as additional searches for unrecorded mounds, prints and birds throughout potential habitat (seeFigure 12 a-c). Habitat features including depth and cover of leaf litter, average stem size of trees, shrub species diversity and cover were collected throughout potential Malleefowl habitat in attempts to relate the presence of the species to habitat characteristics which assisted in habitat mapping.

Regent Parrot survey was conducted in response to observations of the species in November 2013 near the Sturt Highway as part of bird survey activities within the additional survey areas (Figure 2 and Figure 11). The majority of the additional survey areas have since been removed from the project area, or in the case of the proposed transmission line, are yet to be finalised and are subject to a separate approval.

Detailed findings from Malleefowl and Regent Parrot survey are provided within assessments of significance for these species in Appendices 7 and 8.

Table 11. Summary of fauna survey effort

Survey method	Inside project area(or < 1km distant)					Outside of project area(> 1 km)			Total
	Nepean mine	West Balranald mine	Nepean access road	Injection borefield	Water Supply Pipeline	Outside Areas – Nepean	Outside Areas – West Balranald	Outside Areas – Haul Road/Injection borefields	
Camera traps (nights)	63	94	38	154			351	42	742
Elliot traps (nights)	214	304	100	1040			750	360	2,768
Pitfall traps (nights)	166	196	20	98			122	4	606
Reptile Funnels (nights)	214	304							518
Nest Boxes (nights)			240	32			1,920	32	2,224
Diurnal bird survey (20 min surveys)	6	7	22	20	2		87	8	152
Nocturnal call playback (15 min surveys)	2	8	3	1		1			15
Diurnal call playback (15 min surveys)	4	6		16			1	8	35
Diurnal reptile searches (hours)	8	9	7	9		1	11.5	2	47.5
Bat call detectors (stationary -nights)	12	20	14	10			52	2	110
Bat call detectors (handheld - hours)	5	8							13
Harp traps (nights)	10	16	10	2			40		78
Sand plots (nights)	9								9
Frog census and active search (hours)	1	2 *			3		3		9
Predator Scats	22	8							30
Nocturnal spotlight (driven/walked – hours)	9	12	1	10			20	2.5	54.5
Malleefowl Transects (hours)	38	23	7				17	2	97
Malleefowl Mound Checks		4				1	4		9
Regent Parrot – point surveys (hours)		4				-	30		34
R. Parrot – transect surveys walked (hours)							62		62
R. Parrot – transect surveys (driven)		6					14		20

3.4.2 Fauna survey methods

Habitat Assessment

The habitat assessment considered the type and condition of potential habitats for fauna species. Habitat features recorded at each main survey site included:

- topographic features (such as slope, aspect and landscape position)
- geology/soil type
- dominant vegetation community composition, structure and condition at all strata levels (i.e. from ground to canopy cover)
- ground cover type and percentage cover
- form, quality and location of water sources (if any)
- location, type and size of tree hollows
- the presence, number and condition of unique habitat features (such as cracking soils, crevices, loose tree bark, fallen timber and mistletoe)
- the level of disturbance.

Trapping sites

Trapping sites comprised of a combination of the following with occasional slight variations to suit specific site features:

- Pit fall traps: 30 m of drift fence line was erected with three or four plastic buckets (20L), or a steel lining 45 cm deep, placed at regular intervals along the fence (drainage holes were incorporated into the pits). At 13 of the sites the main fence was surrounded by six 5m satellite drift fence lines and a pit. At the remaining five sites within the injection borefields satellite fences were not used. Shade-cloth was placed over pitfalls to provide extra shade and protection from rain. Traps were checked early in the morning and again in the late afternoon where possible.
- Reptile funnels: 10 funnels were set along 13 of the drift fences: four funnels along the main fence and one along each of the six satellite fences. Funnels were not used within the five injection borefield sites.
- Elliot traps: 10 Elliot traps were set along 13 of the drift fences: four traps along the main fence and one along each of the six satellite fences. At the remaining five sites (injection borefields) three Elliot traps were placed along the pitfall fence and either 17 or 22 additional Elliot traps were deployed radiating away from the fence in a linear pattern, with traps placed every 5 to 10 m adjacent to microhabitat features such as hollow logs or under dense shrubs. The Elliott traps were baited with a standard peanut butter, rolled oats and birdseed mixture and bedding was provided.
- Camera traps: At each primary survey site two or three remote cameras (Scout Guard and Moultrie) were fixed to wooden stakes and left in place for the duration of the trapping survey (three to eight nights). The cameras were aimed at the ground below and standard peanut butter/rolled oats baits and/or tinned cat food was used as an attractant. Additional cameras were also used at random locations including water-points, along identified tracks and at five Malleefowl mounds.
- Ultrasonic bat detectors: Anabat and SM2+ recorders were set at primary survey sites as well as 22 additional sites. The detectors were placed on the ground or elevated up to a metre where possible and, pointed upwards at approximately a 45^{o} angle and left in position for the whole night. Any calls recorded were saved onto a SD card via a Storage ZCAIM (Titley Electronics) and the calls were later analysed by computer using Anabat software. In addition, a hand held mobile unit (Anabat SD1 attached to a PDA) was used during the release of bats to record reference calls and also during spotlighting sessions.
- Harp traps: Harp traps were set at 32 sites encompassing primary trap sites and additional sites within close proximity to the project area (additional harp trap sites distant from the project area have not been added to the survey effort). The traps were generally set between trees, particularly where

overhanging branches formed a constricted flyway, and traps were checked in the evening and early morning. As lactating bats were caught towards the end of the surveys, traps were checked before daylight or very soon after day break and the collecting bag removed.

Diurnal bird census

Bird surveys were carried out at primary survey sites and additional sites (59 sites total) by traversing each site in the early-mid morning. Each bird survey was carried out by one person for a period of 20 minutes within a two ha area. Detection of calls and direct observation were used to identify bird species. Birds noted during other activities within each site and within the general project area were also recorded.

Diurnal reptile census

Reptile searches were carried out during the day, avoiding periods of high temperatures. Searches were carried out over one person hour (30mins x two persons) at each of the primary survey sites and involved searching under vegetation and around fallen timber as well as recording active, foraging reptiles. Additional searches at selected opportunistic sites were also carried out.

Nocturnal survey for mammals, reptiles and frogs

Spotlighting searches were carried out at the majority of primary survey sites on one night by two ecologists. Each spotlighting session lasted for approximately an hour. Each session consisted of a traverse through the site sampling the identified habitats using LED torches and/or 50W hand held spotlights. Frog searches were carried out primarily around farm dams and pools retained in road gutters after rain.

Additional searches at selected opportunistic sites were carried out in January 2013, mainly targeting nocturnal reptiles and small mammals. Additional targeted frog searches were carried out along the water supply pipeline (eastern end) on 6December 2014.

Call playback

In 2011, nocturnal call playback was carried out on two nights on the track between Sites 7 and 8 at the West Balranald mine, targeting the Plains-wanderer and Bush Stone-curlew. Calls of each of the targeted species were broadcast for up to five minutes followed by five minutes of listening time. Further nocturnal call playback targeting the Bush Stone-curlew was played at selected sites at Nepean, West Balranald and injection borefield sites.

In January 2013 diurnal bird call playback was conducted at 10 sites (six at West Balranald and four at Nepean), targeting the Redthroat, Rufous Fieldwren, Shy Heathwren, Striated Grasswren and Southern Scrub-robin. The species targeted depended on the available habitat however on average each survey lasted 15 minutes including listening time. Repeats of these surveys were carried out within the injection borefield areas.

Malleefowl mound search transects

The identification of two active Malleefowl mounds within the West Balranald mine area in 2011 prompted further searches for mounds within both the Nepean mine and West Balranald mine survey areas in January 2013 and again in March 2014. Survey included areas outside of the project area to assist with understanding the quality of habitat and density of active and old mounds adjacent to the project area. The location of any nest mounds found was recorded by the use of a hand held GPS and all mound locations,

including NSW Wildlife Atlas records are shown in Figure 11a-c along with Malleefowl transect routes within and adjacent to the project area.

Sand Pads (Nepean mine only)

Sand pads were prepared across access tracks infrequently used by vehicles. The existing sand was loosened and then raked flat to provide a deep sandy area that would record identifiable animal tracks. Additional sand was imported from surrounding areas if required. Three pads were set at least 1km apart along the fence line of the SMCA that traverses the disturbance area (generally between Sites 2 and 5). It was found that footprints could regularly be detected in soft sand across the project area (without having to construct specific sand pads), so the preparation of further sand pads was discontinued as time would be better spent carrying out other activities.

Nepean Access Road

Trapping was confined to harp trapping for the Nepean access Road between the Nepean and West Balranald Mines. The following additional targeted surveys were carried out:

- Habitat assessment.
- Malleefowl mound search transects (within the mallee between Nepean – Arumpo Road in Sept 2012).
- Diurnal reptile searches (Jan 2013 only).
- Nocturnal and diurnal call playback specifically targeting the Bush Stone Curlew, Redthroat, Rufous Fieldwren, Shy Heathwren, Striated Grasswren and Southern Scrub-robin (Jan 2013 only).
- Driven spotlight transects targeting the Plains-wanderer and nocturnal reptiles (2013).

Regent Parrot Survey

Regent Parrot survey consisted of three designated types of survey:

1. 20 minute, 2 hectare bird surveys done by two ecologists at 51 sites within and outside of the project area;
2. Walked transects, generally from 1 – 2 hours performed by one or two ecologists;
3. Driven transects at 15 km/hr or less.

A range of ecological survey activities took place in addition to specific targeted surveys during which there was a moderate to high chance of Regent Parrot detection should the species have been present. Such surveys included (without being limited to) habitat assessment for different transmission line options and crossing points around the Sturt Highway and Murrumbidgee Rivers, habitat assessment for different water pipeline configurations between the Murrumbidgee River and the proposed West Balranald mine, repeated driving along the major dirt roads and highways in and around the project area to check traps and perform other survey activities, malleefowl surveys and spot assessments for borehole mining injection sites. Personnel performing these surveys had almost always observed Regent Parrots through prior surveys or due to having visited reference sites (known roosting areas at Euston) and were well acquainted with the calls of the species having listened repeatedly to recordings of the calls of the species (often en-route to survey sites).

Calculations of survey effort for targeted Regent Parrot surveys does not include this time, however it is suggested that given the coverage and duration of non-targeted survey along with the often conspicuous nature of the Regent Parrot and its distinctive call, non-targeted survey activities increase the certainty regarding the findings and conclusions made for this species in terms of its use of the project area and surrounds.

3.5 Weather conditions

Weather conditions were obtained from the Bureau of Meteorology (Station 049002). The minimum and maximum temperature and rainfall during the survey period for 2011 to 2015 has been provided in Appendix 6.

The majority of fauna survey was conducted during spring and summer. Conditions were frequently dry and hot. Average temperatures during these months ranged from a minimum temperate of 14 degrees, and reached an average of 32 degrees.

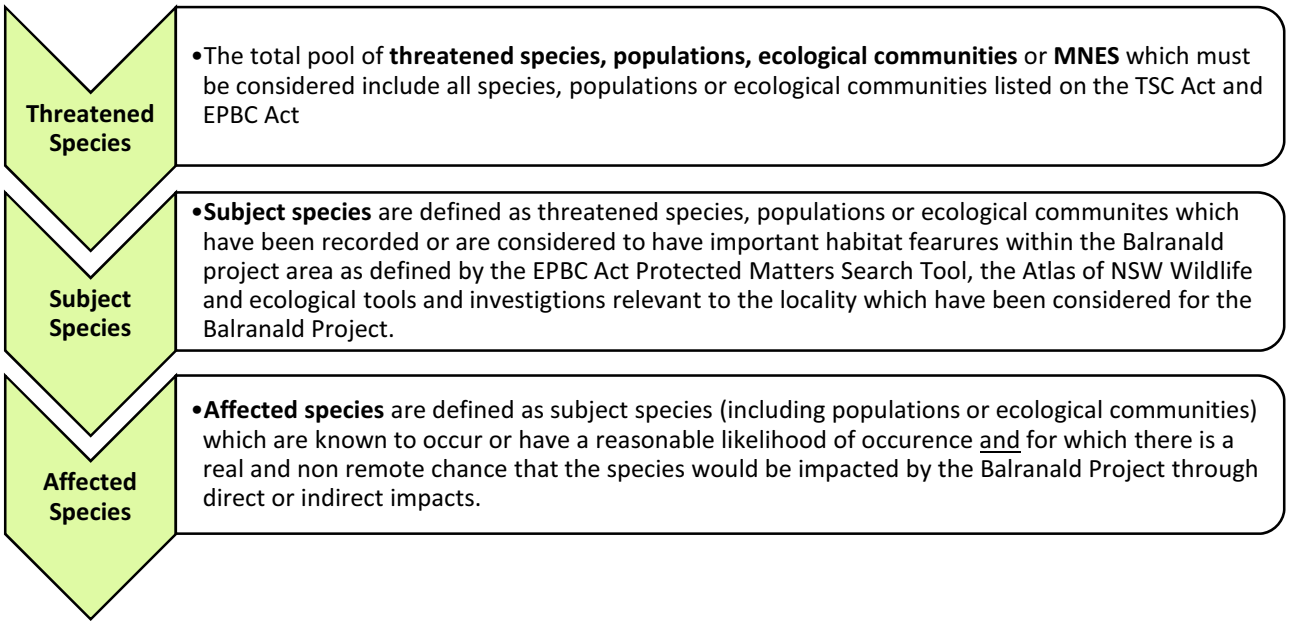
Rainfall occurred on average once or twice each month over the survey period. Average rainfall did not reach over 10 mm during the survey period, although localised rainfall may have been higher than reported over the 3rd and 4th of December 2014 as evidenced by floodplain inundation at the water supply pipeline area and communicated by local landholders.

Weather conditions were taken into account with the survey design. Day temperatures were warm to hot therefore bird and reptile surveys were generally limited to cooler parts of the day. Trap checking was also conducted in the early hours of the morning.

3.6 Approach to impact assessment

Although threatened species may have previously been recorded in the vicinity of the project area, not all species that may occur or for which potential habitat may occur will be impacted by the Balranald Project. To define the sub-set of threatened species potentially impacted by the Balranald Project (subject species), analysis of the likelihood of the threatened species identified in the database and literature searches as occurring or potentially occurring within the project area was completed. The list of potentially impacted (affected) species is determined from consideration of this list. In order to adequately determine the relevant level of assessment to apply to subject species, further analysis of the likelihood of those species occurring within the project area was completed. Diagram 1 provides a representation of the hierarchy of decision making employed to determine which species, populations, ecological communities or MNES are to be considered further in the impact assessment of this report.

Diagram 1: The hierarchy of decision making to define the subject species for this assessment



Five categories for 'likelihood of occurrence' (Table 12) were attributed to the list of threatened species after consideration of criteria such as known records, presence or absence of important habitat features on the subject site, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further in formal assessments of significance pursuant to relevant legislation were those in the 'Known' to 'Moderate' categories and where impacts for the species could reasonably occur from the Balranald Project (refer to the outcomes of the affected species analysis in Section 4).

Although the project area may contain habitat for threatened species, unless the Balranald Project will result in a direct impact on the species (removal during vegetation clearing) or result in indirect impacts (including edge effects, fragmentation, noise etc.) on habitat which the species relies for survival. Subject species are not elevated to become affected species and are not considered further in the impact assessment.

Table 12. Likelihood of occurrence criteria

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species was observed within the project area	The species was observed within the project area
High	It is likely that a species inhabits or utilises habitat within the project area	It is likely that a species inhabits or utilises habitat within the project area
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the project area	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the project area
Low	It is unlikely that the species inhabits the project area	It is unlikely that the species inhabits the project area. If present at the site the species would likely be a transient visitor. The site contains only common habitat for this species which the species would not rely on for its on-going local existence such as limited breeding habitat resources.
None	The species has not been recorded within the project area and habitat within the project area project area is unsuitable for the species	The species has not been recorded within the project area and habitat within the project area is unsuitable for the species project area

3.7 Approach to offsetting

Section 7 of this report details the Biodiversity Offset Strategy for the Balranald Project. It describes the approach to biodiversity offsetting proposed for the Balranald Project in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the Commonwealth EPBC Act 1999 Environmental Offsets Policy.

The approach involved the use of the BioBanking calculator (for major projects) to determine the offset requirement for vegetation impacts and NSW TSC Act threatened biodiversity significantly impacted by the

Balranald Project. The *EPBC Act Environmental Offsets Policy* was applied in this assessment for threatened biodiversity listed under the EPBC Act likely to be significantly impacted by the Balranald Project.

3.8 Limitations

Flora

Due to the very large project area, the ability to visually survey the entire project area was limited. Survey was designed with the site constraints (size, accessibility, weather) in mind. The project area was adequately surveyed to document all vegetation types and major habitats within the project area. A stratified survey approach was adopted in which the primary survey sites and driving transects were spread widely over the project area so as to capture as much floral diversity and site variation as possible.

While some target species are cryptic and detection can be difficult, given the size and scale of the project area, the survey was considered to be sufficiently targeted in order to complete a robust biological assessment for the Balranald Project.

Fauna

Field survey sites were located to sample as much of the project area as possible within the limitations of the site. Survey sites were stratified across the identified types within the project area and selected to target better quality habitat typically after aerial photography interpretation prior to and during field survey.

The survey undertaken conforms to policy and guideline requirements, however the large size of the project area has inherent limitations on the efficacy of field work, particularly in respect to capturing the full range of species. Due to this some species may not have been detected, particularly if seasonal use of the available habitats occurs. These limitations have been taken into account and all threatened species with the potential to utilise the habitats observed within the project area have been discussed and assessed in the Impact Assessment section of this report (Section 5).

Full fauna survey was not conducted along the proposed water supply pipeline route since impacts from the pipeline installation will be relatively minor along the proposed route compared with impacts on comparable habitat within the remainder of the project area. The commitment from Iluka to adopt control measures to protect wetland habitat and limit clearing at the eastern extreme of the proposed pipeline route meant that targeted surveys of wetland bird species or mammals using the area was not required since impacts generated from the works in this area would be minimal.

No targeted surveys were undertaken at the Accommodation Facility as it has very poor habitat (open field with a few trees), however the Accommodation Facility is contiguous with West Balranald Mine area, and therefore this limitation is relatively minor.

4. Field Survey Results

4.1 Vegetation community delineation and mapping

Vegetation within the project area has been mapped previously by Scott (1992). The available mapping was used to aid in vegetation community delineation, with mapped communities adapted to fit classification according to the available BioMetric Vegetation Types for the Lower Murray/Darling and Murrumbidgee CMAs (OEH 2013) based on Benson et al. (2006). This process allowed for results to be directly used in the BBAM.

Eleven BioMetric Vegetation Types were identified within the Balranald Project disturbance area with two additional vegetation or habitat types created to recognise highly modified vegetation communities which cannot be defined by any meaningful native vegetation description. The summary names below were defined for ease of identification and reporting:

1. Spinifex Dune Mallee Woodland (LM130)
2. Chenopod Sandplain/Swale Mallee Woodland (LM116)
3. Black Bluebush Low Open Shrubland (LM102)
4. Pearl Bluebush Low Open Shrubland (LM138)
5. Bladder Saltbush Low Open Shrubland (LM110)
6. Old Man Saltbush Shrubland (LM137)
7. Belah – Pearl Bluebush Woodland (LM107)
8. Belah – Chenopod Woodland (LM108)
9. Black Box Grassy Chenopod Open Woodland (LM105)
10. River Red Gum Woodland (LM143)
11. Flat Open Claypan / Derived Sparse Shrubland/Grassland (LM124)
12. Cultivated Grain Crops / Cleared Weedy Fallow / Developed.

The vegetation communities along with equivalent BioMetric Vegetation Types (and reference codes), Keith Class, Keith Formation, relevant vegetation mapping projects and alignment to the validated vegetation communities is provided in Table 13.

Descriptions are provided for each vegetation community in sections 4.1.1 to 4.1.13. Vegetation community mapping is illustrated in Figure 7 (a – e).

Condition of vegetation throughout the project area is mapped in Figure 7 (f-g) and commentary regarding condition of vegetation is provided throughout relevant sections of reporting and within the description of each of the vegetation types in sections 4.1.1 to 4.1.13.

Table 13. Validated vegetation mapping, Keith Formation, Keith Class and relevant mapping units

Vegetation Formation (Keith 2004)	Vegetation Class (Keith 2004)	BioMetric Vegetation Type OEH(2011)	Benson *et al.* (2006) ID No.	Scott (1992) Map Unit	BioMetric Vegetation Type abbreviation for this ecological assessment	Extent of Vegetation Community within disturbance area (has)[6]								
						Nepean mine	Nepean access road	West Balranald mine	West Balranald access road	Injection Borefield	Water Supply Pipeline	Accommodation facility	Gravel extraction area	Total
Semi-arid woodlands (shrubby sub-formation)	Dune Mallee Woodlands	LM130 - Linear Dune Mallee mainly of the Murray-Darling Basin Bioregion	171	3b – Dune Crest Mallee	1. Spinifex Dune Mallee Woodland (LM130)	187.2	8.6	311.6	7	8.1	0	0	13.9	536.4
	Sand Plain Mallee Woodlands	LM116 - Chenopod sandplain mallee woodland/ shrubland of the arid and semi-arid (warm) zones	170	3c – Swale Mallee	2.Chenopod Sandplain/Swale Mallee Woodland (LM116)	248.4	28	1,392.2	14.4	366.2	2.3	0	0	2,051.5
	Semi-arid Sand Plain Woodlands	LM107 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	221	4 – Belah – Rosewood	7.Belah – Pearl Bluebush Woodland (LM107)	0	5.3	105.8	0	3.7	0	0	0	114.8
		LM108 – Black Oak – Western Rosewood open woodland on deep sandy loams of Murray-Darling Depression and Riverina Bioregions	58	4 – Belah – Rosewood	8.Belah – Chenopod Woodland (LM108)	368.3	8	0	0	62.4	0	0	0	438.7
Semi-arid woodlands (grassy sub-formation)	Inland Floodplain Woodlands	LM105 – Black Box open woodland with chenopod understorey mainly on the outer floodplains of the Riverina and Murray-Darling Depression Bioregions	15	2 – Black Box Woodland	9.Black Box Grassy Chenopod Open Woodland (LM105)	0	0.2	1.4	0	4.3	1	0	0	6.9
Forested wetlands	Inland Riverine Forests	LM143 – River Red Gum – Lignum very tall open forest or woodland on floodplains of semi-arid (warm) climate zone	11	1 –Riverine Forest	10.River Red Gum Woodland (LM143)	0	0	0	0	0	3.8	0	0	3.8
Arid shrublands (Chenopod sub-formation)	Aeolian Chenopod Shrublands	LM102 – Black Bluebush Low Open Shrubland (LM102) of the alluvial plains and sandplains of the arid and semi-arid zones	153	8a/8b – Black Bluebush	3.Black Bluebush Low Open Shrubland (LM102)	0	30	85.6	0	169.3	0	0	0	284.9
		LM138 – Pearl Bluebush Low Open Shrubland (LM138) of the arid and semi-arid plains	154	9 – Pearl Bluebush	4.Pearl Bluebush Low Open Shrubland (LM138)	0	8	1,032.5	0	23.9	0	0	7.7	1,072.1

[6]Vegetation calculations are to one decimal place for this assessment

Vegetation Formation (Keith 2004)	Vegetation Class (Keith 2004)	BioMetric Vegetation Type OEH(2011)	Benson *et al.* (2006) ID No.	Scott (1992) Map Unit	BioMetric Vegetation Type abbreviation for this ecological assessment	Extent of Vegetation Community within disturbance area (has)[6]								
						Nepean mine	Nepean access road	West Balranald mine	West Balranald access road	Injection Borefield	Water Supply Pipeline	Accommodation facility	Gravel extraction area	Total
	Riverine Chenopod Shrublands	LM110 – Bladder Saltbush shrubland on alluvial plains in the semi-arid (warm) zone	157	11 – Bladder Saltbush	5.Bladder Saltbush Low Open Shrubland (LM110)	0	40	0	0	518	0	0	0	558.0
		LM137 – Old Man Saltbush Shrubland (LM137) mainly of the semi-arid (warm) climate zone (south western NSW)	159	19 – Old Man Saltbush	6.Old Man Saltbush Shrubland (LM137)	0	0	19.3	0	0.5	0	0	0	19.8
Saline Wetlands	Inland Saline Lakes	LM124- Disturbed annual saltbush forbland on clay plains and inundation zones of the arid and semi-arid climate zones	166	8b –Black Bluebush (sparse) / 19 – Old Man Saltbush / 22 – Dillon Bush	11.Flat Open Claypan / Derived Sparse Shrubland/ Grassland (LM124)	0	1.7	50.9	0	21	0	0	0	73.6
Not classified		-	-	C – Cleared and/ or cropped	12.Cultivated Grain Crops / Cleared Weedy Fallow / Developed	1.2	27.5	59.4	30.5	36.3	3.8	7.1	20.3	186.1
					TOTAL	**805.1**	**157.3**	**3,058.7**	**51.9**	**1,213.7**	**10.9**	**7.1**	**41.9**	**5,346.6**

4.1.1 Spinifex Dune Mallee Woodland (LM130)

Habitat: Well-drained crests and slopes on east-west linear dunes on red calcareous sand to sand/clay.

Structure/Characteristics: Low woodland to low open woodland dominated by thin-stemmed 'whipstick' mallee eucalypts with a sparse to absent shrub layer, and either (a) a moderate to dense ground layer dominated by dense *Triodia scariosa* or various combinations of spinifex, other grasses and chenopods or (b) sparse shrub and ground layers in which spinifex is absent and replaced by Senna and gall weed.

Distribution within project area: Occurs throughout most of the Nepean mine, northern parts of the Nepean access road and the southern part of the West Balranald mine. This vegetation community occupies the crests and slopes of east-west linear dunes.

Condition and Presence of Weeds: Mostly in good condition in spite of light grazing and disturbances by stock and feral animals. Weeds generally absent or confined to patches near cleared areas.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat Category: 'Least Concern'; Threat/Protected Area Code: LC/3a.

Stratum	Height	% cover*	Dominant Species
Tree layer	5 - 7 m	30 - 50	*Eucalyptus dumosa, E. socialis, E. gracilis, E. leptophylla, E. oleosa*
Shrub layer	1 – 2m	0 - 10	*Maireana pentatropis, Senna artemisioides, Dodonaea viscosa* subsp. *angustissima, Westringia rigida, Grevillea huegelii, Olearia muelleri*
Ground layer	to 0.7 m	15 - 50	*Triodia scariosa, Austrostipa scabra, Lachnagrostis filiformis, Sclerolaena diacantha, S. brachyptera, S. parviflora, Zygophyllum apiculatum, Halgania cyanea, Ptilotus seminudus, Vittadinia dissecta* var. *hirta, Lomandra effusa, L. collina* and *Schoenus subaphyllus*

*Projected foliage cover Photo: Ecotone during 2012 field survey.

4.1.2 Chenopod Sandplain/Swale Mallee Woodland (LM116)

Habitat: Low-lying flat plains or inter-dune swales of calcareous clay to sandy clay.

Structure/Characteristics: Low woodland to low open woodland dominated by robust thick-stemmed mallee eucalypts with a sparse to dense chenopod shrub layer, and a sparse to dense ground layer dominated by grasses and chenopods.

Distribution within project area: Occupies large parts of the flat plain or gently sloping rises and also lower-lying swale areas between the crests of the east-west linear dunes in Nepean mine, northern end of the Nepean access road, southern end of West Balranald mine.

Condition and Presence of Weeds: Areas are predominantly in moderate to good condition depending on level of goat and cattle/sheep disturbance. In areas adjacent to clearing or where vegetation has been reduced to thin fragments, condition becomes poor due to increased soil disturbance and weed presence. Common weeds include *Psilocaulon,* smooth mustard, barley grass and medic.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat **Category:** 'Near Threatened'; Threat/Protected Area Code: NT/4a. Occurs in an area partly covered by conservation covenants.

Stratum	Height	% cover*	Dominant Species
Tree layer	5 - 8 m	20 - 40	*Eucalyptus dumosa, E. oleosa, E. gracilis, E. socialis*
Shrub layer	1 – 2 m	5 - 40	*Maireana pyramidata, M. sedifolia, M. pentatropis, Enchylaena tomentosa, Psilocaulon tenue, Atriplex nummularia, A. vesicaria, A. semibaccata, A. eardleyae, Chenopodium curvispicatum, C. desertorum.*
Ground layer	To 0.7 m	40 - 70	*Sclerolaena brachyptera, S. diacantha, Dissocarpus paradoxus, Austrostipa scabra, A. elegantissima, Eragrostis dielsii, Vittadinia pterochaeta, Einadia nutans, Zygophyllum apiculatum, Z. angustifolium, Actinobole uliginosum.*

*Projected foliage cover Photo: Ecotone during 2012 field survey

4.1.3 Black Bluebush Low Open Shrubland (LM102)

Habitat: Flat open clay to sandy clay plains with poor drainage.

Structure/Characteristics: Low sparse to dense shrubland barely exceeding 1m in height dominated by black bluebush with other chenopod shrubs, copperburrs, herbs and grasses at varying abundance. *Nitraria billardiera* becomes common in more disturbed areas.

Distribution within project area: Northern section of West Balranald mine associated with or adjacent to the large dry lakes and claypan areas. Also present along injection borefields and may be derived in such areas through prior clearing of Mallee or Belah communities.

Condition and Presence of Weeds: Mostly in moderate condition with grazing and disturbance by stock and feral animals. Some areas are interspersed with erosion scalding and are lower condition. Weeds generally absent or light – mainly medics and minor exotic herbs.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat Category: 'Near Threatened'; Threat/Protected Area Code: NT/4a.

Stratum	Height	% cover*	Dominant Species
Shrub layer	1 - 1.5 m	5 - 60	*Maireana pyramidata, M. sedifolia, M. brevifolia, Nitraria Billardiera, Enchylaena tomentosa, Atriplex nummularia, A. vesicaria*
Ground layer	To 1 m	10 - 80	*Austrostipa scabra, A. elegantissima, Austrodanthonia caespitosa, Eragrostis australasica, E. dielsii, Sclerolaena diacantha, S. brachyptera, S. divaricata, Dissocarpus paradoxus Tecticornia tenuis, Einadia nutans, Enneapogon avenaceus, Teucrium albicaule, Zygophyllum angustifolium, Vittadinia pterochaeta, Tetragonia tetragonioides.*

Photo: Ecotone during 2012 field survey

4.1.4 Pearl Bluebush Low Open Shrubland (LM138)

Habitat: Slightly elevated rises in the flat open clay to sandy clay plains with poor drainage.

Structure/Characteristics: Similar to the closely related Black Bluebush Low Open Shrubland (LM102) but dominated by pearl bluebush.

Distribution within project area: mainly in the northern section of the West Balranald mine adjacent to the large dry lakes and claypan areas. Also present along injection borefields. Associated with and intergrades with Black Bluebush Low Open Shrubland (LM102).

Condition and Presence of Weeds: Mostly in moderate condition with grazing and disturbance by stock and feral animals. Some areas are interspersed with erosison scalding and are lower condition. Weeds generally absent or light and include mainly medics and minor exotic herbs except at edges of cleared areas.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat Category: 'Near Threatened'; Threat/Protected Area Code: NT/5a.

Stratum	Height	% cover*	Dominant Species
Shrub layer	1.5 - 2 m	25 - 50	*Maireana sedifolia, M. pyramidata, Nitraria billardierei, Atriplex nummularia A. vesicaria, Chenopodium desertorum*
Ground layer	To 1 m	20 - 50	*Austrostipa scabra, A. elegantissima, Dissocarpus paradoxus, Sclerolaena diacantha, S. brachyptera, Enchylaena tomentosa, Eragrostis australasica, E. dielsii, Daucus glochidiatus, Goodenia fascicularis, Austrodanthonia caespitosa.*

Photo: Ecotone during 2012 field survey

4.1.5 Bladder Saltbush Low Open Shrubland (LM110)

Habitat: Flat open low-lying plains with poor drainage in light grey to tan clay.

Structure/characteristics: Very low shrubland to 1m strongly dominated by *Atriplex vesicaria*. Very species-poor – commonly associated species include *Disphyma crassifolium* and *Tecticornia tenuis*.

Distribution within project area: Occupies a broad band along the catchment of Black Box Creek, at the far northern end of the West Balranald mine and along the central part of the Nepean access road between the two mine sites. Also present along injection borefields.

Condition and Presence of Weeds: Mostly in moderate condition with grazing and disturbance by stock and feral animals. Some areas are interspersed with erosison scalding and are lower condition. Weeds generally absent or light and occur mainly at edges of cleared areas or by roads.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat **Category:** 'Vulnerable'; Threat/Protected Area Code: V/5a.

Stratum	Height	% cover*	Dominant Species
Ground layer	To 1 m	40 - 45	*Atriplex vesicaria, Maireana pyramidata, Nitraria billardierei*
Ground layer	To 0.5 m	10 - 20	*Tecticornia tenuis, Disphyma crassifolium* subsp. *clavellatum, Rytidosperma setaceum*

Photo: Ecotone during 2012 field survey

4.1.6 Old Man Saltbush Shrubland (LM137)

Habitat: Floodplains or elevated depressions with restricted drainage.

Structure/Characteristics: Dense taller shrubland dominated by mature *Atriplex nummularia* to 2m in height with occasional emergent taller trees. Ground layer often including moisture-loving species such as *Juncus* spp. and *Marsilea drummondii*.

Distribution within project area: Limited to isolated, remnant patches in the central part of the West Balranald mine and southern end of the Nepean access road.

Condition and Presence of Weeds: Moderate and condition with many species and high cover abundance of weeds. Remnant saltbush plants are often over-mature to senescent. Common species include *Nothoscordum inodorum* and *Hordeum* spp.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat **Category:** 'Critically Endangered'; Threat/Protected Area Code: CE/5a.

Stratum	Height	% cover*	Dominant Species
Tree layer	5 m	0 - 10	*Alectryon oleifolius*
Shrub layer	2 m	35 - 40	*Atriplex nummularia*
Ground layer	1 m	50 - 70	*Juncus aridicola, Austrostipa scabra, Marsilea drummondii, Daucus glochidiatus, Asphodelus fistulosus, Cotula coronopifolia, Hordeum leporinum*

*Projected foliage cover; Photo Ecotone during 2012 field survey

4.1.7 Belah – Pearl Bluebush Open Woodland (LM107)

Habitat: Flat plains adjoining Communities 3 & 4.

Structure/Characteristics: Woodland to open woodland with a tree layer consisting almost exclusively of belah with a dense shrub and ground layer dominated by *Maireana sedifolia*, *M. pyramidata* and low chenopods.

Distribution within project area: Occurs at the northern end of the Nepean access road and central part of the West Balranald site. Minor occurrences further south.

Condition and Presence of Weeds: Mostly in moderate or good condition. Weed cover generally minor except at interfaces with cleared areas – mainly *Sisymbrium erysimoides*.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat **Category:** 'Near Threatened'; Threat/Protected Area Code: NT/5a.

Stratum	Height	% cover*	Dominant Species
Tree layer	10 - 12 m	25	*Casuarina pauper*
Shrub layer	1 -1.5 m	30 - 50	*Maireana sedifolia, M. pyramidata, Atriplex vesicaria, A. nummularia, Enchylaena tomentosa, Chenopodium desertorum, Nitraria billardierei, Eremophila longifolia, Rhodanthe floribunda*
Ground layer	0.5 – 1 m	20 - 40	*Zygophyllum apiculatum, Sclerolaena brachyptera, Dissocarpus paradoxus, Einadia nutans, Austrostipa scabra, A. elegantissima, Austrodanthonia caespitosa, Tetragonia tetragonioides, Vittadinia pterochaeta, Bulbine semibarbata, Teucrium racemosum.*

*Projected foliage cover; Photo Ecotone during 2012 field survey

4.1.8 Belah Chenopod Woodland (LM108)

Habitat: Flat, dry elevated areas on heavier soil.

Structure/Characteristics: Woodland to open woodland with a tree layer consisting almost exclusively of belah often with a sparse small tree layer and sparse to dense shrub and ground layers dominated by *Maireana pentatropis*, *M. pyramidata*, *Atriplex nummularia*, *Enchylaena tomentosa*, *Chenopodium curvispicatum*, and low chenopods.

Distribution within project area: Occupies several patches throughout the Nepean mine, intergrading mainly with the mallee communities. Also present along injection borefields.

Condition and Presence of Weeds: Mostly in good or moderate condition. Weed cover very minor - small occurrences at interfaces with roads or cleared areas. Shrub layer often lacking or absent.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat **Category:** 'Near Threatened'; Threat/Protected Area Code: NT/4a.

Stratum	Height	% cover*	Dominant Species
Tree layer	8 - 16 m	10 - 40	*Casuarina pauper*
Small tree layer	4 – 6 m	5 - 15	*Exocarpos aphyllus, Duboisia hopwoodii, Myoporum platycarpum, Geijera parviflora, Acacia colletioides*
Shrub layer	1 -1.5 m	2 - 45	*Dodonaea viscosa* subsp. *angustissima, Maireana pentatropis, M. pyramidata, Atriplex nummularia, Enchylaena tomentosa, Chenopodium curvispicatum, C. desertorum*
Ground layer	0.5 – 1 m	5 - 40	*Zygophyllum apiculatum, Sclerolaena brachyptera, S. diacantha, Dissocarpus paradoxus, Austrostipa scabra, A. nodosa, Austrodanthonia setacea, Olearia pimeleoides, Maireana brevifolia*

*Projected foliage cover; Photo Ecotone during 2012 field survey

4.1.9 Black Box Grassy Chenopod Open Woodland (LM105)

Habitat: Poorly drained floodplains or elevated depressions on grey clay in the vicinity of the large dry lakes.

Structure/Characteristics: Open woodland composed solely of black box in the tree layer with a moderate chenopod shrub layer, and a moderate to dense ground layer dominated by spear grass, other grasses and copperburrs.

Distribution within project area: Occurs as small to moderate remnant patches in the central-northern part of the West Balranald mine, southern part of the Nepean access road and parts of the outer floodplain of the Murrumbidgee River.

Condition and Presence of Weeds: Mostly in moderate and poor condition due to past tree thinning and heavy grazing. Weed abundance is moderate to severe.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat **Category:** 'Near Threatened'; Threat/Protected Area Code: NT/5a.

Stratum	Height	% cover*	Dominant Species
Tree layer	8 - 14 m	25 - 30	*Eucalyptus largiflorens*
Shrub layer	1 - 2m	30 - 45	*Atriplex nummularia, A. vesicaria, Maireana pyramidata, M. pentatropis, Enchylaena tomentosa* *Juncus aridicola, Malva preissiana, Nitraria billardierei*
Ground layer	0.5 - 1 m	30 - 60	*Marsilea drummondii, Persicaria lapathifolia, Sclerolaena muricata, S. brachyptera, S. divaricata, S. diacantha, Sisymbrium erysimoides, Einadia nutans, Zygophyllum angustifolium, Austrostipa scabra, Chenopodium curvispicatum, Dissocarpus paradoxus.*

*Projected foliage cover; Photo Ecotone during 2012 field survey

4.1.10 River Red Gum Woodland (LM143)

Habitat: Banks and floodplains of the Murrumbidgee River.

Structure/Characteristics: Woodland composed of *Eucalyptus camaldulensis* in the tree layer with a very sparse to absent shrub layer consisting mainly of regenerating river red gum seedlings and a predominantly sparse ground layer dominated by native and exotic grasses, herbs and weeds. Parts of the community occur within drainage depression areas and are therefore subject to inundation and accordingly include species that respond to seasonal inundation.

Distribution within project area: Confined to the banks and floodplain of the Murrumbidgee River along the eastern portion of the water supply pipeline.

Condition and Presence of Weeds: Mostly in poor condition within project area due to past and ongoing tree thinning, logging and cattle grazing. Weed abundance is moderate in areas where grazing and other disturbances are regular. Overall the trees are generally mature within a predominantly cleared shrub layer and disturbed soil layer from roads and tracks. Further from the road margins condition increases.

Conservation Status: Not listed by NSW or Commonwealth legislation. Benson et al. (2006) Threat **Category:** 'Near Threatened'; Threat/Protected Area Code: NT/3a.

Stratum	Height	% cover*	Dominant Species
Tree layer	25 - 28m	10 - 30	*Eucalyptus camaldulensis*
Shrub layer	2 - 3m	1 - 5	Regenerating *Eucalyptus camaldulensis* saplings, *Duma florulenta, Juncus aridicola, Lycium ferocissimum*
Ground layer	0.5 - 1 m	5 - 20	*Paspalidium jubiflorum, Lachnagrostis filiformis, Austrostipa scabra, Marsilea drummondii, Boerhavia coccinea, Pratia concolor, Brachyscome dentata, Wahlenbergia fluminalis, Centipeda cunninghamii, Pycnosorus globosus, Bromus rubens, Sida corrugata, Oxalis pes-caprae*

*Projected foliage cover; Photo Ecotone during 2012 field survey

4.1.11 Flat Open Claypan/Derived Sparse Shrubland/Grassland (LM124)

The vegetation on the open claypans mainly in the central parts of the project area is very sporadic. The habitat supports very sparse shrubs and ground cover in small, isolated clumps usually where it grades into other chenopod communities. Many areas have no vegetative cover at all even after good rainfall and consist of a bare, crusty red/brown or grey clay surface subject to inundation during wet conditions. The equivalent community (ID 166) of Benson et al. (2006) is considered to be disturbed and probably derived. Shrubs where they do occur include *Maireana pyramidata*, *Nitraria billardierei*, small ground chenopods and minor grasses. It usually occurs in association with or adjacent to the Black Bluebush Low Open Shrubland community. The community has little intrinsic conservation significance with a Benson et al. (2006) threat category of 'least concern'.

Photo: Ecotone during 2012 field survey

4.1.12 Derived Native Grassland/Shrubland

Habitat: Low-lying flat plains on grey clay associated with the large dry lakes.

Structure/Characteristics: Open grassland dominated by spear grass and other native grass species with occasional remnant chenopods (mainly *Maireana pyramidata*). Large clumps of *Nitraria billardierei* also occur in some areas.

Distribution within project area: Along Nepean access road (areas of this community previously within the project area at the northern end of the West Balranald mine area have since been excluded).

Condition and Presence of Weeds: A derived form likely to have been created by past clearing of mallee, belah or chenopod shrubland and conversion to grassland. Subject to moderate or heavy grazing by stock and/ or roadside disturbances. Weeds minor to moderate – mainly medics, paddy melon and minor exotic herbs.

Conservation Status: Not listed by NSW or Commonwealth legislation.

Stratum	Height	% cover*	Dominant Species
Shrub layer	1 m	5 - 10	*Maireana pyramidata, M. sedifolia, Atriplex nummularia, Nitraria billardierei*
Ground layer	To 0.5 m	70 - 80	*Austrostipa scabra, A. elegantissima, Enneapogon avenaceus, Austrodanthonia caespitosa, Eragrostis australasica, E. dielsii, Sclerolaena brachyptera, Teucrium albicaule, Zygophyllum angustifolium, Maireana brevifolia, Vittadinia pterochaeta*

Photo: Ecotone during 2012 field survey (NB: likely to have been taken in better example reference areas for this community that now occur outside of the project area i.e. prior to significant reduction of project area at the northern end of the Balranald mine).

4.1.13 Cultivated Grain Crops/Cleared Weedy Fallow / Developed

This entirely artificial/cultivated community occupies large areas in both the northern and southern parts of the West Balranald site but is practically absent in the central section where the large patch of mallee (Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116) occur. All native vegetation has been cleared from the community in all layers, and the community currently occurs in two main forms on a rotational basis. One form is the large fields of cultivated wheat (Triticum aestivum) which have been sown mainly on the flat dry lakebeds (Tin Tin Lake, Lake Pitarpunga and Muckee Lake) at the northern end of West Balranald Mine and cleared mallee at the southern end. The other form is a fallow phase consisting almost entirely of herbaceous weeds, currently dominated by extensive stands of the noxious onion weed (*Asphodelus fistulosus*).The community has no intrinsic conservation significance and is not a native vegetation community.

Photo: Ecotone during 2012 field survey

4.2 Threatened ecological communities

Seven TECs listed under the TSC Act and EPBC Act were identified by the literature review to occur or potentially occur within 50 kms of the project area (Section 2.8.8). None of the TECs were found to occur within the project area during field surveys, nor is it considered that they potentially occur given knowledge of the project area regarding prevailing landforms, soil characteristics, plant species and other deterministic factors.

A single TEC, *Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions - endangered ecological community (*Acacia melvillei* Shrubland) was recorded approximately 3 kms to the south-west of the project area. *Acacia melvillei* Shrubland is listed under the TSC Act but is not listed on the EPBC Act. The TEC occurs sporadically along sections of the Ivanhoe Road verge and reserve, north from Balranald town for approximately three to four kms. The final design of the water supply pipeline was chosen in part to avoid impacts on this TEC. Small patches of the same TEC were also recorded during survey of potential routes for the proposed transmission line for the Balranald Project, however the alignment of the transmission line is yet to be finalised and will be subject to a separate assessment (i.e. does not form part of this assessment).

One endangered aquatic community listed under the FM Act, Lower Murray River aquatic ecological community (AEC), was recorded. This encompasses the Murrumbidgee River below Burrinjuck Dam. The plan to extract water from the Murrumbidgee will require some interaction with this ecological community. Although the impact is likely to be minimal this component of project will be considered within the impact assessment.

Further details regarding consideration of TEC/AEC presence within the project area is provided in Table 14 below.

Table 14. Threatened and Aquatic Ecological Communities to consider further in impact assessment

Threatened Ecological Community	Listing	Description[7]	Considered further?
Halosarcia lylei low open-shrubland in the Murray Darling Depression Bioregion	TSC Act	The Scientific Determination for *Halosarcia lylei* low open-shrubland in the Murray Darling Depression Bioregion states that the TEC is described by Westbrooke et al. (1998) in their report on the vegetation of the area covered by the Scotia 1:100 000 map sheet in south-western New South Wales (NSW). The community is dominated by the chenopod shrub *Halosarcia lylei* and occurs on saline clay soils on the beds of small salt lakes and around the perimeter of larger salt lakes. Before the Westbrooke et al. (1998) study, both *Halosarcia lylei* low open-shrubland and its dominant species had not previously been recorded from NSW (Harden 1993).	The project area does not occur within the Scotia 1:100 000 map sheet as detailed in Scientific Determination. Not considered further.
Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	TSC Act	The TEC is dominated by *Callitris glaucophylla* that typically occupies red-brown loamy sands with alkaline sub-soils on the alluvial plain of the Murray River and its tributaries, and on parts of the sandplain in south-western NSW. In the Riverina bioregion and the far south-western portion of the NSW South Western Slopes bioregion, the community is typically associated with prior streams and aeolian source-bordering dunes, which are scattered within an extensive alluvial clay plain dominated by chenopod shrublands. In the Murray-Darling Depression bioregion, the community occurs as scattered patches on sandhills and lunettes within an extensive aeolian sandplain dominated by woodlands of mallee eucalypts or belah. Bioregions are defined in Thackway and Cresswell (1995). Sandhill Pine Woodland is characterised by the assemblage of species listed in paragraph 2 of the Determination, and typically comprises an open tree canopy with a sometimes sparse, but highly variable ground layer dominated by grasses and herbs, sometimes with scattered shrubs and/or small trees. The structure and species composition of the community varies depending on disturbance history and temporal variability in rainfall. Sandhill Pine Woodland is characterised by an open tree stratum, which may be reduced to isolated individuals or may be absent as a result of past clearing. The tree layer is dominated by *Callitris glaucophylla*, either in pure stands or with a range of other less abundant trees or tall shrubs. These may include *Acacia melvillei, A.oswaldii, Allocasuarina luehmannii*, *Callitris gracilis subsp. murrayensis*, *Hakea leucoptera*, *H.tephrosperma*, *Myoporum platycarpum* and *Pittosporum angustifolium*. A scattered shrub layer is sometimes present and may include Dodonaea viscosa subsp. angustifolia, *Enchylaena tomentosa*, *Sclerolaena muricata* and/or *Maireana enchylaenoides*. The groundcover is highly variable in structure and composition. It may be sparse or more continuous, depending on the history of disturbance, grazing and rainfall events. It comprises grasses, such as *Austrodanthonia caespitosa*, *A.setacea*, *Austrostipa nodosa*, *A.scabra*, *Enteropogon acicularis*, *Panicum effusum* and *Paspalidium constrictum*; and forbs including *Atriplex semibaccata*, *Einadia nutans*, *Erodium crinatum*, *Oxalis perennans, Sida corrugata* and *Wahlenbergia* spp..	No areas dominated by Callitris spp. were recorded during field survey. Unlikely to be present within project area. Not considered further.

[7] Unless stated, descriptions are from Scientific Committee Determinations.

Threatened Ecological Community	Listing	Description[7]	Considered further?
Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions	TSC Act	Small patches of this community were identified along sections of the Balranald-Ivanhoe Road verge, north from Balranald town for approximately three to four kms outside of the project area. This TEC often occurred as a pure open stand of trees, or sometimes with other less abundant trees or shrubs such as *Casuarina pauper* and *Myoporum platycarpum*. The shrub layer if present included *Enchylaena tomentosa*, *Nitraria billardierei*, *Rhagodia spinescens* and/or *Maireana pyramidata*. The highly variable groundcover was generally sparse, comprising chenopod subshrubs such as Dissocarpus paradoxus, *Maireana* spp., *Sclerolaena* spp., *Einadia nutans* subsp. *Nutans* and grasses and forbs including *Austrostipa nitida*. All patches of the TEC were disturbed to varying degrees by past clearing and ongoing grazing.	The TEC was recorded during the field survey. The TEC was recorded outside of the project area. No areas of the TEC will be impacted by the Balranald Project. Not considered further.
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions;	TSC act and EPBC Act	Weeping Myall Woodlands occur in a range from open woodlands to woodlands, generally 4-12 m high, in which *Acacia pendula* trees are the sole or dominant overstorey species. Weeping Myall trees often occur in monotypic stands, however other vegetation may also occur in the ecological community, though not as dominant species. These include: *Alectryon oleifolius* subsp. *elongatus*; *Eucalyptus populnea*; or *Eucalyptus largiflorens*. *Amyema quandang* commonly occurs on the branches of *Acacia pendula* trees throughout the ecological community's range. *Acacia pendula* was not recorded within the proposed mine sites or transport/utility route.	No individuals of *Acacia pendula* were recorded. Ecotone collected some samples of Acacia with a similar habitat to *A. pendula,* however was confirmed by the Royal Botanic Gardens to not be this species. Unlikely to be present. Not considered further.
Acacia loderi shrublands	TSC Act	The *Acacia loderi* Shrublands is the name given to the plant community that is dominated by the tall shrub/small tree *Acacia loderi* (commonly known in some parts of its range as nelia). Other tree species that may occur in association with *Acacia loderi* are *Acacia aneura, Acacia oswaldii, Callitris gracilis, Casuarina pauper* and *Flindersia maculosa*. The mistletoes *Amyema quandang* and *Lysiana exocarpi* frequently occur on *Acacia loderi*. The community has a naturally open structure of individual shrubs to small trees (to 8 m high) with a low, diverse understorey dominated by chenopod subshrubs, herbs and grasses. The community is often interspersed by woodlands of *Casuarina pauper* (belah), *Alectryon oleifolius* (or *Flindersia maculosa*.	Individuals of *Acacia loderi* were not recorded in the project area during the current or previous surveys. Vegetation surveyed within areas of *Casuarina pauper* were aligned to a Belah woodland community which is not consistent with this TEC. Not considered further.

Threatened Ecological Community	Listing	Description[7]	Considered further?
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (TSC Act) and EPBC Act equivalent - Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	TSC Act and EPBC Act	Predominantly occurs on the drier edge of the temperate grassy eucalypt woodland belt and ranges from central New South Wales through northern and central Victoria into South Australia. The canopy layer is dominated by *Eucalyptus microcarpa* (Grey Box). Other tree species are often present and may be co-dominant with Grey Box at some sites. The species of trees associated with Grey Box vary across the range of the ecological community, depending on the bioregion, landscape or site. The more widespread associated tree species that may be present include: *Allocasuarina luehmannii*, *Brachychiton populneus*, *Callitris glaucophylla, Eucalyptus albens*, *E. camaldulensis*, *E. conica*, *E. leucoxylon,* SA Blue Gum), *E. melliodora* and *E. populnea*. With the exception of River Red Gum, none of these species have been recorded in any parts of the project area.	The TEC was not recorded during current and previous surveys within the project area. The defining species have not been recorded within the project area for all project components. Not considered further.
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	TSC Act EPBC Act	Ecological communities dominated by *Allocasuarina luehmannii*, or occasionally other species, as structural dominants. Slender Cypress Pine, *Callitris gracilis*, and *Eucalyptus microcarpa*, are locally dominant in some occurrences of the nominated community. Component communities are generally characterised as woodland or open woodland with a well-developed ground stratum that is usually grassy, but also includes many subshrubs and herbs; some component communities have understoreys that are predominantly shrubby or herbaceous. Most component communities lack a well-developed tall shrub layer. The composition of the ground stratum varies considerably among component communities. Native grasses often include wallaby grasses, *Danthonia* spp., and spear grasses, *Stipa* spp. Native subshrubs and herbs may include *Einadia nutans*, *Senecio pinnatifolius*, *Sida corrugata*, *Vittadinia* spp., *Convolvulus remotus*, and *Maireana enchylaenoides*. A feature common to many areas where the woodlands occur is the presence of clayey and/or alkaline sub-soils.	Buloke, slender cypress pine or grey box and many of the other characteristic species have not been recorded in any part of the project area The major defining species were targeted during meanders and quadrats within the areas that were sampled in any she-oak communities and found to be absent. Not considered further.

Threatened Ecological Community	Listing	Description[7]	Considered further?
Lowland Murray River aquatic ecological community	FM Act	The lower Murray River endangered ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated portions of the Murray River (also known as the River Murray) downstream of Hume Weir, the Murrumbidgee River downstream of Burrinjuck Dam, the Tumut River downstream of Blowering Dam and all their tributaries anabranches and effluents including Billabong Creek, Yanco Creek, Colombo Creek, and their tributaries, the Edward River and the Wakool River and their tributaries, anabranches and effluents, Frenchmans Creek, the Rufus River and Lake Victoria. Excluded from this recommendation are the Lachlan River and the Darling River and their tributaries, and artificial canals, water distribution and drainage works, farm dams and off-stream reservoirs.	The water extraction will be managed under the Murrumbidgee Water sharing Plan which implements rules of water usage to protect the environment. The disturbance created by the installation of the pump will be minor and mitigated as to have no effect on the aquatic and fish and macroinvertebrates communities. As such the AEC is not considered further.

4.3 Flora

During the field survey, 198 flora species were recorded.

A list of all flora species identified from within the project area including the BioBanking attribute data is included as Appendix 4.

4.3.1 Introduced species

A total of 46 introduced species were recorded during the survey.

Some patches of the natural vegetation within the project area, mainly fallow areas and edges adjoining cleared areas, were in a moderately modified condition due to disturbances from past clearing and ongoing agricultural activities including cropping or sheep/cattle grazing.

Noxious and environmental weeds were generally absent or sparse within the majority of the project area, but a few species of note including one declared noxious species were recorded.

The noxious weeds recorded within the project area that are declared under the *Noxious Weeds Act* 1993 for the Balranald Shire Control Area together with the legal requirements for their control are listed in Table 15.Only one species, *Lycium ferocissimum*, was recorded within the project area.

Table 15. Noxious weeds recorded in the project area

Scientific Name	Common Name	Class	Legal Requirements
Lycium ferocissimum	African Boxthorn	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed

Note: Class 4 – Locally Controlled Weeds: Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.

Apart from declared noxious species, common environmental weed species recorded within the project area include *Psilocaulon tenue* (Match-head Plant or Wiry Noon Flower), *Medicago minima* (Woolly Burr Medic), *Sisymbrium erysimoides* (Smooth Mustard or Turnip), *Cirsium vulgare* (Spear Thistle or Black Thistle), *Cucumis myriocarpus* (Paddy Melon), *Nicotiana glauca* (Tree Tobacco), *Hordeum leporinum* (Barley Grass) and other species of exotic herbs and grasses. All recorded weed species have the potential to spread in response to disturbances of various kinds. Invasion of exotic perennial grasses into native communities is also a key threatening process under the NSW TSC Act.

Additional invasive flora species which were predicted to occur within the in the Balranald LGA by the EPBC Protected Matters Report as a result of Bioclimatic Modelling and thus may have habitat within the project area include:

- *Asparagus asparagoides* (Bridal Creeper) Noxious – Class 4
- *Carrichtera annua*(Ward's Weed)
- *Chrysanthemoides monilifera*(Bitou Bush, Boneseed)
- *Chrysanthemoides monilifera* subsp. *monilifera*(Bitou Bush, Boneseed)
- *Lycium ferocissimum*(Onion Weed)
- *Olea europaea*(African Olive)
- *Opuntia* spp (Prickly Pear)
- *Prosopsis* spp (Mesquite)
- *Rubus fruticosus* species aggregate (Blackberry)
- *Senecio madagascariensis* (Fireweed).

None of these species were recorded in the project area during surveys. Bridal creeper and blackberry are more likely to occur in wetter riverine floodplain areas, habitat that does not occur in the project area. Ward's weed is a weed of roadsides and degraded pastures and known to inhabit mallee communities but is more common in the Broken Hill district in NSW.

4.3.2 Threatened flora recorded

No threatened flora listed on either the NSW TSC Act or Commonwealth EPBC Act were recorded within the project area.

Based on the results of the data review (section 2), 34 subject threatened flora species have been previously recorded within the area bounded by the six map sheets, or have potential habitat within 50 kms of the centre of the West Balranald mine or centre of the Nepean mine.

From this list, those species with a moderate to high likelihood of occurrence within the project area are determined as affected species. Whilst none of the species had a moderate-high likelihood of occurrence, those species with a low-moderate have been determined as affected, and include; *Brachyscome papillosa* (EPBC Act listed), *Lepidium monoplocoides* (EPBC Act listed), *Maireana cheelii*, *Pterostylis cobarensis* (EPBC Act listed), *Santalum murrayanum* (EPBC Act listed), *Swainsona murrayana* (EPBC Act listed), and *Swainsona pyrophila*(EPBC Act listed)(Appendix 1). Each of these species and the area of potential habitat are discussed below.

Brachyscome papillosa: This species was not recorded within the project area during the field surveys and has not been recorded within the project area. Potential habitat for *Brachyscome papillosa* is within clay soils on *Atriplex vesicaria* and *Maireana aphylla* plains within the project area. Vegetation communities which may provide habitat for the species include: Bladder Saltbush Low Open Shrubland (LM110) and Pearl Bluebush Low Open Shrubland (LM138). The species was recorded as part of the environmental assessment for the Atlas Campaspe project to the north. This species has been considered further in this assessment.

Lepidium monoplocoides: This species was not recorded within the project area during the field surveys. The species occurs predominantly in mallee scrub in semi-arid areas. Sites are seasonally moist to water-logged with heavy, fertile soils and a mean annual rainfall of around 300 to 500 mm. Seasonally, the species may potentially occur within a broad range of vegetation communities within the project area including: chenopod mallee, black box, black bluebush, saltbush, claypan or grassland communities. The species was recorded as part of the environmental assessment for the Atlas Campaspe project to the north. This species has been considered further in this assessment.

Maireana cheelii: This species was not recorded within the project area during the field surveys. The species is usually found in chenopod shrubland and grassland communities on heavy clay soils, dominated by various native shrubs, grasses and herbs, notably *Maireana pentagona, Maireana excavata, Nitraria billardierei, Austrostipa nodosa, A. scabra, Erodium crinitum, Rhodanthe corymbiflorum, Hyalosperma semisterile* and *H. glutinosa*. In NSW the species appears to favour heavier grey clay soils that support *Atriplex vesicaria* communities. *Maireana cheelii* typically occupies sparsely vegetated sites, with a high proportion of bare ground, often as a result of over-grazing and subsequent wind erosion. Whilst the species has not been recorded within the project area, potential habitat occurs within the following vegetation communities: Bladder Saltbush Low Open Shrubland (LM110), Pearl Bluebush Low Open Shrubland (LM138), Black Bluebush Low Open Shrubland (LM102) and Old Man Saltbush Shrubland (LM137). As potential habitat for this species is present, *M. cheelii* has been further assessed in this report.

***Pterostylis cobarensis*:** This species was not recorded within the project area during the field surveys. However, the species is known to be present at a site approximately 20 kms to the north of the Balranald project area (Resource Strategies 2013).Habitats are eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include *Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna spp.* and *Eremophila* spp. Potential habitat for the species within the project area includes: Spinifex Dune Mallee (LM130) Woodland and Chenopod Sandplain/Swale Mallee Woodland (LM116).Potential habitat for this species exists within the Balranald Project, thus this species has been considered further in this assessment.

***Santalum murrayanum*:** was not recorded within the project area during the field surveys. Generally grows in gravely and sandy loam soils on dunes, in open woodland and tall shrubland and has also been recorded in sand in spinifex-shrub steppe. NSW populations are found in mallee habitats on soft linear dune-crests, with deep and well-drained calcareous earths or red and brown sands, loamy sands or clay-loams. Associated species include *Eucalyptus socialis* and *Pimelea microcephala*. A reference population of this species was investigated along the Sturt Highway near Balranald during field survey.

A record of the species exists on the Arumpo Road near the Nepean mine. A closely-related non-listed species, *Santalum acuminatum*, was recorded in spinifex mallee habitat near the southern end of the West Balranald mine site. It was confirmed as the non-listed species by the Royal Botanic Gardens, but *Santalum murrayanum* could potentially occur in similar habitat and therefore could occur in the Spinifex Dune Mallee Woodland (LM130). There are known records of this species near to the project area on Arumpo Road, thus this species has been further assessed within this report.

Swainsona murrayana: This species was not recorded within the project area during the field surveys. The species has been recorded in NSW in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams.

Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. Despite not being recorded in the project area, the species may have potential habitat within the following vegetation communities: Belah – Pearl Bluebush Woodland (LM107), Belah – Chenopod Woodland (LM108), Black Box Grassy Chenopod Open Woodland (LM105), River Red Gum Woodland (LM143), Black Bluebush Low Open Shrubland (LM102), Pearl Bluebush Low Open Shrubland (LM138), Bladder Saltbush Low Open Shrubland (LM110) and Old Man Saltbush Shrubland (LM137).Potential habitat exists for this species within the project area, thus this species has been further assessed in this report.

Swainsona pyrophila: This species was not recorded within the project area during the field surveys. However, the species is known to be present at scattered sites in mallee lands 30 to 50kms to the west and south-west of the Nepean mine site, and therefore could be present in the project area.

The species would be most likely to occur in sandy or loamy soil in spinifex mallee communities (Spinifex Dune Mallee Woodland (LM130), particularly with *Eucalyptus dumosa*, but could also occur in chenopod mallee (Chenopod Sandplain/Swale Mallee Woodland (LM116).Potential habitat exists for this species within the project area, thus this species has been further assessed in this report.

4.4 Fauna

4.4.1 Broad habitat types

Investigations for the habitat assessment comprised a survey site inspection noting both floral and faunal habitat types and features. Within the recorded vegetation communities several broad fauna habitats were observed (see Table 13 below) Fauna survey was stratified to include all habitat types but survey effort was biased towards higher condition areas and within those habitats with a greater likelihood of supporting threatened fauna (i.e. targeted threatened species surveys). Areas experiencing minimal disturbance from clearing or other development activities were not included as primary fauna survey sites. The broad habitat types included are tabled below:

Table 16. Fauna habitat within the project area

Broad Habitat Type	Component Vegetation Communities	Primary fauna survey sites in project area
Mallee with spinifex ground cover	Spinifex Dune Mallee Woodland (LM130)	WB2,WB4, N4, N5
Mallee with chenopod ground cover	Chenopod Sandplain/Swale Mallee Woodland (LM116)	WB1, WB3, N1, N2, IB1; IB2; IB3, IB4, IB5, IB7
Belah with chenopod/saltbush ground cover	Belah – Pearl Bluebush Woodland (LM107)(LM107) Belah – Chenopod Woodland (LM108)(LM108)	WB5, N3, IB6
Saltbush Plains	Black Bluebush Low Open Shrubland (LM102)(LM102) Pearl Bluebush Low Open Shrubland (LM138) Bladder Saltbush Low Open Shrubland (LM110) (LM110) Old Man Saltbush Shrubland (LM137)(LM137)	WB7, WB8
Black Box Open Woodland	Black Box Grassy Chenopod Open Woodland(LM105)	WB6
River Red Gum Woodland (LM143)		No primary site (negligible impacts)
Open claypans and modified cropping/grazing land	Flat Open Claypan / Derived Sparse Shrubland/Grassland (LM124) Cultivated Grain Crops / Cleared Weedy Fallow /Developed	No primary site (limited biodiversity/impact)

KEY: WB = West Balranald; N = Nepean; IB = Injection Borefields

Descriptions of the structure and floristics of the vegetation communities are given in Section 4.1and a description of the microhabitat features present in these broader habitats is described below.

4.4.2 Fauna habitat condition and disturbance

Condition of vegetation and thus fauna habitat throughout the project area is variable in response to farming practices as well as past and present disturbance regimes. Most of the project area is subject to grazing by livestock (sheep or cattle), with the exception of SMCAs (see Figure 2). While livestock grazing is not permitted in conservation areas, grazing by feral herbivores is common throughout these areas as evidenced by observations of goats and the general absence or reduced diversity of palatable herb and shrub species. A lower than expected diversity of passerine birds was attributed to limited ground cover and understorey cover and floral diversity in all communities.

Clearing of mallee for agriculture and charcoal production is taking place in designated areas (negotiated under the Southern Mallee Conservation Agreements) and patches of mallee near Fauna Site WB1 had recently been burnt (within the past year). Some minor approved clearing has taken place for exploration

works (access tracks and drilling sites). There was no evidence of recent bushfire throughout the project area.

Shrub and ground cover is generally moderate to dense within the saltbush plains to a height of <1 m. Within the mallee there was moderate to dense ground cover where spinifex occurs however in mallee with chenopod shrubs the shrub and ground cover was often sparse as a result of grazing by livestock or feral goats.

The surveys indicated that foxes, feral cats, rabbits, brown hares, pigs, house mice and goats are common within the project area. The presence of these species has a negative impact on vegetation cover and regeneration and consequently native fauna species populations and diversity.

4.4.3 Fauna microhabitats

Specific fauna habitat elements (microhabitats) within the vegetation types throughout the project area that are known to be potentially important to threatened fauna within the locality are provided in Table 17 below.

Table 17. Fauna micro-habitats within the project area

Habitat feature	Description	Associated vegetation types	Distribution within project area
Spinifex clumps	Spinifex grass species that have a dense clumped habit and spinifex is a tough and sharp grass species which therefore provides refuge to a range of small, ground-dwelling mammal and reptile species.	Almost exclusively confined to Spinifex Dune Mallee Woodland (LM130) with some sparse or small isolated areas within Chenopod Sandplain Mallee Woodland (LM116) areas.	Present within almost all areas of Spinifex Dune Mallee Woodland (LM130), which occur predominantly within the southern part of the West Balranald mine area and the Nepean mine area.
Hollow bearing trees and stags	Trees or stags with hollows ranging from small (5 – 10 cm diameter) to medium (10 – 30 cm diameter) and large (> 30 cm diameter).As most hollows developed are from mallee eucalypts, the number of hollows greater than 30 cm diameter is relatively low. Hollows were located along branches or trunks with snapped or burnt trunks a common hollow type for Mallee communities. Hollows offer important roost and breeding habitat for hollow dependant species.	Present in all vegetation communities with trees, however hollow abundance within Spinifex Dune Mallee Woodland (LM130) was very low or absent. The presence of hollows within the project area is attributed to the apparent absence of recent (within the last 40 years) hot fires throughout most of the area (Figure 4).	Almost all hollows were in Chenopod Sandplain Woodland (LM116) and Belah vegetation communities (Figure 13 a-c). For CSW, there was a notably higher hollow frequency within lower lying areas corresponding with larger tree diameters. Most hollows within Mallee and Belah communities were small or within the lower medium range (i.e. 5 – 15 cm).
Hollow logs and fallen timber	Hollow logs (generally occurring within fallen branches c. 10 cm or greater in diameter) and non-hollow fallen timber. These features offer shelter and breeding habitat for various ground-dwelling fauna. Log dumps, where fallen timber is cleared and piled, were also present particularly near tracks.	Fallen timber present in all vegetation communities with trees, however concentration within Spinifex Dune Mallee Woodland (LM130) (LM 130) was lower (and hollow logs generally absent).	Distribution and frequency of hollow logs generally corresponded well with hollow tree distribution described above. Fallen timber was moderately common within Spinifex Dune Mallee Woodland (LM130) areas.

Habitat feature	Description	Associated vegetation types	Distribution within project area
Permanent water features	Permanent water features such as dams, creeks or rivers. These provide habitat for waterfowl, herons, egrets and waders as well as frog species.	River Red Gum Woodland (LM143) and Old Man Saltbush Shrubland (LM137).	Permanent water features are generally restricted to occasional farm dams for most of the project area. A small area of permanent wetland habitat is present along the eastern end of the water supply pipeline consisting of sumps and pools with a limited number of fringing small trees or shrubs, occasional sparse fringing sedges and tussock grasses, emergent aquatic macrophytes and woody debris. These features have been modified due to works on the adjacent track. The sumps and pools are connected to an oxbow lake to the north and are part of a large wetland complex. The eastern extreme of the water supply pipeline is situated at the Murrumbidgee River.
Ephemeral water features	Intermittent water features such as lakes, wetlands and creeks. These provide temporary watering and foraging habitat for mobile fauna.	River Red Gum Woodland (LM143) and Old Man Saltbush Shrubland (LM137).	Lakes such as Tin Tin and Muckee lakes have long been dry and are used for cropping. They are no longer considered active lakes, though may experience shallow pooling after significant rain events. A similarly altered hydrological regime (almost permanently dry) exists for Box Creek and Paika Creek. Ephemeral and permanent wetland habitat occurs at the eastern end of the water supply pipeline area. Ephemeral ponds and drainage swales occur adjacent to the raised track intermittently along a 2.5 km section of the proposed water supply route.

4.4.4 Fauna recorded from field surveys

Field surveys using the methods described in section 3 were undertaken in each of the above identified habitats for fauna species with the suite of methods employed in each habitat type dependant on the potential presence of subject threatened fauna within that habitat type. Opportunistic sightings whilst travelling between sites within the project areas were also recorded. A complete species list is provided in Appendix 5.

The fauna survey highlighted the following results:

- within the West Balranald mine area 171 vertebrate species were recorded consisting of two frog, 111 bird, 36 reptile and 25 mammal species (Appendix 5)
- within the Nepean mine area, 143 vertebrate species were recorded consisting of two frog, 82 bird, 33 reptile and 26 mammal species (Appendix 5)
- within the injection borefield areas 107 vertebrate species were recorded consisting of 62 bird, 21 reptile and 24 mammal species (Appendix 5)
- fifteen species were recorded from the proposed water supply pipeline route where targeted survey was limited to nocturnal frog searches (Appendix 5)
- one-hundred and one species were recorded from survey outside of the project area but within its locality.

A summary of the number of species by fauna group recorded at each primary survey sites and opportunistically for the major components of the project area (West Balranald mine, Nepean mine and injection borefield area) is given in Table 18 -

Table 21 with comments on the distribution and abundance of fauna groups also provided below.

Species richness was greater in areas of woodland, decreasing within shrubland habitats particularly those distant from woodland areas. A large number of species, mainly birds, were recorded as opportunistic observations only.

4.4.4.1 West Balranald mine fauna observations

Summary results of fauna survey conducted at primary survey sites (which included trapping and other fauna survey techniques discussed in Section 3.3) within and adjacent to the West Balranald mine area (Figure 9) are presented below. These results are discussed in relation to species composition immediately after the table.

Table 18. Number of species recorded for each major fauna group at primary survey sites and opportunistically within and adjacent to the West Balranald mine area.

Fauna Group	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Opportunistic
Vegetation Community/Habitat type	2. Chenopod Sandplain/ Swale Mallee Woodland (LM116)	1. Spinifex Dune Mallee Woodland (LM130)	1. Spinifex Dune Mallee Woodland (LM130)	1. Spinifex Dune Mallee Woodland (LM130)	7. Belah – Pearl Bluebush Woodland (LM107)	2. Chenopod Sandplain/Swale Mallee Woodland (LM116)	4. Pearl Bluebush Low Open Shrubland (LM138)	3. Black Bluebush Low Open Shrubland (LM102)	
Amphibians	-	1	-	1	1	-	-	-	1
Reptiles	6	11	11	12	8	8	7	8	15
Birds	35	18	22	23	18	12	11	13	75
Native Mammals	11	11	10	9	10	10	5	6	8
Introduced Mammals	3	4	9	3	3	3	3	3	5
Total Species	55	45	46	48	40	33	26	30	104

Amphibians

Two species of frog were recorded during survey with the Banjo Frog *Limnodynastes dumerilli* trapped in pitfalls at Sites 2 and 4 following overnight rain on the first night of the survey. The Spotted Grass Frog *Limnodynastes tasmaniensis* was found to be common around the farm dams and roadside pools of water after rain.

Reptiles

A total of 36 reptile species were recorded for all West Balranald mine surveys with species diversity per primary site (2011) ranging from six species at Site 1(Chenopod Sandplain/Swale Mallee Woodland (LM116)) to 12 species at Site 4 (Spinifex Dune Mallee Woodland (LM130)). Most species recorded were in the Family Scincidae (15 species), followed by geckos (8 species), dragons (4 species), snakes (2 species), goannas (2 species) and one species of legless lizard. Apart from Site 1, the mallee habitats recorded a higher species diversity than the saltbush plains. The poor result at Site 1 is likely to be a result of the sparse groundcover and possibly more recent fire although, interestingly, Site 1 had the highest fauna species diversity overall. The results showed a strong habitat preference, with some species only found in the mallee (e.g. Wood Gecko(*Diplodactylus vittatus*, Military Dragon(*Ctenophorus* spp), Nobby

Dragon(*Amphibolurus nobbi*), Shrubland Morethia Skink(*Morethia obscura*),Southern Mallee Ctenotus(*Ctenotus atlas*), Short-clawed Ctenotus(*C. brachyonyx*), Barred Wedgesnout ctenotus(*C. schomburgkii*)and Eastern Robust Slider(*Lerista punctatovittata*) whereas others preferred the saltbush plains (e.g. Beaded Gecko. (*Diplodactylus damaeus*), Box-patterned Gecko (*Lucasium steindachneri*), Saltbush Morethia Skink (*Morethia adelaidensis*) and *Ctenotus olympicus* (no common name).

Birds

Birds comprised a large proportion (64%) of the overall species richness (111 species) with opportunistic sightings within the project area making up the bulk of the records (75 species compared to a maximum 35 at Site 1 (Spinifex Dune Mallee Woodland (LM130)) and minimum of eleven species at Site 7(Pearl Bluebush Low Open Shrubland (LM138)). Farm dams recorded twelve species of waterfowl, herons, egrets and the Black-tailed Native Hen. The open plains recorded the larger birds of prey and smaller ground/ shrub species such as quail, fairy-wrens, Southern Whiteface, songlarks and pipits. The mallee and belah habitats recorded woodland birds such as robins, honeyeaters, Rufous Whistler, Grey Shrike thrush, Thornbills and Nightjars. Some species, such as the parrots and pigeons, used a variety of habitats particularly where treed habitat occurred near cropped areas.

Mammals

Twenty five species of mammal were recorded and positively identified during the survey (three additional bat species were only recorded with *possible* certainty by ultrasonic call recordings). Bats made up more than half of the mammal species (13 species) followed by introduced species (seven), macropods (two), dasyurids (two) and one monotreme. Native small mammal captures were very low with only one Common Dunnart (*Sminthopsis murina*) caught at Site 1 and one *S. crassicaudata* Fat-tailed Dunnart caught at Site 8 (Black Bluebush Low Open Shrubland (LM102)). House mice were either caught in the Elliott traps or on camera at every site. Bats were recorded at all sites although species diversity and activity were lower in the low open habitats of Sites 7 and 8. Goats and the Western Grey Kangaroo were mostly encountered in or near to the mallee habitat whereas the Red Kangaroo was occasionally sighted in the open plains. Cats and rabbits appeared to be more common in the saltbush plains although they are expected to occur throughout the project area.

4.4.4.2 Nepean mine area fauna observations

Summary results of fauna survey conducted at primary survey sites (which included trapping and other fauna survey techniques discussed in Section 3.3) within and adjacent to the Nepean mine area (Figure 9c) are presented below. These results are discussed in relation to species composition immediately after the table.

Table 19. Number of species recorded for each major fauna group at primary survey sites and opportunistically within and adjacent to the Nepean mine area.

Fauna Group	Site 1	Site 2	Site 3	Site 4	Site 5	Opportunistic
Amphibians	-	-	-	-	-	2
Reptiles	3	14	11	12	11	13
Birds	23	21	12	21	25	56
Native mammals	6	11	15	11	15	18
Introduced mammals	2	1	1	3	1	5
Total Species	34	47	39	47	52	94

Amphibians

Only two species of frog were recorded during the survey with the Long-thumbed Frog (*Limnodynastes fletcheri*) and Spotted Grass Frog (*Limnodynastes tasmaniensis*) was found to be common around the farm dams in the south of the project area.

Reptiles

A total of 33 reptile species was recorded during all surveys with species diversity per site ranging from three species at Site 1 (Chenopod Sandplain/Swale Mallee Woodland (LM116)), to 14 species at Site 2 (Spinifex Dune Mallee Woodland (LM130)) in 2011. Most species recorded were in the Family Scincidae (13 species), followed by geckos (six species), dragons (four species), snakes (three species), goannas (two species) and one species of legless lizard. The poor result at Site 1 is likely to be caused by the sparse groundcover resulting from heavy grazing pressure by feral goats. The results showed a strong habitat preference, with some species only found in the mallee (e.g. Jewelled Gecko, Beaded Gecko, Military Dragon, Nobby Dragon, Common Dwarf Skink, Royal ctenotus, Short-clawed Ctenotus, Barred Wedgesnout ctenotus and Eastern Robust Slider) whereas others were recorded in both the mallee and the belah woodland (e.g. Painted Dragon, Wood Gecko, Bynoe's Gecko, Thick-tailed Gecko, Egernia striolata Tree Skink and Southern Mallee ctenotus).

Birds

Birds comprised a large proportion of the overall species richness (82 species) with opportunistic sightings within the project area making up the bulk of the records (56 of the 73 species recorded in 2011 compared to a maximum 25 at Site 5 (Belah – Pearl Bluebush Woodland (LM107)) and minimum of 12 species at Site 3 (Spinifex Dune Mallee Woodland (LM130)). Water was limited to farm dams and troughs in the far south of the project area and only accounted for two waterbirds, the Hardhead (duck) (*Aythya australis*)and (*Tachybaptus novaehollandiae*)Australasian Grebe. The more open partially cleared habitats in the south recorded birds of prey such as the (*Aquila audax*) Wedge-tailed Eagle, (*Circus assimilis*) Spotted Harrier and (*Elanus axillaris*) Black-Shouldered Kite although the Brown Goshawk (*Accipiter fasciatus*) and Little Eagle (*Hieraaetus morphnoides*) were also seen foraging within the mallee. Smaller ground/ shrub species such as quail, fairy-wrens, and Southern Whiteface, Rufous Songlarks and Australian pipits were also mainly recorded in the more open habitats. The mallee and belah habitats recorded woodland birds such as robins, honeyeaters, treecreepers, babblers, Crested Bellbird, Rufous Whistler, Grey Shrike thrush, thornbills and parrots. Large congregations of woodswallows and budgerigars were recorded, particularly near the drilling rig near Site 3 (Spinifex Dune Mallee Woodland (LM130)) where water was available. Nocturnal birds were well represented with the Southern Boobook (*Ninox boobook*), Barn Owl, Australian Owlet-nightjar (*Aegotheles cristatus*), Spotted Nightjar (*Eurostopodus argus*) and Tawny Frogmouth *(Podargus strigoides*) recorded. A Malleefowl was observed on the edge of Arumpo Road within Wampo Conservation Area but outside of the project area.

Mammals

Twenty six species of mammal were recorded during the Nepean survey, however due to the difficulty in positively identifying some micro-bats from recorded ultrasonic calls, three of the micro-bat species were only recorded as possible identifications. Bats made up more than half of the mammal species (15 species), followed by introduced species (6), macropods (2), dasyurids (2) and one monotreme, the echidna. Native small mammal captures were low with only two common dunnart caught (Site 3 and opportunistic hand capture) and six southern ningaui caught in spinifex at Sites 4 (Spinifex Dune Mallee Woodland (LM130))

and 5 (Belah – Pearl Bluebush Woodland (LM107)). House mice were either caught in the Elliott traps or on camera at every site. Bats were recorded at all sites although species diversity was lowest (5 species) at the more disturbed Site 1. The other sites recorded between ten to twelve bat species. The Western Grey Kangaroo was encountered in all available habitats whereas the Red Kangaroo was less frequently recorded in the open plains and belah at Site 3. Goats were common outside of the Southern Mallee Conservation Area but were less frequently encountered within the fenced reserve. Evidence of foxes was recorded throughout the project area whereas cats and rabbits appeared to be more common in the open disturbed habitats, although they are expected to occur throughout the project area (rabbits recorded at Site 4).

4.4.4.3 Injection borefield area fauna observations

Summary results of fauna survey conducted at primary survey sites (which included trapping and other fauna survey techniques discussed in Section 3.3) within and adjacent to the proposed injection borefields (Figure 9b) are presented below. These results are discussed in relation to species composition immediately after the table.

Table 20. Number of species recorded for each major fauna group at primary survey sites and opportunistically within and adjacent to borefield injection areas.

Fauna Group	South of borefield 3	Borefield 3	Borefield 4	Borefield 6	Borefield 7	Non primary sites and Opportunistic
Birds	20	20	22	20	43	8
Introduced Mammals	1	2	2	1	3	1
Native Mammals	11	8	7	1	9	9
Reptiles	1	6	1	3	16	2
Total Species	33	36	32	25	71	20

Amphibians

No frog species were recorded during the surveys and no targeted frog surveys were carried out due to there being no water features within disturbance areas. The nearby project area included only small farm dams with poor potential habitat for threatened frog species.

Reptiles

A total of 21 reptile species were recorded during all surveys. There was a general tendency towards a greater species richness of reptiles at Belah trap sites compared with Mallee trap sites.

Birds

Sixty-two bird species were recorded within the injection borefield surveys primarily consisting of woodland birds. Frequent observations of species such as the Brown Treecreeper and the presence of the threatened Varied Sittella were indicative of the old-growth characteristics throughout much of the area within woodland habitat where hollows and logs were moderately common. Other patterns observed were similar to those described for the Nepean and West Balranald Areas.

Mammals

Twenty-four species of mammal were recorded during the injection borefield survey including 15 bat species, four introduced species, two macropods and one monotreme. Native small mammal captures did not occur with only House mice caught in Elliott traps or on camera at three sites. Bats were recorded at all and species richness was highest within Belah woodland. Sheep were common throughout and goats were moderately common.

4.4.5 Threatened fauna species recorded

A total of 20threatened fauna species were recorded (two not confirmed –Plains-wanderer, Pied Honeyeater – see details in below table) during all field surveys in and around the project area. All of these species are listed as threatened species on the TSC Act and four of these species (Corben's Long-eared Bat, Malleefowl and Plains-wanderer and Regent Parrot) are also listed on the EPBC Act (

Table 21 and Figure 11a - c). These species are discussed in more detail in the table below and within Appendix 7 and Appendix 8.

Table 21. Threatened species recorded in and around the Balranald project area

Scientific name	Common name		Status TSC Act	Status EPBC Act	Site Recorded
Cinclosoma castanotus	Chestnut Quail-thrush		V	-	25 records predominantly from woodland vegetation. Recorded at West Balranald mine, Nepean mine and injection borefield 6.
Nyctophilus corbeni	Corben's Long-eared Bat		V	V	Harp trapped along Nepean access road with junction of injection borefield 7; and approximately 6.5 km west of the West Balranald mine area (southern portion).
Pomatostomus temporalis temporalis	Grey-crowned Babbler		V	-	Near Site 1 at Nepean mine. Various observations outside of project area closer to Murrumbidgee River.
Melanodryas cucullata	Hooded Robin		V	-	WB1, WB2, near N3, along Nepean access road near Nepean mine and near injection borefield 4.
Vespadelus baverstocki	Inland Forest Bat		V	-	Possible, probable and definitive echolocation calls throughout most of project area.
Strophurus elderi	Jewelled Gecko		V	-	Five sites in and around Nepean mine area in Spinifex Mallee.
Hieraaetus morphnoides	Little Eagle		V	-	Ten observations in and around project area (all components) and additional records outside of the project area.
Chalinolobus picatus	Little Pied Bat		V	-	Various echolocation records concentrated within woodland areas throughout project area. Large number of captures at IB6. One dead bat was found in Tin Tin property shearer's quarters east of the West Balranald mine.
Cacatua leadbeateri	Major Mitchell's Cockatoo		V	-	Twelve observations in and around project area, becoming more frequent with increasing distance to the north.
Leipoa ocellata	Malleefowl		E1	V	Three active mounds and scattered prints at West Balranald along with recent mounds and many old mounds. Prints along the Nepean access road. Two old mounds scattered throughout Nepean mine area.
Certhionyx variegatus	Pied Honeyeater(unconfirmed)		V	-	Single possible record at WB4.A single bird thought to be this species was recorded at Site 4. The closely related black honeyeater *Certhionyx niger* was also recorded at Sites 1 and 2 and therefore a confident recording of the pied honeyeater cannot be fully substantiated. The study area is within the predicted range of both species therefore both could occur. Opportunistic surveys in Sept 2012 and Jan 2013 failed to record this species.
Pedionomus torquatus	Plains-wanderer (unconfirmed)		E1	V	Possible call between Sites WB7 & WB 8.A bird thought to be a Plains-wanderer responded to call playback near Site 7 at West Balranald. A property owner indicated that Plains-wanderer was present within their holdings

Scientific name	Common name		Status TSC Act	Status EPBC Act	Site Recorded
					approximately 5 km to the east of the project area within Pitarpunga Lake east of Burke and Wills Road. Therefore it is possible that the species could occur in the open grasslands and blue bush plains within the study area, however such habitat is limited and does not have the same character of that of Pitarpunga Lake. Although targeted surveys in Jan 2013 failed to identify this species, it cannot be completely discounted as occurring.
Pyrrholaemus brunneus	Redthroat		V		Thirteen observations from shrubland between West Balranald (northern areas) and injection borefield areas.
Polytelis anthopeplus monarchoides	Regent Parrot		E	V	Six observations of between one and twenty individual birds were made over the course of a week (Figure 11). All six observations were of birds flying overhead or foraging on lerp around the Sturt Highway approximately 10 km south of the West Balranald mine area.
Ningaui yvonneae	Southern Ningaui		V	-	Sites N4 andN5
Circus assimilis	Spotted Harrier		V	-	Various records (12) are well distributed throughout project area and outside of area.
Daphoenositta chrysoptera	Varied Sittella		V	-	Eleven records from West Balranald mine, injection borefield and Nepean mine areas becoming more common with distance north. All records from woodland areas.
Tiliqua occipitalis	Western Blue-tongue		V	-	Single observation approximately 4 km west of Nepean mine (northern extent).
Epthianura albifrons	White-fronted Chat		V	-	15 records predominantly in shrubland areas at northern end of West Balranald mine. Records extend to borefield injection areas along Nepean access road.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat		V	-	Probable and possible echolocation records throughout project area.

4.4.6 Threatened fauna with potential to occur

A number of additional threatened fauna species have the potential to occur within the project area but were not recorded due to one or more of the following reasons:

- may occur only sporadically within the area (e.g. nomadic birds)
- cryptic species that are typically difficult to find despite targeted surveys (e.g. Mallee Worm-lizard)
- extensive targeted survey was not performed due to assumed presence and minimal impacts from project (e.g. wetland birds and Southern Bell Frog along the eastern edge of the water supply-pipeline).

The above species are tabled in Appendix 2 as species with a moderate or higher chance of occurring. They have been considered within assessments of significance where there is some potential for the Balranald project to impact them.

4.4.7 Migratory species (EPBC Act)

The following migratory species were recorded during field survey. A number of additional listed migratory species have been recorded from the locality and are included in Appendix 2.

- *Ardea alba* Great Egret– recorded at the southern portion of West Balranald mine and along the water supply pipeline
- *Merops ornata* Rainbow Bee-eater – throughout woodland areas within the project area.

5. Impact assessment

5.1 Assessment under Division 4.1 State Significant Development of the EP&A Act

The following impact assessment has been conducted considering the Threatened Species Assessment Guidelines (DECC 2007). These guidelines have been utilised here in relation to affected threatened biodiversity as listed on the TSC Act.

5.2 Potential impacts

The Balranald Project would impact biodiversity, including threatened biodiversity through both direct and indirect impacts during construction and operation. The majority of impacts on biodiversity would occur as a result of direct impacts inside the project area (i.e. the disturbance area) through clearing of native vegetation and removal of habitat for a range of flora and fauna. Indirect impacts are also considered within the overall assessment of impacts.

Impacts on biodiversity would occur over the operational life of the West Balranald and Nepean mines, with revegetation of mined areas to take place concurrently with decommissioning of mined areas. While rehabilitation of mined areas will be important in mitigating long-term impacts from the Balranald Project, for the purpose of conducting this impact assessment, minimal consideration has been given to the likelihood of threatened species re-establishing populations within the rehabilitated mined areas.

5.3 Direct Impacts

The main impact on biodiversity associated with the Balranald Project is clearing of native vegetation and removal of habitat including threatened species habitat within the disturbance area. Once clearing takes place, topsoil is removed and overburden removal will occur for areas associated with the mine voids.

Details regarding the areas of vegetation to be disturbed are provided in Table 13.

The extent of clearing of native vegetation communities is conservatively estimated at 5,160.4ha. A further 186.1ha of exotic pasture and existing cleared land will be developed as a result of the Balranald Project. The total of the disturbance is 5,346.6 ha.

5.3.1 Significance of vegetation to be directly impacted

The areas of disturbance, along with the estimate of each vegetation community within the locality and percentage cleared within the bioregion are provided in Table 22.

As previously discussed in section 4.1, no direct impact will occur toward any vegetation listed as a TEC under the TSC Act or EPBC Act.

To determine the significance of vegetation impacts a comparison of disturbance areas from the Balranald Project has been made with vegetation within the overall locality. A desktop mapping assessment using

existing mapping projects and aerial photography interpretation was undertaken. The locality calculations were estimated within a 20 km radius of the project area. Vegetation communities which were similar in terms of landscape position and aerial photography interpretation were Black Bluebush Low Open Shrubland (LM102) and Pearl Bluebush Low Open Shrubland (LM138); Bladder Saltbush Low Open Shrubland (LM110) and Old Man Saltbush Shrubland (LM137); and Belah – Pearl Bluebush Woodland (LM107) and Belah – Chenopod Woodland (LM108). As such these similar communities were combined for this assessment. Flat Open Claypan/Derived Sparse Shrubland / Grassland (LM124) was hard to distinguish from areas of erosion and cleared areas and has therefore been left off the locality calculations.

Based on the locality calculations, no vegetation communities will impact more than 5.6% of the local extent. Spinifex Dune Mallee Woodland (LM130) was the least extensive (9,486.0 ha) community within the locality and impacts associated with the Balranald Project will impact upon 5.6% of this local extent. Chenopod communities within the disturbance area, Black Bluebush Low Open Shrubland (LM102) and Pearl Bluebush Low Open Shrubland (LM138), are likely to reduce the local extent by approximately 2.5%. The remainder of the vegetation would impact less than 1% of similar vegetation communities within the locality.

When compared to the Lower Murray Darling CMA clearing estimates of each vegetation community as provided in the OEH BioMetric Vegetation Type Database, the only vegetation community that has been cleared extensively within the CMA is Old Man Saltbush Shrubland (LM137). It has been estimated that Old Man Saltbush Shrubland (LM137) has been 90% cleared. Only a small proportion of the disturbance area (19.8 ha) contains this community. Bladder Saltbush Low Open Shrubland (LM110), Flat Open Claypan / Derived Sparse Shrubland / Grassland (LM124) and River Red Gum Woodland (LM143) had percentage cleared estimates ranging from 35-50%, whilst the other vegetation communities were less than 30%.

Table 22. Significance of vegetation to be disturbed

BioMetric Vegetation Type abbreviation for this ecological assessment	Listed as TEC	Total area of disturbance	Approximate area in locality (hectares)	Proportion of vegetation within the locality to be cleared (%)	Percent already cleared in CMA
1. Spinifex Dune Mallee Woodland (LM130)	Not listed	536.4	36,137	1.5	5
2.Chenopod Sandplain/Swale Mallee Woodland (LM116)	Not listed	2,051.5	127,317	1.6	30
3.Black Bluebush Low Open Shrubland (LM102)	Not listed	284.9	37,177	0.8	10
4.Pearl Bluebush Low Open Shrubland (LM138)	Not listed	1,072.1	10,325	10.4	10
5.Bladder Saltbush Low Open Shrubland (LM110)	Not listed	558.0	131,416	0.4	40
6.Old Man Saltbush Shrubland (LM137)	Not listed	19.8	2,646.4	0.7	90

BioMetric Vegetation Type abbreviation for this ecological assessment	Listed as TEC	Total area of disturbance	Approximate area in locality (hectares)	Proportion of vegetation within the locality to be cleared (%)	Percent already cleared in CMA
7.Belah – Pearl Bluebush Woodland (LM107)	Not listed	114.8	42,601	0.3	20
8.Belah – Chenopod Woodland (LM108)	Not listed	438.7			20
9.Black Box Grassy Chenopod Open Woodland (LM105)	Not listed	6.9	11,913	0.1	15
10.River Red Gum Woodland (LM143)	Not listed	3.8	30,147	0.0	35
11.Flat Open Claypan / Derived Sparse Shrubland / Grassland (LM124)	Not listed Not listed	73.6	15,759	0.5	50
12.Cultivated Grain Crops / Cleared Weedy Fallow / Developed	Not listed	186.1	73,150	0.3	-
TOTAL		5346.6	518,588	1.0	

5.4 Indirect impacts

Indirect impacts will occur within and adjacent to the project area as a result of mine construction and operation. Such impacts will largely operate on a short to medium timeframe (i.e. the life of the mine) and will be minimised where possible through management procedures. A range of indirect impacts are likely to, or could, occur as a result of the Balranald Project including:

- increased noise, dust and light from mine construction and operational activities
- loss of connectivity and fragmentation of habitats at a regional scale through clearing of intact areas of native vegetation within the project area
- erosion or sedimentation in areas adjoining construction and operational activities
- increased spreading of weed propagules
- increased edge-effects for surrounding vegetated areas
- changes in vegetation composition and structure as well as available fauna habitats due to altered fire regimes (more or less frequent fire).

The indirect impacts described above are variable in terms of the distance they may extend from actual disturbance areas, and in many cases, due to buffer areas that have been incorporated into the project areas, the indirect impacts will be completely contained within the project area. Within this assessment, for the West Balranald and Nepean mine areas, conservative calculations of the disturbance area have been applied by assuming disturbance of the entire project area. However, in developing the project areas, a series of informal buffers were applied to account for a range of geotechnical and logistical constraints, and to provide some flexibility to account for minor changes during mine design. The following general buffer distances were adopted when developing the disturbance areas for the West Balranald and Nepean mines:

- West Balranald mine: the disturbance area was based on an approximate 200 m wide buffer from the location of infrastructure, with reduced buffers of 100 m and 50 m adopted in areas of high risk for heritage significance and identified Aboriginal cultural heritage sites, respectively.
- Nepean mine: the disturbance area was based on an approximate 200 m wide buffer from the location of infrastructure.

Based on these buffers, approximately 33% of the project area at the West Balranald mine (i.e. 1,000 ha), and 43% of the project area at the Nepean mine (i.e. 350 ha) have been incorporated into the calculated disturbance areas. The combined informal buffer area, assessed as a direct impact area (and totalling 1350 ha or 25% of the overall project's disturbance area) is considered sufficient to cover the quantification of indirect impacts from all elements of the proposal. It is anticipated that a significant majority of informal buffer areas will remain undisturbed, but are required to allow for flexibility during detailed design. Regardless of the measures used to quantify the overall extent of direct and indirect impacts from the Balranald Project, mitigation measures proposed in section 6 would be applied to mitigate indirect impacts in all areas as far as possible.

For other project elements, the disturbance area was calculated as follows:

- West Balranald access road: a corridor of approximately 150 m wide was surveyed which comprises the project area. Within this corridor, a disturbance area of 60 m wide has been adopted, although the actual area of disturbance is likely to be less in some areas. Due to the prevailing vegetation and its condition, along with current land use within this area, indirect impacts are expected to be minor.
- Nepean access road: a corridor of 50 m wide was surveyed which comprises the project area. Within this corridor, a disturbance area of 40 m wide has been adopted. Of the total 39 km length of the Nepean access road, approximately 22 km is existing public roads (Burke and Wills Road and Arumpo Road) which would generally not result in disturbance outside the existing road corridor. The remainder of the Nepean access road would be subject to indirect impacts due to clearing of established woodland vegetation communities. It is considered that the incorporation of buffer areas for the Nepean mine areas into the direct disturbance area calculations is ample to cater for indirect impacts along the Nepean access roads. Impacts will be managed in accordance with Section 6.
- Injection borefield: a total of eight injection borefields are included in the project area. Each borefield is approximately 400-500 m wide and contains two 50 m wide corridors containing linear groundwater infrastructure. Therefore a 100 m wide corridor (i.e. 2 x 50 m corridors) for each borefield was adopted that would be directly impacted. The injection borefield areas are predominantly grazed shrubland and woodland environments. Indirect impacts would be greatest for densely vegetated woodland areas. It is considered that the incorporation of buffer areas for the Nepean mine areas into the direct disturbance area calculations is ample to cater for indirect impacts along the proposed injection borefields. Impacts will be managed in accordance with Section 6.
- Accommodation facility: a disturbance area of 7 ha was adopted that would be directly impacted.
- Water supply pipeline: a corridor of 40 m wide was surveyed which comprises the project area, and a disturbance area of 15 m wide was adopted that would be directly impacted. The water supply pipeline route is predominantly along cleared areas consisting of cropped land or tarred and dirt road verges. Additional indirect disturbances within these areas are likely to be minimal. Impacts will be managed in accordance with Section 6.
- Gravel extraction areas: a total disturbance area of 42 ha was adopted that would be directly impacted. Gravel extraction areas all occur within grazed/farmed open shrubland habitats and indirect impacts in these areas are likely to be minimal. Impacts will be managed in accordance with Section 6.

Indirect impacts and how they relate to the ecology of the project area are discussed in more detail in the sections below.

5.4.2 Edge effects

Edge effects are those changes that may occur to a population or community at the edge of a patch of vegetation or habitat. Developments that create new edges (for e.g. through vegetation clearing) will have edge effects on the remnant vegetation or habitats. Introduction of disease, weeds and predators are examples of edge effects.

The establishment of the West Balranald and Nepean mines, injection borefields, access roads and other project elements would create a number of new edges.

Alterations to the local habitat condition and flora species composition are likely to occur in habitats adjacent to the new edges. The new edges could facilitate the establishment and spread of introduced plant species. Disturbance areas may also facilitate the movement of feral animals throughout the locality, particularly where paths are established in consolidated areas of dense vegetation. Feral animals, particularly goats, are already common throughout the Balranald project area and surrounds.

It should be noted the Balranald Project would involve appropriate monitoring and control measures to counter act weed invasion and pest control.

5.4.3 Weeds

Weeds have the opportunity to establish themselves in areas of disturbed vegetation. The greatest establishment of weeds are in areas already disturbed or subject to agricultural land use.

Approximately 186.1 ha of the disturbance area (3.5%) is exotic pasture or cleared areas. The remaining 5,160.4 ha (96.5%) consists of native vegetation within in a moderately modified condition due to disturbances from past clearing and on-going agricultural activities including cropping or sheep/cattle grazing with weeds generally concentrated in areas edging cleared areas or within areas of heavy grazing.

The Balranald Project has the potential to increase or lead to the establishment of weed species where they do not currently exist through the operation of machinery during construction and operation. New weed species can potentially be introduced as a result of the movement of construction vehicles and materials into the project area from transport movements.

Areas more likely to be exposed to weed increases are areas of native vegetation that occur adjacent to disturbance areas, and areas of native vegetation which will be fragmented as a result of the Balranald Project.

In particular, the West Balranald and Nepean mines are situated within large expanses of native vegetation (Figure 7). Thus, disturbance will expose the adjacent patches of native vegetation to edge effects. It is likely that native vegetation outside of the disturbance area, which is adjacent to the cleared/weedy fallow patches within the disturbance area, will be more exposed to weeds during the construction phase. Disturbing weedy fallow during construction is likely to spread weed propagules. Much of this land is located toward the south of the West Balranald Mine.

5.4.4 Erosion and sedimentation

The Balranald project area is located with a predominantly flat landscape with dunes varying in height. No major creeks are located within the disturbance area, however the Murrumbidgee River is located at the end point of the water supply line.

Erosion of soils during construction and operation of the Balranald Project may involve the following:

- Alteration of soil structure beneath infrastructure items, hardstand areas and roads (these have been taken into consideration within the disturbance area calculations).
- The deposition of soil particulates in drainage lines and within remnant vegetation as a result of the Balranald Project is also unlikely to be significant. Mitigation measures will be put in place during the construction and operations to limit the erosion and sedimentation caused by the Balranald Project.

It is unlikely that a significant reduction in habitat quality will occur as a result of the above.

5.4.5 Dust

Dust from the construction and operation of Balranald Project has the potential to impact the function of plants and vegetation. Research shows that the impacts of dust on vegetation can have both positive and negative impacts, however the impacts of increased levels of dust on animals are unknown (Farmer 1993).Farmer anticipated that dust may increase the susceptibility of plants and vegetation to secondary stresses, such as drought, insects and pathogens, or allow penetration of toxic metals or phytotoxic gaseous pollutants.

As part of the environmental impact assessment for this Balranald Project, the generation of dust and particulate pollution was assessed by Environ Pty Ltd. Changes to the ground level concentrations of PM_{10}, $PM_{2.5}$, TSP and dust deposition were modelled for years 1, 4 and 8 of the operational phase. The modelling shows that there are no predicted exceedances of the impact assessment criteria (incremental or cumulative) for any of the parameters assessed across the three mine years modelled. Dust impacts will be mitigated through the onsite use of water suppression and the progressive rehabilitation of disturbance. Further, vegetation clearing protocols for the Balranald Project will seek to minimise exposed areas with the potential to generate dust by completing vegetation clearing as close to mining as practical.

5.4.6 Noise

Noise generated by the proposed project was assessed the Balranald Project by EMGA Mitchell McLennan. The noise assessment predicted that:

- noise generation is most substantial around the Nepean and West Balranald mines, however the noise contours show that at a distance of 10km from the mine, noise generated by the mine will be ~35db
- the Balranald Project will have a negligible increase in road related noise
- low frequency noise impacts from the Balranald Project are considered unlikely
- Iluka will monitor and manage operating noise levels, which will include provisions for low frequency noise identification.

Research has found that traffic noise can mask the important contact calls of the budgerigar, canary, and Zebra Finch, (Lohr et al. 2003). Parris and Schneider (2008) found that it was increased volumes of noise and not increased volumes of traffic that were important. Various studies have indicated that changes in bird calls in response to traffic noise are twofold, either the birds change the characteristics of their call to avoid interaction of the sound of the call with the created sounds or they limit calling to periods when the levels of noise are reduced.

Frogs show a similar pattern with Hoskins and Goosem (2010) and Parris et. al. (2009), finding that frogs change the frequency and structure of calls to minimise interference and may abandon an area if the noise levels are too great. However, breeding sites adjacent to roads with only moderate or lower levels of traffic were readily used indicating that only sites with high volumes of traffic (usually highways) created a

significant noise impact that frogs avoided. Such traffic volumes will not result from the Balranald Project. Further to this, frog habitat is generally absent along the road corridor unless during times of heavy rainfall.

Impacts of noise generated within the project area are likely to have minor impact on biodiversity values, however it is anticipated that these impacts will not extend far from the mine footprint. Some impact may occur along new road infrastructure, where road noise does not currently occur, however as stated above the levels are negligible.

5.4.7 Loss of connectivity

From a regional perspective, the habitats within the Balranald project area are connected to a larger expanse of vegetation to the west and south. The land to the east is predominantly cleared for agriculture.

From a national perspective, the Balranald project area does not form part of any national landscape corridors (SEWPaC 2012a) and no identified OEH wildlife corridors occur within the vicinity of the project area or surrounds (OEH 2011a).

Land clearance for the Balranald Project would contribute to the fragmentation of fauna populations and habitat locally. The amount of contiguous bushland remaining, however, means the vast majority of the surrounding native vegetation cover would remain physically connected.

Parts of the project area, including the West Balranald and Nepean mines are situated within large expanses of native vegetation which have been subject to grazing and feral animal impacts. Due to the depth and width of the proposed mine pits, there would be some loss of local connectivity either side of the mine pits, primarily for non-flying fauna. Connectivity losses would primarily occur for the life of the mine with connectivity being progressively reinstated during mine rehabilitation.

The Nepean mine is unlikely to disrupt regional connectivity as extensive areas of woodland extend from its boundaries in all directions. Conversely, the construction of the southern half of the West Balranald mine is likely to lead to some reduction of regional east-west connectivity as the mine dissects a large patch of woodland vegetation leaving the eastern portion less well connected to surrounding woodland vegetation to the west. There has been a reduction in the southern extent of the West Balranald mine to allow for retention of a 500 m wide woodland corridor (at its narrowest point), which would assist in maintaining connectivity east and west of the mine. Again losses of connectivity would improve after mine closure and rehabilitation. Additional assessment of connectivity impacts for Malleefowl is included in section 5.13 and Appendix 8.

Vegetation to be disturbed for the water supply pipeline is unlikely to result in an increase in loss of connectivity given the relatively narrow linear disturbance.

5.4.8 Fire

Historically, arid zone bushfires tend to be associated with a proficient growth of native grasses following large rain events. During summer following rain events, dry swards of grasses pose a bushfire hazard when placed near a source of ignition (AMBS 2013). Vehicles driven through long grass and hot exhaust may attribute to fire ignition. This may occur during construction and operation of the Balranald Project particularly during the hotter months.

The Biodiversity Management Plan will incorporate bushfire management protocols as discussed in section 6.5.

5.4.9 Cumulative Impacts

Cumulative impacts are the successive, incremental and combined impacts (both positive and negative) of an activity on society, the economy and the environment (Franks et al., 2010). They can arise from the compounding activities of a single operation given the interaction of that operation with past, current and future activities that may or may not be related to the existing development. Cumulative impacts may also arise through the interaction of one development with other types of activities and industries, such as grazing and broad scale agriculture.

In relation to the Balranald Project, the cumulative impacts are considered to be the total impact on the environment that would result from incremental impacts (including both direct and indirect impacts) from the development added to other existing impacts and proposed developments in the locality and region.

The primary cumulative impacts of the Balranald Project are associated with the Balranald Project's direct and indirect impacts described in Sections 5.3and 5.4, respectively. The condition and composition of the habitat to be cleared for the Balranald project area is described in Section 4. Impacts which are likely to be cumulative within the Balranald project areas include the clearing of vegetation, loss of individuals, potential increases in feral animal populations and weed invasion. It is likely that the accumulating impacts would increase linearly and proportionally with the area of disturbance. The cumulative impacts listed may not be fully expressed until well after completion of mining due to the characteristics of semi-arid woodland (dependent on sporadic rainfall for completion of reproductive processes, seedlings and young plants significantly prone to grazing by goats and rabbits) and the time-delay of flow-on effects on fauna.

The Balranald Project will result in cumulative impacts with the Atlas-Campaspe Mine which is located approximately 80 km north of Balranald. The Atlas-Campaspe Mine would require the clearance of approximately 4,158 ha of native vegetation, which will occur progressively over approximately 20 years. The predominant vegetation types to be impacted for the Atlas-Campaspe Mine are Belah-Rosewood Woodland (2,035 ha) and Linear Dune Mallee (1,040 ha). The Balranald Project will predominantly impact Chenopod Sandplain/Swale Mallee Woodland (LM116) (2,051.5 ha) and Pearl Bluebush Low Open Shrubland (LM138) (1072 ha) vegetation types, thus the impacts from these two projects will be spread over a range of vegetation types within the region. The Balranald Project and Atlas-Campaspe Mine considered together would result in cumulative impacts from native vegetation and habitat clearing totalling approximately 9,318 ha.

The Atlas-Campaspe Mine will result in impacts to the following threatened flora and their habitats which were found within the disturbance areas: *Brachyscombe papillosa*, *Lepidium monoplocoides, and Pterostylis cobarensis* (AMBR 2012). The Balranald Project may add to the cumulative impact to these threatened flora species through removal of potential habitat.

Similarly, the Atlas-Campaspe Mine will result in impacts to the following threatened fauna and their habitats, which were recorded within the disturbance area and are also subject to impacts from the Balranald Project: Malleefowl, Freckled Duck, Spotted Harrier, Little Eagle, Bush Stone-curlew, Australian Painted Snipe, Major Mitchell's Cockatoo, Regent Parrot, Redthroat, Pied Honeyeater, White-fronted Chat, Hooded Robin, Chestnut-backed Quail-thrush, Varied Sittella, Gilbert's Whistler, Southern Ningaui, Western Pygmy-possum, Yellow-bellied Sheathtail-bat, Corben's Long-eared Bat, Little Pied Bat, Inland Forest Bat, Bardick, Jewelled Gecko, Mallee Worm-lizard and Spinifex Slender Blue-tongue.

Beyond these major projects, the main industries and land uses in the surrounding locality are cattle, sheep and goat grazing on native semi-arid pasture along with cropping. The majority of land within the bioregion is used for agriculture (84%), with most of this being used for grazing native or modified pastures (ABS

2009).The Balranald Project will result in the disturbance of approximately 145.7ha of cropping land. A further 5,160.4 ha consists of native vegetation, most of which is used for grazing.

The majority of the project area still retains native vegetation although clearing for agriculture, timber harvesting and the impacts of grazing have altered the structure and composition of the vegetation.

The proposed impact avoidance and mitigation measures are likely to assist with mitigating these cumulative impacts in the Balranald project area. The indirect impacts will be managed and monitored through mitigation strategies as detailed in section 5.

Conservation-oriented mechanisms, such as nature reserves, national parks, conservation reserves and historic sites occupy 421,082 has (ha) or 5.25 percent (%) of the bioregion (NSW Office of Environment and Heritage [OEH], 2011a). National parks and nature reserves (under the NSW National Parks and Wildlife Act 1974 [NPW Act]) make the greatest contribution to the area conserved, occupying 279,343 ha, or about 3.48% of the bioregion. The Willandra Lakes Region World Heritage Area, which occupies approximately 240,000 ha or almost 3% of the bioregion, is included on the internationally recognised World Heritage List. About 10% of the Willandra Lakes Region World Heritage Area is in Mungo National Park.

Whilst the Balranald Project will result in an increase in degradation to natural ecosystems within the Murray Darling Depression Bioregion, it should be noted that the Balranald Project will involve an offset that will contribute to managed conservation areas within the Bioregion. The Balranald Project will add significantly to the conservation of native vegetation and threatened species habitat in the locality and region, through the proposed Biodiversity Offset Package.

5.4.10 Generation of light

Lighting will be present in a number of areas that will be operational at night, including:

- active pit area where active mining is occurring - lighting plants will be located within the pit (some of which will be below the ground surface and therefore light spill will be minimal to negligible) and on overburden stockpiles
- along internal haul roads between the active pit and the processing area
- at the accommodation facility
- at the processing area at West Balranald
- lighting from the headlights of trucks travelling along the designated product transport routes and the Nepean access road (between Years 6-8 only) will also occur.

The following mitigation measures are proposed to minimise visual and lighting impacts:

- install directional light fittings in the processing area to minimise light spill
- use of low wattage lighting
- limit placement of lighting at the top of overburden stockpiles (at night), where safe and practical, to provide screening and limit light spill on top of overburden stockpiles.

While lighting is required for the effective functioning of the mine at night time, light infrastructure will be restricted to areas within the mine that will be subject to direct impacts (mine pits, stockpiles and injection borefields) generally with minimal habitat values. Light spill from infrastructure areas, into adjacent retained habitat will be reduced through the use of low wattage and directional lighting. Subject to the proposed avoidance and mitigation strategies, the impact of lighting on biodiversity is considered minimal and has not been addressed further in this assessment (note that animal/vehicle collision is considered separately in this report despite acknowledgement that truck lighting is likely to contribute to the risk of collisions).

5.5 Willandra Lakes Region World Heritage Area

The Willandra Lakes Region World Heritage Areas is located approximately 32 km from the West Balranald Mine and 19 km from the Nepean Mine. The Willandra Lakes Region World Heritage Area covers 240,000 ha of semi-arid landscape mosaic comprising dried saline lake bed plains vegetated with saltbush communities, fringing sand dunes and woodlands with grassy understoreys (SEWPAC 2008).

No impacts to the threatened biodiversity of the Willandra Lakes Region World Heritage Area are likely as a result of the Balranald Project. The same conclusion was reached for the Atlas-Campaspe Mine (AMBS 2013) which is located 10 km to the east of the Willandra Lakes Region World Heritage Area.

5.6 Mungo National Park

The Mungo National Park is located approximately 30 km to the north-east of the Balranald project area. Mungo National Park covers an area of 112,586 ha of which approximately 65% falls within the Willandra Lakes Region World Heritage Area (DEC 2006a). The flora of the Mungo National Park is characterised by shrublands dominated by *Maireana* spp., *Atriplex* spp. and semi-arid woodlands of mallee, *Callitris* spp. and Casuarina pauper (DEC 2006).

No direct impact to threatened biodiversity within the Mungo National Park is likely to occur as a result for the Balranald Project. The same conclusion was reached for the Atlas-Campaspe Mine (AMBS 2013) which is located five km to the east of Mungo National Park.

5.7 Southern Mallee Conservation Areas

The Balranald Project will result in impacts to three Southern Mallee Conservation Areas (SMCAs). The SMCAs act to offset the impacts of local vegetation clearing for agriculture, charcoaling or small- scale gypsum mining. The SMCAs collectively tended to support better condition vegetation and more observations of threatened fauna were made from these areas. The SMCAs to be impacted by the Balranald Project are detailed below along with extent to which they would be impacted. The extent to which individual threatened species will be impacted by the clearing of SMCAs is discussed within impact assessments for affected threatened species in Appendices 7 and 8.

Table 23. Southern Mallee Conservation Areas affected by the Balranald Project

SMCA Name	Location within Project Area	Total Extent of Conservation Area (hectares)	Extent of Conservation Area within Project Area (hectares)	Proportion of Conservation Area Affected (%)
Wampo	Nepean mine area	17,790	377	2
Pine Lodge	West Balranald mine area	3,690	800	22
Hugh Dale	West Balranald mine area	1,094	2	0.2
Totals		**22,574**	**1,179**	**5**

An additional four SMCAs are located within the locality, being the Coogee, Koolaman, Carinya and Dundomalle conservation areas. Collectively these four additional conservation areas cover 26,592 hectares.

5.8 Affected threatened ecological communities

No TECs listed on either the TSC Act, or the EPBC Act occur or will be impacted by the Balranald Project. As such, Assessments of Significance are not required.

The water extraction on the Murrumbidgee River has been identified as part of the Lower Murray AEC listed under the FM Act. However, the ecological community is unlikely to be significantly impacted by the Balranald Project, as the extraction will be licenced through the Water Sharing Plan for the Murrumbidgee Regulated River Water Source MWSP under the *Water Management Act 2000* (WMA 2000). The MSWP allocates water for users and the environment and as such will manage water usage to ensure there is no minimal to the Murrumbidgee aquatic ecology. The design of the pump will be as such to minimise disturbance to the aquatic environment. The installation of the pump is unlikely to significantly impact this AEC as industry standard mitigation measures will be in place to limit erosion and sedimentation during construction.

5.9 Affected threatened flora (TSC Act)

A total of seven threatened flora have been identified in this assessment as potentially affected species (Table 24). The potentially affected species were determined by considering the likelihood of occurrence for each threatened species from the list of subject species. None of the potentially affected species were recorded during survey, however there is a low to moderate potential for these species to occur, and therefore be impacted by the Balranald Project, since local records exist and the habitat within the project area is suitable. Assessments of Significance were completed, however, none of these species were predicted to be significantly impacted by the Balranald Project.

Table 24. Potentially affected threatened flora for the Balranald Project

Scientific name	Common name	TSC Act	EPBC Act	Likelihood of occurrence	Area of potential habitat that may be impacted	Potential for impact/Significance of impact
Brachyscome papillosa	Mossgiel Daisy	V	V	Moderate	1630 ha - Bladder Saltbush Low Open Shrubland (LM110) and Pearl Bluebush Low Open Shrubland (LM138).	Moderate - chance of some impact– see assessment of significance. A significant impact is not likely.
Lepidium monoplocoides	Winged Peppercress	E	E	Moderate	295.6 ha - based on potential habitat within Black Box Grassy Chenopod Open Woodland (LM102), River Red Gum Woodland (LM143) and Black Bluebush Low Open Shrubland (LM102).It should be noted this is a conservative estimate of potential habitat as the species occurs in the damper areas.	Moderate - chance of some impact– see assessment of significance. A significant impact is not likely.
Maireana cheelii	Chariot Wheels	V	V	Low to Moderate	1934.73 ha – based on potential habitat within Black Bluebush Low Open Shrubland (LM102), Pearl Bluebush Low Open Shrubland (LM138), Bladder Saltbush Low Open Shrubland (LM110) and Old Man Saltbush Shrubland (LM137).	Moderate - chance of some impact– see assessment of significance. A significant impact is not likely.
Pterostylis cobarensis	Greenhood Orchid	V	-	Low to Moderate	2587.91 ha – based on potential habitat within Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116).	Moderate - chance of some impact– see assessment of significance. A significant impact is not likely.
Santalum murrayanum	Bitter Quandong	E	-	Moderate	3141.41 ha – based on potential habitat within Spinifex Dune Mallee Woodland (LM130), Chenopod Sandplain/Swale Mallee Woodland (LM116),Belah – Pearl Bluebush Woodland (LM107) and Belah – Chenopod Woodland (LM108).	Moderate - chance of some impact– see assessment of significance. A significant impact is not likely.
Swainsona murrayana	Slender Darling Pea	V	V	Moderate	2498.97 ha – based on potential habitat within Belah – Pearl Bluebush Woodland (LM107), Belah – Chenopod Woodland (LM108), Black Box Grassy Chenopod Open Woodland (LM105),River Red Gum Woodland (LM143), Black Bluebush Low Open Shrubland (LM102), Pearl Bluebush Low Open Shrubland (LM138), Bladder Saltbush Low Open Shrubland(LM110) and Old Man Saltbush Shrubland (LM137).	Moderate - chance of some impact– see assessment of significance. A significant impact is not likely.
Swainsona pyrophila	Yellow Swainson-pea	V	V	Low to Moderate	2587.91 ha – based on potential habitat within Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116).	Moderate - chance of some impact– see assessment of significance. A significant impact is not likely.

Potential impacts from the Balranald Project on each of the affected species are discussed in detail in Appendices 7 and 8 as part of the Assessments of Significance under State and Commonwealth legislation and application of relevant guidelines.

None of the affected threatened flora species would be significantly impacted by the Balranald Project at a State or Commonwealth level. Potential habitat for these species will be removed, however there would be no removal of known individual plants. The potential habitat that would be removed does not constitute habitat that is known to be particularly important to these species and is similar to other potential habitat that is widely available within the locality.

5.10 Affected threatened flora (EPBC Act)

Five threatened flora species (Table 24) are considered to be affected by the Balranald Project after application of the process described in section 3.5. The Commonwealth Significant Impact Criteria were applied to each of the affected threatened species (Appendix 8). It is concluded that none of the affected threatened species would be significantly impacted by the Balranald Project.

5.11 Affected threatened fauna (TSC Act)

Twenty-six threatened and migratory fauna species (Table 25) are considered to be affected by the Balranald Project (affected species) after application of the process described in section 3.6 for determining affected threatened species from the list of subject species. An assessment of significance was applied to each of the affected threatened species (Appendix7). It is concluded that six of the 26 affected species could potentially be significantly impacted such that a local population of the species could be placed at risk of extinction. Species that could be significantly impacted are generally those species that have limited abundance, area of occupancy and/or mobility within the locality.

Table 25. Affected threatened and migratory fauna for the Balranald Project

Scientific name	Common name	TSC Act	EPBC Act	Likelihood of occurrence	Potential for Impact/Significance of impact
Amphibians					
Litoria raniformis	Southern Bell Frog	E	V	Moderate	Moderate - chance of some impact– see assessment of significance. A significant impact is not likely.
Birds					
Cinclosoma castanotus	Chestnut Quail-thrush	V	-	Moderate	**Known –** see assessment of significance. Significant impact not likely.
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	Known	Known – will be impacted – see assessment of significance. A significant impact is possible.
Pachycephala inornata	Gilbert's Whistler	V	-	Moderate	Moderate- chance of some impact – see assessment of significance. A significant impact is not likely.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Known	Known – will be impacted– see assessment of significance. A significant impact is not likely.
Hieraaetus morphnoides	Little Eagle	V	-	Known	High– likely to be impacted–

Scientific name	Common name	TSC Act	EPBC Act	Likelihood of occurrence	Potential for Impact/Significance of impact
					see assessment of significance. A significant impact is not likely.
Cacatua leadbeateri	Major Mitchell's Cockatoo	V	-	Known	Known - will be impacted– see assessment of significance. A significant impact is not likely.
Leipoa ocellata	Malleefowl	E	V	Known	Known– will be impacted– see assessment of significance. A significant impact is likely.
Certhionyx variegatus	Pied Honeyeater	V	-	Moderate	Moderate- chance of impact – see assessment of significance. A significant impact is not likely.
Pedionomus torquatus	Plains-wanderer	E	V	Moderate	Moderate- chance of impact – see assessment of significance. A significant impact is not likely.
Merops ornatus	Rainbow Bee eater		M	High	Known – will be impacted see assessment of significance. A significant impact is not likely.
Pyrrholaemus brunneus	Redthroat	V	-	Known	Known– will be impacted– see assessment of significance. A significant impact is not likely.
Polytelis anthopeplus monarchoides	Regent Parrot	E	V	High	Known– will be impacted– see assessment of significance. A significant impact is not likely.
Circus assimilis	Spotted Harrier	V	-	Known	Moderate - chance of impacts– see assessment of significance. A significant impact is not likely.
Daphoenositta chrysoptera	Varied Sittella	V	-	Known	Known– will be impacted– see assessment of significance. A significant impact is not likely.
Epthianura albifrons	White-fronted Chat	V	-	Known	Known– will be impacted– see assessment of significance. A significant impact is not likely.
Mammals					
Pseudomys bolami	Bolam's Mouse	E	-	Moderate	Known –will be impacted - see assessment of significance. A significant impact is not likely.
Nyctophilus corbeni	Corben's Long-eared Bat	V	-	Known	Known - will be impacted - see assessment of significance. A significant impact is not likely.
Vespadelus baverstocki	Inland Forest Bat	V	-	Known	Known - will be impacted - see assessment of significance. A significant impact is not likely.
Chalinolobus picatus	Little Pied Bat	V	-	Known	Known - will be impacted - see

Scientific name	Common name	TSC Act	EPBC Act	Likelihood of occurrence	Potential for Impact/Significance of impact
					assessment of significance. A significant impact is possible.
Ningaui yvonneae	Southern Ningaui	V	-	Known	Known - will be impacted - see assessment of significance. A significant impact is not likely.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Known	Known - will be impacted - see assessment of significance. A significant impact is not likely.
Cercartetus concinnus	Western Pygmy Possum	E	-	Moderate	Moderate – chance of impacts - - see assessment of significance. A significant impact is not likely.
Reptiles					
Echiopsis curta	Bardick	E	-	Moderate	Moderate - will be impacted - see assessment of significance. A significant impact is not likely.
Diplodactylus elderi	Jewelled Gecko	V	-	Known	Known - will be impacted - see assessment of significance. A significant impact is possible.
Aprasia inaurita	Mallee Worm-lizard	E	-	Moderate	Moderate - will be impacted - see assessment of significance. A significant impact is possible.
Tiliqua occipitalis	Western Blue-tongued Lizard	V	-	Known	Moderate - will be impacted - see assessment of significance. A significant impact is possible.

5.12 Affected threatened fauna including Malleefowl (EPBC Act)

Four threatened and one migratory fauna species (Table 25) are considered to be affected by the Balranald Project (affected species) after application of the process described in section 3.5 for determining affected threatened species from the list of subject species. The Commonwealth Significant Impact guidelines were applied to each of the affected species (Appendix 8). It is concluded that one (Malleefowl) of the seven affected threatened species could potentially be significantly impacted by the Balranald Project.

5.13 Additional considerations regarding impacts to Malleefowl

5.13.1 Background

During the DoE submissions period of the draft EIS and accompanying Biodiversity Assessment for the Balranald Project, concerns were raised regarding the risk of extinction of Malleefowl from the patch of mallee vegetation east of Box Creek (referred to hereafter as the subject area) within which the proposed West Balranald mine is located. This section (5.13) examines the likelihood of extinction of Malleefowl from within the subject area in addition to the overall Assessment of Significance for the species in Appendix 8 (these two assessments should be considered together).

5.13.2 Revision of assessment of significance (EPBC Act)

In relation to the subject area, the assessment of significance for Malleefowl states that “The proposal was assessed by assuming the clearing of 1,306 hectares of known and potential West Balranald Malleefowl

Subpopulation (WBMS) habitat of which 1,169 hectares is considered core habitat (very high and high). This would constitute removal of approximately 13% of the core area of habitat for the WBMS east of Box Creek"

Questions within the EPBC Act assessment of significance are primarily aimed at assessing the impact on a population of the protected matter. As Malleefowl are known to be capable of relatively long dispersal events between areas (Benshemesh 2007) the WBMS populations was considered to constitute not only individual Malleefowl within the subject area but also larger and more extensive areas west of Box Creek as occasional dispersal events between the two areas are likely to occur. In relation to dispersal ability of Malleefowl, the following text of the National Recovery Plan is considered in relation to adult birds:

> *Malleefowl appear to disperse on foot, and various anecdotal reports suggest they use corridors of relatively thick vegetation when dispersing through open landscapes. These include sightings of single birds (D. Martin pers. comm.; S. Dennings and K. Vaux pers. comm.) and pairs (K. Willis pers. comm.) walking along wooded strips of vegetation along roadsides several kilometres from the nearest remnant of native scrub. Similarly, birds have been reported to use strips of dense unburnt vegetation when dispersing through an otherwise burnt landscape (Benshemesh 1992a).*

In relation to juvenile birds:

> *Mean dispersal rates of over 600 m per day have been measured for newly hatched chicks, with some chicks averaging over two kilometres per day (Benshemesh 1992a)….dispersing chicks readily moved out of the unburnt habitats in which they were released and into recently burnt mallee and open woodlands with little cover.*

The EPBC Act assessment of significance refers to numerous potential impacts on the local population (i.e. the population of Malleefowl within the subject area) of the species as compared with the overall population and it was considered that the impact from the project may cause a decrease in the size of the overall population through impacts to the local population – i.e. the removal of core habitat within the subject area. In relation to impacting the recovery of the species it was considered that "the Balranald Project may contribute towards the extinction of the local population of Malleefowl". To clarify, this acknowledges that it is feasible that removal of the identified core habitat may be a significant *contributor* (along with other existing and future threats) in extinction of the local population; rather than, that the action alone would cause such an extinction, or extinction of the overall population.

It was reasoned that protection and management of large areas of offset habitat in close proximity to the subject area could be effective in compensating for the impacts on Malleefowl within the subject area given the threats already in operation and that management would decrease these threats.

5.13.3 Review of likely impacts within the subject area

Threats and Patterns of decline

Local populations of Malleefowl occur throughout the Balranald region and whilst it is difficult to predict the existing level of threat to these populations via key threatening processes such as vegetation clearing, fox predation and degradation of habitat through grazing by exotic herbivores, it is possible that any local population may become extinct over time due to the operation of these threats. Decline of local Malleefowl populations is likely to have occurred already (as is evident by the apparent increase in comparative densities of recent versus old mounds) and whether such decline will continue to occur or has been arrested, allowing for lower but sustainable carrying capacities, is unknown.

The pattern of Malleefowl decline appears consistent with other areas across the its distribution range and this pattern appears to occur regardless of the remaining patch size of reserves, with declines having occurred in larger reserves (e.g. >10,000 hectares) as well as small ones (<1,000 hectares) (e.g. Pridell and Wheeler 1999). Therefore, vegetation clearing is an obvious factor that has contributed to malleefowl decline across the region but it is evident that Malleefowl decline may continue to occur regardless of clearing and that other threats need to be managed to allow for the protection of Malleefowl. Larger remnants will have the capacity to support higher numbers of birds than small reserves (other factors being equal), but-well managed remnants are also likely to support higher densities of birds in comparison with reserves where threats (other than clearing) are allowed to continue unmanaged. Therefore, within a given area it should be possible that short-term impacts from clearing can be compensated for by better management of remnants provided that clearing does not create an unviable remnant and that sufficient birds remain within the remnant (or are introduced into the remnant via dispersal of birds from other areas) to sustain the local population.

Regional Malleefowl densities

Previous assessment of the Atlas Campaspe mine within the region gave a 'conservative' estimate of birds within the area to be impacted by the mine (AMBS 2012). It was estimated that density might be as high as one breeding pair of Malleefowl per 100 hectares of core habitat (Spinifex and Chenopod Mallee) of which 1,575 hectares was to be removed. On this basis approximately 15 pairs would be impacted by the Atlas Campaspe Project. It is noted that two active mounds were identified within the impact area for this assessment.

A review of long-term monitoring data (1989 – 2010) from Mallee Cliffs National Park was undertaken to estimate likely Malleefowl densities to inform the current assessment. Three 2 km x 2km grid cells have yielded maximum densities of active Malleefowl nests of 2, 3 and 7/year respectively. Grid positioning was biased towards Spinifex dune mallee where nesting is favourable for the species and therefore breeding density recorded within the grids would be significantly higher than adjacent inter-dunal areas. Considering these factors and the results from the Mallee Cliffs National Park monitoring, the estimated density of Malleefowl throughout the subject area is 'conservatively' (i.e. an upper limit) estimated at a single breeding pair per 300 hectares. Applying this estimate yields a total of approximately four breeding pairs within the proposed West Balranald mine development area and 30 breeding pairs within the subject area. Therefore the proposal would result in the removal of habitat for 4 out of 30 breeding pairs.

It is considered highly unlikely that the breeding pairs would be killed as a direct result of clearing due to the proposed clearing protocols and slow moving machinery involved. As Malleefowl are known to use multiple nests/mounds between breeding seasons over an established territory of one to several square kilometres (Benshemesh 2007), and as breeding pairs can elect to move longer distances (several kilometers) away from their typically established breeding areas (Frith 1959), the impacts experienced by breeding pairs may not necessarily prevent ongoing breeding capability, but may instead force these breeding pairs (or adjacent breeding pairs) to reestablish or change territories, or diminish the size of territories presently used. This is likely to negatively impact breeding success over the short to medium term. If improvements in vegetation condition occurs in areas adjacent to the disturbance area, reductions in territory may become more sustainable due to increases in food availability. Likewise possible reductions in breeding output may be offset by a reduced threat of predation through activities such as effective fox control. Medium to longer-term improvements in the condition of the subject area are likely to occur via management of the subject area in accordance with the Biodiversity Management Plan outline in Section 6 of the Biodiversity Assessment (Niche 2015). In addition, since publication of the Biodiversity Assessment

Iluka has confirmed that the remaining Southern Mallee Conservation Areas (SMCAs) of Pine Lodge and Hugh Dale will be managed in accordance with their existing conditions for at least the life of the mine.

In consideration of the above factors, and provided proper management of areas adjacent to the mine disturbance areas, it is considered unlikely that the Malleefowl population within the subject area would become extinct as a result of the proposal. Notwithstanding this analysis, as the current status of all local Malleefowl populations in the region is poorly understood and as clearing of vegetation within the subject area will place additional pressure on the existing population there is some residual risk that the proposal would add to existing threats such that there would be extinction of Malleefowl from the subject area. It is considered highly unlikely that the wider population of Malleefowl described as the West Balranald Malleefowl Subpopulation within the Assessment of Significance would become extinct due to the proposed clearing.

5.14 Affected aquatic fauna (FM Act)

No aquatic fauna are considered to be affected species after the application of the process described in section 3.5. There are known recent occurrence of some threatened species such as endangered Silver Perch, however the impact of pump installation and water extraction, and operation will have negligible impact on threatened species as the Balranald Project will extract water from the Murrumbidgee River in accordance in accordance with the rules of the MWSP. The MWSP will be allocated to Iluka via a license, which states the water allocations. Approximately 450 ML would be required per annum. High security unit shares and/or licences would be purchased by Iluka for the Balranald Project in order to supply the required volumes.

The MWSP applies to the Murrumbidgee Regulated River Water Source, which lies within the Murrumbidgee Water Management Area and the Murray Water Management Area. The water source is defined as the water between the banks of all rivers, from the upper limit of Burrinjuck Dam water storage (being the Taemas Bridge crossing) and Blowering Dam water storage (being the dam wall and spillway for Jounama Pondage), downstream to the junction of the Murrumbidgee River and the Murray River. This includes the Murrumbidgee River at Balranald where freshwater is proposed to be extracted to supply the project.

The provisions in the MWSP provide water to support the ecological processes and environmental needs of the Murrumbidgee River and direct how the water available for extraction is to be shared. The plan also sets rules that effect the management of water access licences, water allocation accounts, the trading of or dealings in licences and water allocations, the extraction of water, the operation of dams and the management of water flows.

The Balranald project will be licensed under the MWSP which has provisions to support ecological processes. For this reason the aquatic ecology of the Murrumbidgee is not expected to be impacted by water extraction.

5.15 Key fish habitat and fish passage under the FM Act

The Murrumbidgee is mapped as key fish habitat and classified as Type 1 - Highly sensitive key fish habitat and Class 1 Major key fish habitat in terms of fish passage (Policy & Guidelines Aquatic Habitat Management and Fish Conservation (NSW Fisheries 2013). However no loss of key fish habitat is predicted to occur as a result of the proposed extraction of water from the Murrumbidgee River and as such offsetting or compensatory efforts will not be required. The water use will be managed in accordance with

allocation / licence requirements as discussed in 5.14 above. . There are expected to be no obstructions to fish passage from the operations and development of infrastructure from the Balranald Project.

5.16 Key threatening processes

A list of Key Threatening Processes (KTPs) is maintained under Schedule 3 of the TSC Act and under the EPBC Act. Key-threatening processes relevant to the Balranald Project are listed in Table 26 and detailed further below. Unless otherwise stated, the information regarding the KTPs has been derived from the Final Determinations or Profile of the KTP.

Table 26. Key Threatening Processes relevant to the Balranald Project

Key Threatening Process (TSC Act)	EPBC Act Equivalent	Operating presently or historically	Increased by Balranald Project
Alteration of habitat following subsidence due to longwall mining	None	No	No
Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands	None	No	No
Clearing of native vegetation	Land clearance	Yes	Yes
Competition and grazing by the feral European rabbit (Oryctolagus cuniculus)	Competition and land degradation by rabbits	Yes	Yes
Competition and habitat degradation by feral goats (Capra hircus)	Competition and land degradation by unmanaged goats	Yes	Yes
Ecological consequences of high frequency fires	None	No	No
Human-caused climate change	Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	Yes	Potential
Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis	Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Yes	No
Infection of native plants by *Phytophthora cinnamomi*	Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	No	Very low potential
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	None	No	Unlikely
Invasion and establishment of exotic vines and scramblers	None	No	No. Exotic vines of concern listed in the KTP not recorded in project area.
Invasion of native plant communities by exotic perennial grasses	(only N. Aust)	Yes	Yes
Predation by the European red fox (Vulpes vulpes)	Predation by European red fox	Yes	Yes
Predation by the feral cat (Felis catus)	Predation by feral cats	Yes	Yes

Key Threatening Process (TSC Act)	EPBC Act Equivalent	Operating presently or historically	Increased by Balranald Project
Loss of hollow-bearing trees	None	Yes	Yes
Removal of dead wood and dead trees	None	Yes	Yes

5.16.1 Clearing of native vegetation

Clearing of native vegetation is listed as a KTP on Schedule 3 of the TSC Act. An equivalent KTP is also listed under the EPBC Act: Land clearing.

Clearing of native vegetation has been recognised as causing destruction of habitat, fragmentation of populations, riparian zone degradation, disturbed habitat which may permit the establishment and spread of exotic species and loss of leaf litter.

The Balranald Project would lead to the clearing of a total of 5,160.4 ha of native vegetation. This has discussed in detail in section 5.3.

5.16.2 Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*) and habitat degradation by feral goats (*Capra hircus*)

Grazing and burrowing rabbits have the potential to cause erosion problems, reduce recruitment and survival rate of native plants and alter landscapes. Feral goats will browse shrubs and trees, graze forbs and grass, and eat fallen fruit capsules, bark and other dead plant material.

Rabbits and goats are known to occur in the Balranald project area and the locality. The creation new corridors and disturbing vegetation canopy and ground would provide an environment that would allow rabbits and goats to increase in numbers. Rehabilitation areas would also provide young plants palatable to rabbits and goats.

Protection of the vegetation during the life of the mine and rehabilitation areas would require the control of rabbits and removal of goats.

5.16.3 Ecological consequences of high frequency fires

The survival of flora and fauna over repeated fires is dependent upon two key features namely the ability of the species to maintain life cycle processes, and the maintenance of vegetation structure over time as habitat for animal species. Where fires occur close together in time (high frequency fire) both these key features can be disrupted (NSW Scientific Committee 2000).

High frequency fire is defined as two or more successive fires close enough together in time to interfere with or limit the ability of plants or animals to recruit new individuals into a population, or for plants to build-up a seedbank sufficient in size to maintain the population through the next fire. Sustained high frequency fire would consequently lead to a loss of plant species, a reduction in vegetation structure and a corresponding loss of animal species (NSW Scientific Committee 2000).

Historically, arid zone bushfires tend to be associated with a proficient growth of native grasses following large rain events. During summer following rain events, dry swards of grasses pose a bushfire hazard when

placed near a source of ignition (AMBS 2013). Vehicles driven through long grass and hot exhaust may attribute to fire ignition. This may occur during construction and operation of the Balranald Project.

The Biodiversity Management Plan will incorporate bushfire management protocols as discussed in section 6.

5.16.4 Infection of native plants by *Phytophthora cinnamomi*

Infection of native plants by *Phytophthora cinnamomi* was listed as a KTP on Schedule 3 of the TSC Act. An equivalent KTP is listed under the EPBC Act: 'Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)'.

Phytophthora cinnamomi is a soil borne pathogen that spreads in plant roots in warm, moist conditions. *Phytophthora cinnamomi* infects a large range of species. Susceptible species display a range of symptoms; some are killed, some are damaged but endure, and some show no apparent symptoms. Infection of native plants by *Phytophthora cinnamomi* has been identified as a threat to a number of threatened species.

The soil of the project area is dry and unlikely to be subject to *Phytophthora cinnamoni*. As such, the Balranald Project is unlikely to significantly increase the threat of this KTP with vehicles and personnel moving around site during construction and operations.

5.16.5 Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

Exotic disease-causing rusts are known to constitute a major threat to native Australian plants of the Myrtaceae family. It has a potential to cause direct mortality in the estimated 10% of all Australian native forest plant species (and the great majority of dominant species) that belong to the family Myrtaceae, and with indirect effects that may include habitat loss for native fauna and flora, retarded regeneration and recruitment of younger trees and successional species, greater impact of fire and abiotic effects as a result of canopy decline including erosion, reduced water quality, reduced water retention in soil and vegetation and potentially large losses through lost production to the forestry industry. The area of highest risk of establishment of exotic disease-causing rusts in New South Wales is the coastal zone from the Illawarra north to the Queensland border.

Given none of the species listed on the KTP Scientific Determination has been recorded in the project area, and the area is not within the coastal zone of NSW, it is unlikely that the Balranald Project will increase the threat of this KTP.

5.16.6 Loss of hollow-bearing trees

Loss of hollow-bearing trees is listed as a KTP on Schedule 3 of the TSC Act. An equivalent KTP is listed under the EPBC Act: 'Land Clearance'.

Hollow-bearing trees will be removed for the West Balranald and Nepean mines and associated access tracks, injection borefields and gravel extraction areas. Hollow-bearing trees were located predominantly within the following vegetation communities: Spinifex Dune Mallee Woodland (LM130), Chenopod Sandplain/Swale Mallee Woodland (LM116), Belah – Pearl Bluebush Woodland (LM107), Belah – Chenopod Woodland (LM108), Black Box Grassy Chenopod Open Woodland (LM105) and River Red Gum Woodland (LM143).

Most of the hollow-bearing trees or stags contained hollows ranging from small (5 – 10 cm diameter) to medium (10 – 30 cm diameter) and large (> 30 cm diameter).As most hollows developed are from mallee eucalypts, the number of hollows greater than 30 cm diameter is relatively low.

The larger hollows tended to be associated with the *Eucalyptus camaldulensis* River Red Gums, *Eucalyptus largiflorens* blackbox and *Casuarina pauper* Belah. Almost all hollows were in Chenopod Sandplain Woodland (LM116) and Belah vegetation communities (Figure 13 a-c). Distribution and frequency of hollow logs generally corresponded well with hollow tree distribution described in section 4.4.1.

5.16.7 Loss of dead wood and dead trees

Loss of dead wood and dead trees is listed as a KTP on Schedule 3 of the TSC Act. An equivalent KTP is listed under the EPBC Act: 'Land Clearance'.

Dead wood and dead trees will be removed for the development of the West Balranald and Nepean mines and associated access tracks, injection borefields and gravel extraction areas.

Fallen logs offer shelter and breeding habitat for various ground-dwelling fauna. Log dumps, where fallen timber is cleared and piled, were also present particularly near tracks. Fallen logs are present in all vegetation communities with trees, however concentration within Spinifex Dune Mallee Woodland (LM130) was lower (and hollow logs generally absent). Distribution and frequency of hollow logs generally corresponded well with hollow tree distribution. Fallen timber was moderately common within Spinifex Dune Mallee Woodland (LM130) areas.

5.16.8 Predation by the European red fox (*Vulpes vulpes*), feral cats (*Felis catus*) and other animals

Feral cats are known to occur within the Balranald project area. Feral cats were observed during the field survey within the disturbance area of the Injection borefields. The vegetation within the Balranald project area is fragmented and therefore is unlikely to substantially increase the movement of feral cats. Without management there is some potential for the Balranald Project to increase the fragmentation of fauna habitat in the Balranald project area which may provide increased foraging opportunities for the exotic predators.

5.16.9 Key threatening processes under the FM Act

A list of Key Threatening Processes (KTPs) is maintained under the FM Act. Key-threatening processes relevant to the Balranald Project are listed in Table 27and detailed further below. Unless otherwise stated, the information regarding the KTPs has been derived from the Final Determinations or Profile of the KTP.

Table 27. Key threatening processes under the FM Act

Key Threatening Process (TSC Act)	Increased by Balranald Project
Current shark meshing program in NSW waters	No
Hook and line fishing in areas important for the survival of threatened fish species	No
Human-caused climate change	Possibly
Instream structures and other mechanisms that alter natural flow	No
Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales	No

Key Threatening Process (TSC Act)	Increased by Balranald Project
The introduction of fish to fresh waters within a river catchment outside their natural range	No
The removal of large woody debris from NSW rivers and streams	No
The degradation of native riparian vegetation along New South Wales water courses	No

5.17 Critical Habitat

The Director General of OEH maintains a Register of Critical Habitat under the TSC Act. The Threatened Species Scientific Committee and the Minister for DoE maintain a Register of Critical Habitat under the EPBC Act.

No Critical Habitat has been declared for threatened species within the project area.

The DoE (2013) *EPBC Act Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* states that 'habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

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

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

In regards to habitat critical to the survival of threatened flora which have been previously recorded within 20km of the Project Area and have potentially suitable habitat within the Project Area, the following was taken into consideration in Assessments of Significance (Appendix 7):

Lepidium monoplocoides. A recovery Plan exists for this species (Mavromihalis 2010). The Plan details the 10 known populations. None of the known populations for the species occur in the Project Area. The species was not recorded in the Project Area. As noted in the Assessment of Significance, potential habitat for the species may be impacted, however this habitat is not considered critical to the survival of the species.

Solanum karsense: No recovery plan exists for the species and no habitat for the species has been listed on the Register of Critical Habitat. As noted in EIS, potentially suitable habitat may be present, however no habitat critical to the survival of the species is likely to be impacted.

Santalum murrayanum: No recovery plan exists for the species and no habitat for the species has been listed on the Register of Critical Habitat. As noted in EIS, potentially suitable habitat may be present, however no habitat critical to the survival of the species likely to be impacted.

In regards to habitat critical to the survival of threatened fauna which have been considered affected species in the EIS, the following was taken into consideration in the Assessments of Significance:

Southern Bell Frog (*Litoria raniformis*): A recovery Plan exists for this species (Clemann and Gillespie 2012). The Plan states that habitat critical to the survival of the Southern Bell Frog differs throughout its range, however does not reference any habitat within the Project Area or in NSW. The Plan discusses the importance of considering habitat critical for survival of the Southern Bell Frog at both a local and a landscape scale, and also considering non-breeding refugia and habitat along dispersal / recolonisation routes. As discussed in the Assessment of Significance, potential habitat for the species may be impacted, however this habitat has not been deemed critical to the survival of the species (see Appendix 8 of Biodiversity Assessment for detail).

Malleefowl (*Leipoa ocellata*): species was considered to be significantly impacted (see Appendix 8 of Biodiversity Assessment for detail).

Plains-wanderer (*Pedionomus torquatus*): No recovery plan exists for the species and no habitat for the species has been listed on the Register of Critical Habitat. As noted in the Biodiversity Assessment (Niche 2015) no habitat critical to the survival of the species is likely to be impacted (see Appendix 8 of Biodiversity Assessment for detail).

Regent Parrot (*Polytelis anthopeplus monarchoides*): A recovery Plan exists for this species (Baker-Gabb and Hurley 2011).The habitat critical to the survival of the eastern Regent Parrot contains all known sites for nesting, food resources, water, shelter, essential travel routes, dispersal, and buffer areas, and is defined in this Recovery Plan as all potential eastern Regent Parrot habitat within its 'current normal range'. The Biodiversity Assessment has detailed that the marginal foraging habitat is limited and that no breeding habitat for the species would be impacted by the Balranald Project. It is therefore unlikely that any habitat critical to the survival of the species would be impacted by the proposed development.

Greater Long-eared Bat (*Nyctophilus corbeni*): No recovery plan exists for the species and no habitat for the species has been listed on the Register of Critical Habitat. Habitat present within the Project Area, despite including breeding and foraging habitat, was not considered critical to the survival of the species due to the widespread availability of comparable habitat throughout the region.

No Critical Habitat under either the TSC or EPBC Acts will be impacted by the Balranald Project.

6. Avoidance, Management and Mitigation

In accordance with the NSW Biodiversity Offsets Policy for Major Projects proponents must demonstrate the measures employed to avoid, mitigate and offset impacts of a project on biodiversity values. This section of the report outlines the avoidance, management and mitigation measures that Iluka will or has employed for the project to reduce impacts on biodiversity values. Section 7 of this report describes the offset strategy for the Balranald Project to account for residual impacts that cannot be avoided or mitigated.

Avoidance, management and mitigation measures associated with each stage of the Balranald Project are outlined in the following sections. The four broad stages of the project include:

1. project design
2. construction
3. operation
4. rehabilitation and closure.

A key feature of documenting and carrying out management activities to avoid and mitigate impacts from the Balranald Project will be the formulation of a Biodiversity Management Plan (BMP) for the life of the project. The BMP will also cover management activities for threatened biodiversity (see section 6.5).

6.1 Project Design

Project design relates to site selection, designing and redesigning elements of the project to minimise vegetation clearing, avoid impacts to significant habitats and vegetated corridors as well as to avoid direct impacts to threatened biodiversity values.

6.1.1 Site selection

Site selection for the Balranald Project has been largely dictated by the presence of the resource within Iluka's exploration tenements. The Balranald and Nepean mines follow the mineable resource precisely, however the location of project plant and equipment, roads, stockpiles and ancillary infrastructure (water injection borefields etc.) have all been tailored to avoid impacts to ecology or other significant environmental values such as highly significant cultural heritage sites wherever possible. Competing constraints (e.g. ecology and heritage) means that at times a compromise must be made between certain values, and it has not been possible to minimise impacts on ecology as far as might otherwise be possible.

6.1.2 Design considerations

Iluka has aimed to avoid and minimise environmental impacts from the Balranald Project during the design process. Generally, this process has involved:

- overlay and consideration of the preliminary project footprint on aerial photography together with information on constraints such as available vegetation mapping, NSW Wildlife Atlas database information, cadastral information, property boundaries, existing roads and utility corridors etc.
- review of the location of specific project infrastructure relative to vegetation on aerial photography and regional vegetation mapping
- refinement of the location of project infrastructure to avoid known constraints where possible
- baseline vegetation and fauna surveys to identify and confirm ecological constraints within the project area and surrounds

- avoidance of direct impacts to identified constraints during design, for example through relocation of infrastructure (such as roads, stockpiles, ancillary infrastructure etc.) where reasonable and feasible
- where significant features could not be avoided, identification of mitigation measures to minimise impacts, or commitment to compensation (i.e. offset measures) if impacts are not able to be sufficiently mitigated.

Specific principles adopted to avoid or minimise impacts on biodiversity are discussed below for the mine footprint and access roads.

West Balranald and Nepean mines

The area directly disturbed by mining is primarily defined by the location of the mineral sands resource and therefore there was limited scope to avoid impacts that would occur in the direct path of the mine. There were limited opportunities to reduce the footprint of the actual mine pit that would not affect the economically viable and safe extraction of the resource, which is highly influenced by geotechnical considerations.

However, significant re-design of the mine plan was completed to maximise the direct placement of overburden materials within the mine void, thereby reducing the volume of material that requires stockpiling at the surface (Figure 14). This resulted in significantly less surface disturbance including broad-scale clearing that would have otherwise been required for placement of stockpiles outside the pit.

Key drivers for the re-design of the mine plan were economics and management of overburden materials; however, the final proposed location of remaining required stockpile areas was guided by the presence of environmental constraints at the surface resulting in a reduction in impacts to native vegetation.

Two key areas of impact reduction arising from redesign of the West Balranald and Nepean mine footprints include:

1. A significant reduction of the total clearing footprint for the Nepean mine: approximately 50% of the original mine footprint (Figure 14).
2. a 'shortening' of the southern end of the West Balranald mine footprint resulting in reduction in the clearing of mallee vegetation and the retention of a large east-west running vegetation corridor (at least 400 m wide) south of the disturbance area (see Figure 2 and Figure 7a).The West Balranald access road will still be located within the east-west vegetated corridor to the south of the disturbance area at the West Balranald mine however this road is not likely to prevent Malleefowl or other fauna moving through the area. Importantly, the vegetation to be retained in this location is known Malleefowl habitat and also forms part of a Southern Mallee Conservation Area within the proposed West Balranald mine area (see discussion in Section 7.3.2).

Access roads

Several access road options were considered for haulage of ore from the Nepean mine to the West Balranald mine, and transport of product to the Sturt Highway. During the options analysis, minimisation of environmental impacts occurred through consideration of vegetated areas, conservation areas and important Malleefowl habitat. The Nepean access road uses public roads such as Arumpo Road and Burke and Wills Road as far as possible reducing potential impacts to biodiversity. The following principles were adopted in selecting the proposed route:

- maximise use of existing road corridors

- maximise use of existing fence lines and/or property boundaries (which include existing fire break clearing lines)
- local deviations of haulage routes to avoid environmental impacts (e.g. avoidance of known Malleefowl mounds).

Injection borefield

An extensive area was surveyed to identify environmental constraints associated with numerous injection borefield options (in the order of 110 km cumulative length). A key constraint was the hydrogeological properties of these areas and their suitability for groundwater injection. While vegetation communities were relatively consistent across the surveyed areas, archaeological investigations identified areas with a greater potential for Indigenous heritage significance, and therefore the areas of heritage significance were considered as far as practical in the location of infrastructure.

6.1.3 Threatened MNES species benefiting through the selected design consideration

Affected MNES species will benefit from the above-mentioned design considerations via:

- A reduction in overall habitat clearing (compared with the initial project area) has reduced possible clearing of Malleefowl habitat by approximately 3,000hectares and potential Corbens Long-eared Bat habitat by approximately 2,000 hectares (Figure 14a-c). The reduced project area will also mean a larger area of high and very high potential Malleefowl habitat is retained east of the mine totalling approximately 1000 hectares, which will assist the ability of Malleefowl to continue to inhabit this area.

- A reduction in the southern extent of clearing for the West Balranald Mine area by approximately 1.9 km has resulted in the potential to include a 600 m wide corridor area within the Mallee vegetation at the southern end of the mine, which is very high potential habitat for Malleefowl (Figure 12a). This will serve to allow continued connectivity between east and west parts of known Malleefowl habitat which will be fragmented by the mine. It is noted that the proposed access road to the West Balranald mine will interrupt the proposed corridor, however this interruption is unlikely to represent a barrier to occasional movement of Malleefowl between the eastern and western side of the proposed mine.

- Reductions in overall clearing and retention of a significant 600 m wide corridor of mallee woodland at the southern end of the West Balranald mine would aid in the retention of marginal foraging habitat for the Regent Parrot (however it is noted that the species was not recorded further north than the Sturt highway despite extensive survey).

- Reductions in the extent of clearing for the West Balranald project area and reduction in its eastern extent around the Burke and Wills road area has resulted in a larger buffer between the disturbance area and potential Plains Wanderer habitat within Pitarpunga Lake (Figure 14a). The preferred project area has increased the buffer area between proposed disturbance and potential habitat areas by 500 m to 1 km.

6.2 Construction

Impacts arising from the construction of the West Balranald and Nepean Mines and their associated infrastructure and access roads will primarily relate to vegetation clearing. Iluka proposes to undertake vegetation clearing in accordance with the following mitigation and management actions.

6.2.1 Vegetation Clearing

Pre-clearing Surveys

Extensive flora and fauna surveys have been undertaken for the Balranald Project between 2011 and 2014. Those surveys were carried out across the extent of the project disturbance footprint and often adjacent to or beyond the disturbance footprint as well. In relation to threatened species, this report outlines the threatened species recorded within the field surveys and those which could occur, even if not recorded, on the basis of the presence of suitable habitat and recent, local and credible records for those species.

Surveys for Malleefowl (which are known to use specific mound sites for breeding and will therefore benefit from further investigations identifying such sites) will be undertaken prior to clearing to identify areas where temporal clearing controls should be implemented. Iluka does not propose to undertake broad scale non-targeted threatened species surveys for other species prior to clearing for four primary reasons:

1. a pre-clearing survey program will likely yield similar results as previous surveys in the same area thus it is unlikely that the surveys will record threatened species not previously recorded or considered unlikely to be present.
2. the final proposed footprint is not amenable to amendment and therefore there is limited scope to further avoid concentrations of particular threatened species.
3. other threatened species impacted by the proposal do not have specific, identifiable, seasonal breeding sites which can be avoided during a breeding season to assist with mitigation of the loss of such habitat during a single breeding season, and/or these species are not considered likely to be significantly impacted such that a local population is placed at risk of extinction.
4. prior to clearing, the offset package will have already accounted for the threatened species and their habitat within or potentially occurring within the disturbance area and thus recording these species prior to clearing within the disturbance area will not lead to changes in the quantum or type of offsets required. Section 7 of this report outlines the offset strategy for the Balranald Project which accounts for residual and unavoidable impacts on biodiversity values including on the threatened species recorded or assumed to be present.

Pre-clearing surveys for Malleefowl will be aimed at identifying the location of active Malleefowl mounds. Incidental observations of the species will be noted but it is the location and protection of active mounds that is the focus of the pre-clearing surveys so that the timing of localised clearing can be adjusted to avoid coinciding with the nesting period for the species. Accordingly, targeted surveys of very high, high and moderate potential Malleefowl habitat as mapped in this report (Appendix 7; Figure 12- c) are proposed to inform the clearing program for the project within the proposed clearing period.

Timing of clearing

In general terms, confining the period of clearing to a short clearing window will necessitate more extensive singular clearing events to ensure that enough contingency clearing is undertaken to allow the mine to progress at an efficient pace (i.e. in order that mining operations are not ceased or delayed by having underestimated the amount of clearing required within the narrow clearing window).

Extensive clearing events within a short clearing window are not favoured for the Balranald Project for the following reasons:

- clearing large areas of land in a short period of time anticipating the progress of the mining activities up to and including the next clearing period will leave a greater area of soil exposed to erosive forces for a longer period of time

- this style of clearing control will lead to longer storage periods (e.g. 1-2 years) for topsoil and stockpiled vegetative material before such material is re-used for revegetation thus reducing the viability of the soil stored and branch stored seed banks which are critical to good site rehabilitation practice.

With regards to mitigating impacts to threatened species, clearing window restrictions should be informed by important lifecycle events of the threatened species that would genuinely benefit from it (i.e. the threatened species known or likely to occur within the project area which are likely to be significantly impacted by the Balranald Project). Further, clearing restrictions should only be applied to areas of habitat in which the species would be reliant during those important lifecycle events. Table 28 describes the clearing restrictions that Iluka proposes to observe for the Balranald Project. In general terms, clearing restrictions are proposed to be applied to some areas of mallee vegetation on the basis of habitat mapping for Malleefowl, the Little Pied Bat and Corben's Long-eared Bat. No clearing restrictions are proposed for saltbush or chenopod vegetation habitats.

Table 28. Threatened species likely to be or possibly significantly impacted by the Balranald Project with readily identifiable breeding habitat and their seasonal considerations to inform a restricted clearing window

Scientific name	Common name	Important Lifecycle events	Timing of event	Habitat used during important lifecycle event	Proposed clearing restrictions
Leipoa ocellata	Malleefowl	Egg incubation period and active nest tending.	September to February	Mallee	Between September and February - restrict clearing within 200m of any active mound in moderate - very high potential habitat as mapped in Figure 12 a-b of this report.
Chalinolobus picatus *Nyctophilus corbeni*	Little Pied Bat Corben's Long-eared Bat	Winter hibernation and early spring birthing.	May to October	Woodland habitat supporting trees with hollows	Between May and October - restrict clearing to area of medium to very high hollow density as shown in Figure 13 a-c.

* Temporal clearing controls applied for this spices will also benefit other hollow-dependant bat species

Clearing Method

The Rehabilitation and Closure Strategy (EMM 2015) outlines the clearing method (s) that will be employed. In areas where vegetation clearing will be followed by topsoil removal, clearing using a dozer is proposed with the cleared vegetation to be used elsewhere in the project for progressive rehabilitation (see below).

Where vegetation clearing will not be followed by topsoil removal, for example where vegetation removal is proposed to facilitate temporary access for the construction of the injection borefields, Iluka intends to use the trittering or mulching method of vegetation removal where possible. This method of vegetation removal, as the name suggests, mulches the above ground vegetation in situ which provides significant advantages to the rehabilitation success of the area including:

- Minimal disturbance to the topsoil of the area as the root ball of the mulched vegetation is left intact with only the above ground vegetation being mulched.

- direct “sowing” of canopy held seed into the area where vegetation has been mulched, i.e. the canopy held seed is mulched with the rest of the vegetation and spread in the immediate location of the parent plant.

Rehabilitation of areas that have been subject to vegetation removal using trittering is considerably faster than areas which have been subject to vegetation and topsoil removal using graders (pers. obs.).

Vegetation Clearance Protocol

The following measures are recommended for inclusion within a vegetation clearance protocol for the Balranald Project:

- Vegetation clearing will occur progressively towards patches of vegetation that will be retained in order to provide displaced fauna a greater opportunity to move through as yet un-cleared vegetation into refuge areas adjacent to the project area.
- it is recommended that a two-stage clearing process be employed within areas of medium to high hollow densities (Figure 13a-c) that allows hollow bearing trees(as defined by the Biobanking Operations Manual) to remain intact for a period of 48 hours after all other surrounding habitat is cleared. This will assist in encouraging species such hollow-roosting bats to evacuate hollows prior to clearing. It is recommended that alternative methods that achieve this aim could be developed in consultation with OEH for inclusion within the BMP.
- clearly define clearing limits and manage disturbances at newly created edges with retained vegetation (by means of fencing or use of flag fences, no-go areas etc.)
- prior to clearing, develop designated areas for stockpiling of cleared vegetation and topsoil and prevent compression of stockpiles.
- salvage viable hollow trees and logs for later placement within rehabilitated areas.
- ensure appropriate identification and disposal of any exotic perennial grasses or other environmental weeds, including their propagules, during vegetation clearing and undertake periodic removal of any environmental weeds from within edge zones that have invaded.

6.2.2 Fencing and signposting

Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the disturbance area.

Signposting will be used to inform project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with threatened species - e.g. speed limits and warning signs along the West Balranald and Nepean access roads in this vicinity of known Malleefowl habitat.

6.2.3 Pest and weed management

Pest and weed management activities will be prescribed in the BMP and will include:

- management protocols for feral animals such as foxes, goats, pigs and cats within the rehabilitation area
- management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to the rehabilitation area) and also within the rehabilitation area.

6.2.4 Fire management

A suite of threatened species affected by the Balranald Project are associated with areas of mallee that are long unburnt with such areas occurring throughout parts of the project area and adjacent areas to be retained. Accordingly, fire prevention and suppression will be an important consideration for the BMP.

Controlling fire however is not limited to the mitigating fire impacts to threatened species and as such Iluka will prepare an Emergency Management Plan for the Balranald Project.

6.3 Operations

The majority of the impacts on biodiversity values will occur in the construction phase of the Balranald Project however mitigation of direct and indirect impacts which may arise from the operational phase of the project includes the following:

- minimise dust generation by minimising the extent and time that bare soil is exposed
- dust suppression activities where relevant through the project area
- procedures for the management of spills throughout the project area including the requirements for vehicles to carry spill kits
- directing artificial lighting into the project area to minimise light spill
- ensuring vehicles remain on designated roads and tracks through use of signposting and driver education during the induction process and in ongoing project discussions
- management and removal of all rubbish from the project area.

6.4 Rehabilitation and Closure

As parts of the mine are decommissioned and backfilling of the mine area occurs, progressive rehabilitation will occur. Best practices for rehabilitation, drawing on previous experience from Iluka's other operations has been documented within the Rehabilitation and Closure Strategy for the Balranald Project (EMM 2015). Key rehabilitation actions that will be employed in the Balranald Project include:

- Establishment of native vegetation communities suitable for intermittent and low intensity grazing uses consistent with the Rehabilitation and Closure Strategy. Species selected will encourage the re-establishment of the pre-agricultural vegetation communities in those areas defined for woody vegetation establishment and, in the medium to longer term, create habitat and corridors for native fauna.
- relocation of topsoil and cleared vegetation (including stumps and logs) as soon as possible to areas being rehabilitated, in order to maximise the chance of viable seed drop and germination at the receiving location and to provide shelter for emerging vegetation and ground fauna that may colonise the area.
- supplementation of seed-bank material with collected native provenance seed and or tubestock where required.
- ongoing and repeated monitoring of revegetation programs based on accepted monitoring protocols to assist in quantifying success of revegetation programs and allow for adaptive management of strategies.

Importantly, the Closure and Rehabilitation Strategy recognises the importance of establishing mallee dominated vegetation links across the final landform of the rehabilitated project area in order to provide suitable cover habitat for fauna species to disperse through the rehabilitated landscape.

6.5 Biodiversity Management Plan

A Biodiversity Management Plan (BMP) would be prepared in consultation with OEH to inform and manage various activities throughout the life of the Balranald Project in order to protect and manage important biodiversity values. Key commitments to be covered by the BMP include threatened species management (including specific provisions for Malleefowl), pest and weed management, fire management and site hygiene practices. The BMP will identify potential risks to the successful implementation of the plan, and include a description of the contingency measures that would be implemented to mitigate against these

risks. The BMP will include details of who would be responsible for monitoring, reviewing and implementing the plan.

6.5.1 Threatened species management

The BMP will include specific protocols dealing with any potential interaction between the project activities and threatened flora or fauna species during the life of the Balranald Project. The plan will include directions for survey, monitoring and management of key threatened species known or considered to be potentially impacted by the Balranald Project (in particular Malleefowl) and protocols for reporting and managing any unforeseen threatened species occurrences within the project area. Measures designed to mitigate impacts on threatened species would be monitored for success.

6.5.2 Malleefowl management

A specific Malleefowl management and monitoring plan will be developed, consistent with the '*National Manual for the Malleefowl Monitoring System*' and the '*National Recovery Plan for Malleefowl*'. The Malleefowl plan will form a significant component of the BMP for the project area, and Management Actions Plans for the offset site(s). Active management of Malleefowl within the project area will occur during construction, operations and rehabilitation phases.

Objectives

The key objectives of Iluka's proposed Malleefowl management activities are to:

- ensure compliance with Commonwealth and State legislation relating to Malleefowl;
- minimise the impact on the abundance, diversity, geographic range and productivity of Malleefowl within the Balranald project area;
- identify, monitor and record Malleefowl activity within the project area during all phases of the Project;
- identify known and potential impacts arising from mining and rehabilitation activities and ensure those impacts are managed;
- contribute to the conservation of Malleefowl by sharing data obtained with relevant stakeholders; and
- continue to liaise with relevant stakeholder groups.

Avoidance and mitigation measures

Key management measures for avoidance and mitigation of potential impacts to Malleefowl are tabled below.

Table 29. Avoidance and mitigation measures for impacts to Malleefowl resulting from the Balranald Project

Impact	Risk of increase/severity of impact	Avoidance	Mitigation
Land Clearance	Certain/High	Reduction in clearing areas	Pre clearance surveys or remote sensing in very high - moderate potential habitat to detect active mounds. 200 m buffer established around active mounds until hatching occurs which will be determined through monitoring protocol.
Fragmentation	Certain/Moderate to	Maintenance of corridor at southern end of West	Management of vegetation and development of BMP and Fire

	High	Balranald mine area (see section 6.1.2/ 6.1.3). Identified corridors to be specifically targeted in predator control programs. Offsets to be targeted to areas close to impacted areas.	Management Plans for impact and offset areas to reduce the risk of high intensity/frequency fire. Consolidation of vegetation and removal of tracks where appropriate within offset areas as per offset management plans to be established.
Predation (fox and cat)	Likely to be reduced given management introduction	Unavoidable	Develop and implement BMP focussing on feral management. Inclusion of predator control programs within the Balranald project area including fox and cat baiting. Trapping, shooting or poisoning programs depending on the most effective identified methods or combination of methods.
Road strike	Moderate-low after controls are introduced.	Largely unavoidable	Communications protocols to inform staff and contractors of the presence and importance of Malleefowl and controls in place for impact minimisation. Planning to minimise road-strike for Malleefowl by limiting truck speeds and provision of appropriately sized signage along access roads, particularly areas close to active or recently active mounds, or where Malleefowl prints are observed. Development of methods and communication tools to monitor road-strike and mortality of Malleefowl and disseminate such information to the public and appropriate state and local authorities/interest groups.
Competition and land degradation by rabbits	Moderate/Low	Unavoidable	Rabbit control including burrow ripping within offset areas and Iluka managed areas.
Competition and land degradation by unmanaged goats	Likely to be reduced given management introduction	Unavoidable	Develop and implement BMP focussing on feral management. Removal of watering points, fencing and collecting of goats (e.g. via one way gate systems) will be features of offset management plans. Ongoing monitoring of response of vegetation to goat exclusion in offset areas.
Edge effects	Likely with low severity - predominantly weed impacts and predator access facilitation	Unavoidable	Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to the rehabilitation area) and also within the rehabilitation area.
Weeds	Moderate/likely to be limited increases given appropriate control	Unavoidable	Management protocols for the identification of noxious or important environmental weeds within areas to be

	measures. Receiving environment (Malleefowl habitat) not particularly vulnerable		cleared (in order to avoid transporting the weeds to the rehabilitation area) and also within the rehabilitation area.
Dust	High/likely to be limited increases given appropriate control measures. Receiving environment (Malleefowl habitat) not particularly vulnerable.	Unavoidable	Establishment of dust control procedures and monitoring within site management plan. Special measures to be taken (e.g. increased frequency of road wetting) where active mounds occur within 200 m of roads or other dust sources and outside of clearing areas.
Noise	High/likely to be increases in specific areas adjacent to mining operations. Receiving environment (Malleefowl habitat) may not be particularly vulnerable (Malleefowl have been known to continue breeding close to areas with noise).	Mostly unavoidable	Once the mine layout and position of active Malleefowl mounds is established measures can be investigated to lower machinery and vehicle noise in areas adjacent to Malleefowl nesting.
Loss of connectivity	High/Moderate	Maintenance of corridor at southern end of West Balranald mine area (see section 6.1.2/ 6.1.3)	Identified corridors within the Balranald project area to be specifically targeted in predator control programs. Offsets to be targeted to areas close to impacted areas.
Fire	Low/Potentially very high impacts if significant areas are burnt due to mine activities.	Establishment of fire management planning and exclusion measures within construction and offset areas	Establishment of fire management planning and exclusion measures within construction and offset areas
Generation of light	Moderate for areas adjacent to certain mine areas/low given local impacts	Largely unavoidable	Special measures to be taken (e.g. blocking or diminishing of night light) where mounds occur within 200 m of roads or other dust sources and outside of clearing areas.

Monitoring

Monitoring of Malleefowl will occur using a combination of LiDAR survey, drone survey, real time monitoring cameras, walked transects, site visits, and opportunistic observations depending on what methods are established as being the most effective and efficient throughout the process of BMP formulation. A preliminary proposed monitoring program has been included below. This programme will be finalised and incorporated into the BMP and offset site management plan(s) as relevant.

Balranald project area				
Parameter	**Frequency**	**Method**	**Location**	**Purpose**
Mound locations	Pre clearing survey(s)	Combination of LiDAR or drone survey with ground-truthing; walked transects or other appropriate methods	Balranald project area within identified potential Malleefowl habitat (moderate to very high)	• Identification of previously unidentified Malleefowl mounds • Identify active mounds • Tag mounds (in non-clearing areas), and collect data consistent with the National Malleefowl monitoring plan • Photograph site
Breeding activity	Monthly record of activity at active or potentially active mounds throughout identified breeding period	Physical inspection or real time monitoring cameras	Known active or potentially active mounds within project area	• Confirm breeding activity at active/potentially active mounds • Confirm timing of breeding season, particularly the end of the season. • Identify possible threats to breeding success and target feral or other control accordingly and communicate knowledge to stakeholders.
Malleefowl sightings.	Ongoing - opportunistic observations.	Opportunistic sightings by all on-site personnel	Within and around Balranald Project area	Identify movements around site and communicate knowledge to stakeholders.

Balranald offset site(s)				
Parameter	**Frequency**	**Method**	**Location**	**Purpose**
Mound locations	One off during offset site establishment	Combination of LiDAR or drone survey with ground-truthing; walked transects or other appropriate methods	Balranald project area within identified potential Malleefowl habitat (moderate to very high)	• Locate mounds • Identify active mounds • Tag mounds, and collect data consistent with the National monitoring plan for the species • Photograph site
Breeding activity.	Monthly record of activity at active or potentially active mounds throughout identified breeding period	Physical inspection or real time monitoring cameras	Known active or potentially active mounds within offset site(s).	• Confirm breeding activity at active/potentially active mounds • Confirm timing of breeding season, particularly the end of the season. • Identify possible threats to breeding success and target feral or other control accordingly and communicate knowledge to stakeholders.

Reporting

Results of the Malleefowl monitoring in and around the Project site will be collated on an annual basis and reported as required. Reporting will include details of:

- Annual surveys to identify mound locations;
- Malleefowl breeding activity within the project area;
- Malleefowl sightings in and around the project area;
- Management activities within the offset site(s); and
  Other management activities with a direct relationship to Malleefowl management e.g. feral animal control activities (both with the Balranald project area and offset site(s)).

6.5.3 Corben's Long-eared Bat management

Avoidance and mitigation measures

Key management avoidance and mitigation measures are tabled below in reference to potential impacts to Corben's Long-eared Bat.

Table 30. Avoidance and mitigation measures for impacts to Corben's Long-eared Bat resulting from the Balranald Project

Impact	Risk of increase/Severity	Avoidance	Mitigation
Land Clearance	Certain/High	Reduction in clearing areas (see section 6.1.2/ 6.1.3)	Avoidance of clearing during hibernation period (1st May – 31st of July) or pre-clearance survey and exclusion techniques. Employment of two-stage clearing methods. Offsets targeted at areas including hollow bearing trees.
Loss of roost and breeding habitat (tree hollows)	Certain/High	Reduction in clearing areas (see section 6.1.2/ 6.1.3)	Offsets targeted at areas including hollow bearing trees. Retention of hollow bearing trees within areas to be cleared wherever practicable.
Fragmentation	Certain/Moderate	Maintenance of corridor at southern end of West Balranald mine area (see section 6.1.2/ 6.1.3). Offsets to be targeted to areas close to impacted areas.	Management of vegetation and development of BMP and Fire Management Plans for impact and offset areas to reduce the risk of high intensity/frequency fire. Consolidation of vegetation and removal of tracks where appropriate within offset areas as per offset management plans to be established.
Predation (fox and cat)	Likely to be reduced given management introduction	Unavoidable	Develop and implement BMP focussing on feral management. Inclusion of predator control programs within Iluka managed areas adjacent to mining areas including fox and cat baiting. Trapping, shooting or poisoning programs depending on the most effective identified methods or combination of methods.
Competition and land degradation by rabbits	Moderate/Low	Unavoidable	Rabbit control including burrow ripping within offset areas and Iluka managed areas.
Competition and land degradation by unmanaged goats	Likely to be reduced given management introduction	Unavoidable	Develop and implement BMP focussing on feral management. Removal of watering points, fencing and collecting of goats (via one way gate systems) will be features of offset management plans. Ongoing monitoring of response of vegetation to goat exclusion in offset areas.
Edge effects	Likely with low severity – predominantly weed impacts and predator access facilitation.	Unavoidable	Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to the rehabilitation area) and also within the rehabilitation area.
Dust	High/likely to be increases in specific areas adjacent to	Unavoidable	Establishment of dust control procedures and monitoring within site management plan.

	mining operations. Severity low.		
Noise	High/likely to be increases in specific areas adjacent to mining operations.	Mostly unavoidable	None proposed as difficult to define roost areas for the species given multiple roost use.
Loss of connectivity	Moderate/Moderate	Maintenance of corridor at southern end of West Balranald mine area (see section 6.1.2/ 6.1.3)	Identified corridors to be specifically targeted in predator control programs. Offsets to be targeted to areas close to impacted areas.
Fire	Low – mining activities unlikely to increase existing threat given controls/Potentially very high impacts if significant areas are burnt due to mine activities.	Establishment of fire management planning and exclusion measures within construction and offset areas	Establishment of fire management planning and exclusion measures within construction and offset areas. Establishment of a rapid response protocol to control bushfires, particularly those affecting mallee habitat, within or adjacent to the project area (this will form part of Iluka's Emergency Management Plan)
Generation of light	Moderate for areas adjacent to certain mine areas/moderate to low given local impacts and species roost choice plasticity. May provide some foraging benefits.	Largely unavoidable	None proposed as difficult to define roost areas for the species given multiple roost use.

6.6 Monitoring management and mitigation success

The BMP will outline monitoring programs to be set up to measure the success of biodiversity management protocols and activities across the Balranald Project such as management actions for threatened species, pest management activities, and rehabilitation and revegetation activities. Monitoring programs will include goals and performance indicators to measure the success of proposed mitigation measures. These will be specific, measureable, achievable, realistic and timely (SMART).

7. Biodiversity Offset Strategy

7.1 Introduction

The NSW Biodiversity Offsets Policy for Major Projects (OEH 2014j) states that biodiversity offsets provide benefits to biodiversity to compensate for the adverse impacts of an action. Biodiversity offsets assist in achieving long-term conservation outcomes while providing development proponents with the ability to undertake actions that have unavoidable impacts on biodiversity. Similarly the Commonwealth EPBC Act Environmental Offsets Policy (EPBC Act Offsets Policy) (DSEWPAC 2012) states that offsets are defined as measures that compensate for the residual adverse impacts of an action on the environment.

Unavoidable impacts to biodiversity are those impacts that are residual, i.e. impacts that remain, even after any project design elements have resulted in impact avoidance and management and mitigation measures are employed to reduce the type or magnitude of biodiversity impacts. Section 6.1 of this report outlines the design changes that Iluka has implemented through the feasibility and pre-feasibility stages of the project in order to avoid impacts to a range of values including biodiversity values. Section 6.2 and Section 6.3 of this report outline a range of management and mitigation actions that the project will employ to further reduce direct and indirect impacts to biodiversity values. Section 5 of this report outlines the residual impacts on biodiversity values that must be addressed within the biodiversity offset package for the Balranald Project.

This section of the report (Section 7) describes the approach to biodiversity offsetting for the Balranald Project in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the EPBC Act Offsets Policy.

7.1.1 Biodiversity offset strategy and offset package

This section outlines the approach to biodiversity offsetting, i.e. the offset strategy for the Balranald Project, however it does not describe the proposed offset package in detail. The overall offset package will address both Commonwealth offset requirements and NSW offset requirements. Currently only the subject offset site for this project to address Commonwealth offset requirements has been developed, and this part of the offset package is documented within an addendum to this report titled *Balranald Mineral Sands EPBC Act Biodiversity Offset Package* (Niche 2016). The subject offset site will also contribute significantly towards the NSW offset requirement but additional offset measures will be needed to fulfil this requirement.

Presently, specific details of the location of the subject offset site have not been given publically due to privacy limitations, however its characteristics in regard to biodiversity values (particularly in relation to Malleefowl and Corben's Long-eared Bat) along with its capacity to meet EPBC offset requirements are presented within the addendum to this report (Niche 2016) and summarised in section 7.3.3. Specific details (i.e. location, habitat information, spatial results of field surveys and vegetation mapping) of the subject offset site have been provided to DoE in-confidence to allow for a full consideration of the adequacy and appropriateness of the site.

Initial investigation into numerous other candidate offset properties has occurred and works undertaken to date have identified that suitable offsets exist, both in quantum and type, within the vicinity of the Balranald Project to satisfactorily cover the remaining offset requirement after securing of the subject offset site.

Both the NSW and Commonwealth offset requirements acknowledge the staging of the Balranald Project and allowance is made to enact the required offset measures coincidently with the two mining stages (West Balranald and Nepean mines) to reflect the timing of impacts on biodiversity. In addition, the NSW offset requirement for the West Balranald mine (stage one) is deferrable until three years after the commencement of any clearing associated with mining activities. This acknowledges impending changes to offset policy in NSW. Conversely, Commonwealth offset measures (offsets for impacts to Malleefowl and Corben's Long-eared Bat) must be in place prior to the commencement of any mining activities for the West Balranald mine.

7.2 Framework for the development of the offset strategy

The Balranald Project is likely to have residual impacts on a number of threatened species listed on both the TSC Act and EPBC Act as well as impacts on native vegetation. As such the proposed offset strategy must account for the offsetting policies of both NSW through the NSW Biodiversity Offsets Policy for Major Projects and the Commonwealth through the EPBC Act 1999 Offsets Policy.

7.2.1 NSW Biodiversity Offsets Policy for Major Projects

The NSW Biodiversity Offsets Policy for Major Projects applies to the Balranald Project in accordance with the Secretary's Environmental Assessment Requirements (SEAR's) (see Section 1.6) and on the basis of further advice provided by the Chief Executive of the NSW OEH in December 2014 (OEH 2014k). The policy is currently in a transitional period.

The policy:

1. Establishes a set of offsetting principles for Major Projects.
2. Defines key thresholds for when offsetting is required.
3. Adopts an assessment methodology to quantify and describe the offset required.
4. Defines mechanisms required to establish offset sites.
5. Provides a range of flexible options that can be used in lieu of providing offsets, including rehabilitation actions and supplementary measures.

Further to point 4, advice was provided to the Director of Planning, Land and Community - NSW Mining by the Chief Executive of the NSW OEH in December 2014 (OEH 2014k) relating to the mechanisms available to major project proponents in NSW to secure an offset site. The mechanisms available to major project proponents are listed below however the advice only applies to projects which will receive project approval within the transitional period, which applies to the Balranald Project. According to the advice supplied, interim mechanisms for securing offsets include:

1. Biobanking agreement (preferred).
2. Dedication of land under the *National Parks and Wildlife Act 1974* (NPW Act)[8].
3. A trust agreement under the *Nature Conservation Trust Act 2001.*
4. A property vegetation plan registered on title under the *Native Vegetation Act 2003.*

[8]The advice further states that: *A conservation agreement under the NPW Act can only be used in limited circumstances where this process is and existing proposal that has previously been agreed by the Office of Environment and Heritage*.

Notwithstanding the information presented above, the NSW Biodiversity Offsets Policy for Major Projects contains within it provision for the establishment of an offset fund into which proponents may contribute financially an amount which otherwise would be equal to the cost of establishing independent offset sites. The fund is not yet available and the timing for the development of the fund has not been confirmed. However, if the fund is established within a timeframe that may make it available to Iluka as an option for securing biodiversity offsets for the project, contributing to the fund will be considered as an option for securing offsets for the Balranald Project.

The biodiversity offset strategy presented here has relied on both the NSW Biodiversity Offsets Policy for Major Projects and the subsequent advice from the Chief Executive of the NSW OEH.

7.2.2 Environment Protection and Biodiversity Conservation Act 1999 Offsets Policy

Offsets are to be determined having regard to the EPBC Act Offsets Policy. Similar to the NSW Biodiversity Offsets Policy for Major Projects, environmental offsets are provided as measures that compensate for the residual adverse impacts of an action under the EPBC Act Offsets Policy. Offsets should counterbalance the impacts that remain after avoidance and mitigation measures have been implemented. For assessments under the EPBC Act, offsets are only required if residual impacts are significant on MNES.

An offsets package is defined in the EPBC Offsets Policy as a suite of actions that a proponent undertakes in order to compensate for the residual significant impacts of a project. An offsets package can comprise of a combination of direct offsets and other compensatory measures. Direct offsets are actions that deliver a measurable conservation gain for an impacted protected matter. Conservation gains 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 values of a heritage place.
- Averting the loss of a protected matter or its habitat that are under threat.

Under the EPBC Act Offsets Policy, biodiversity offsets may be secured through a number of mechanisms including:

1. Developing offsets of public lands.
2. Developing offsets on private lands.
3. Developing offsets on Indigenous owned lands.
4. Developing offsets in the marine environment (not applicable to this project).
5. Providing indirect measures to supplement a direct offsets site (s).

Indirect measures or other compensatory measures that are not directly related to securing land based, otherwise unprotected, habitat for those MNES which will be significantly impacted by a proposal, may include measures that are anticipated to lead to benefits for the impacted protected matter. Other compensatory measures may include funding for suitable research or education programs. Under the EPBC Offsets Policy, a minimum of 90% of the offset requirements for any given impact must be met through direct offsets.

The EPBC Offsets Policy is guided by ten overarching principles to be applied when determining the suitability of offsets. The overarching principles and how they are addressed in the Biodiversity Offset Strategy is provided in Table 37.

7.3 Quantifying the offsets required

Section 5 of this report assesses the impacts of the Balranald Project on biodiversity values. Direct impacts of the Balranald Project will result in the loss of vegetation and habitat for a range of threatened species which will result in a significant impact to a number of threatened species listed on the TSC Act and the EPBC Act. As such the offset strategy must quantify the required offsets for the Balranald Project in accordance with both the TSC Act and EPBC Act.

7.3.1 NSW Biodiversity Offsets

The NSW Biodiversity Offsets Policy for Major Projects requires the quantification of offsets by applying a reliable transparent assessment methodology and the policy identifies the FBA as the appropriate mechanism to do this. The FBA identifies the BioBanking Credit Calculator (BBCC) as the appropriate tool for quantifying the precise nature of the offsets required in both Ecosystem Credit and Species Credit terms. The 'major project' function of the BBCC is used under the FBA. Accredited BioBanking assessors can access and "run" the BBCC and in the case of the current assessment the calculations were undertaken by Luke Baker who is an accredited BioBanking assessor.

A calculation of the nature and extent of offset credits required due to the biodiversity impacts associated with the Balranald Project has been undertaken using Version 4.0 of the BBCC. The values generated within the BBCC have been presented to NSW OEH and revised after consultation. Additional offsetting requirements were also added to the generated credit values to further compensate for impacts to SMCA areas, with the total agreed offset requirement in terms of credits and hectares documented within the NSW development consent conditions and reproduced in Table 34.

To run the BBCC a range of assumptions and landscape measurements must be developed as inputs into the calculator. Those assumptions and landscape measurements are determined based on the methodology contained within the BBAM[9].

Table 31 presents a summary of the assumptions and landscape measurements used as inputs into the calculator. Appendix 9 includes the full output of the BBCC for the Balranald Project which defines the Ecosystem and Species Credits required to offset the impacts of the project on biodiversity in accordance with the NSW Biodiversity Offsets Policy for Major Projects.

Table 31. Landscape input in preliminary credit estimate

Assessment stage/Item	Entry	
Opening Page		
CMA	Lower Murray Darling CMA	
Mitchell Landscape	Mallee Cliffs Sandplains	
Assessment Circle A		
IBRA Subregion	Lachlan (A)	
	Before development	**After development**
% Native Vegetation Cover in 15,000 ha Circle	86-90%	76-80%
% Native Vegetation Cover in 1,500 ha Circle	96-100%	66-70%

[9] The Linear Method (Appendix 5 of the BBAM) has not yet been finalised by OEH. Correspondence with the OEH BioBanking team indicated that the old methodology of assessment circles should be used in replacement of the Linear Method.

Assessment stage/Item	Entry	
Connectivity Width	>500m	>500m
Over-storey Condition	Projected foliage cover at > 25% lower benchmark	Projected foliage cover at > 25% lower benchmark
Mid-storey or ground cover Connectivity Condition	Projected foliage cove of mid-storey/ground cover > 50% lower benchmark	Projected foliage cove of mid-storey/ground cover > 50% lower benchmark
Assessment Circle B		
IBRA Subregion	South Olary Plain (E)	
	Before development	**After development**
% Native Vegetation Cover in 15,000ha Circle	76-80%	61-65%
% Native Vegetation Cover in 1,500ha Circle	96-100%	41-45%
Connectivity Width	>500m	>500m
Over-storey Condition	Projected foliage cover at > 25% lower benchmark	Projected foliage cover at > 25% lower benchmark
Mid-storey or ground cover Connectivity Condition	Projected foliage cove of mid-storey/ground cover > 50% lower benchmark	Projected foliage cove of mid-storey/ground cover > 50% lower benchmark

Ecosystem Credits

The original offset calculations for vegetation disturbance are shown in Table 32 along with indicative offset ratios.

The caclulations of Ecosystem Credits required for each vegetation type were used in the Credit Converter provided by OEH to estimate the area of offset required for each vegetation type (Appendix 9). It is noted that the Credit Converter is based on a number of assumptions and simplifications and provides a rough estimate only of required offsets. However, the true value of credits generated from offsets will need to be determined by carrying out BioBanking Assessments over the actual areas of land intended to be secured as biodiversity offsets for the project. This will be conducted during the development of the offset package once detailed assessments of potential offset sites have been completed. The converter uses a median value of 9.3 credits generated per hectare of offset land for all vegetation types.

The final agreed to NSW offset requirement for clearing of native vegetation, as documented within the NSW development consent, is provided in Table 34.

Table 32. Estimated vegetation offset requirements for the Balranald Project

Vegetation Formation (Keith 2004)	Vegetation Class (Keith 2004)	BioMetric Vegetation Type OEH (2011)	BioMetric Vegetation Type Abbreviation for Ecological Assessment	Disturbance area (ha)[10]	Ecosystem Credits required	Credits per hectare	Area of offset required (ha)	Indicative Offset ratio
Semi-arid woodlands (shrubby sub-formation)	Dune Mallee Woodlands	LM130 - Linear Dune Mallee mainly of the Murray-Darling Basin Bioregion	1. Spinifex Dune Mallee Woodland (LM130)	536.4	23,433	43.7	2,519.7	4.7:1
	Sand Plain Mallee Woodlands	LM116 - Chenopod sandplain mallee woodland/ shrubland of the arid and semi-arid (warm) zones	2.Chenopod Sandplain/Swale Mallee Woodland (LM116)	2,051.5	124,074	60.5	13,341.3	6.5:1
	Semi-arid Sand Plain Woodlands	LM107 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	7.Belah – Pearl Bluebush Woodland (LM107)	114.8	5,638	49.1	606.2	5.2:1
		LM108 – Black Oak – Western Rosewood open woodland on deep sandy loams of Murray-Darling Depression and Riverina Bioregions	8.Belah – Chenopod Woodland (LM108)	438.7	31,356	71.5	3,371.6	7.7:1
Semi-arid woodlands (grassy sub-formation)	Inland Floodplain Woodlands	LM105 – Black Box open woodland with chenopod understorey mainly on the outer floodplains of the Riverina and Murray-Darling Depression Bioregions	9.Black Box Grassy Chenopod Open Woodland (LM105)	6.9	361	52.3	38.8	5.6:1
Forested wetlands	Inland Riverine Forests	LM143 – River Red Gum – Lignum very tall open forest or woodland on floodplains of semi-arid (warm) climate zone	10.River Red Gum Woodland (LM143)	3.8	151	35.0	14.3	3.8:1

[10]Disturbance area has been calculated to one decimal place

Vegetation Formation (Keith 2004)	Vegetation Class (Keith 2004)	BioMetric Vegetation Type OEH (2011)	BioMetric Vegetation Type Abbreviation for Ecological Assessment	Disturbance area (ha)[10]	Ecosystem Credits required	Credits per hectare	Area of offset required (ha)	Indicative Offset ratio
Arid shrublands (Chenopod sub-formation)	Aeolian Chenopod Shrublands	LM102 – Black Bluebush Low Open Shrubland (LM102) of the alluvial plains and sandplains of the arid and semi-arid zones	3.Black Bluebush Low Open Shrubland (LM102)	284.9	12,765	44.8	1,372.6	4.8:1
		LM138 – Pearl Bluebush Low Open Shrubland (LM138) of the arid and semi-arid plains	4.Pearl Bluebush Low Open Shrubland (LM138)	1,072	47,613	44.4	5,119.7	4.8:1
	Riverine Chenopod Shrublands	LM110 – Bladder Saltbush shrubland on alluvial plains in the semi-arid (warm) zone	5.Bladder Saltbush Low Open Shrubland (LM110)	558	14,929	26.8	1,605.3	2.9:1
		LM137 – Old Man Saltbush Shrubland (LM137) mainly of the semi-arid (warm) climate zone (south western NSW)	6.Old Man Saltbush Shrubland (LM137)	19.8	831	42.0	89.4	4.5:1
Saline Wetlands	Inland Saline Lakes	LM124 - Disturbed annual saltbush forbland on clay plains and inundation zones of the arid and semi-arid climate zones	11.Flat Open Claypan / Derived Sparse Shrubland / Grassland (LM124)	73.6	2,412	32.7	259.4	3.5:1
			TOTAL	5,160.4	263,563	-	28,338.3	

Species Credits - threatened flora

No known threatened flora will be directly or indirectly impacted by the Balranald Project. No significant impacts to threatened flora under State and Commonwealth legislation are likely. No specific offset for threatened flora is therefore proposed. It should however be noted that the offset of BioMetric Vegetation Types will subsequently conserve habitat for threatened flora in perpetuity.

Species Credits - threatened fauna

Table 33 details four Species Credit fauna species associated with the Balranald Project which have a moderate likelihood of occurrence within the project area. No Species Credit fauna species were recorded within the project area despite extensive targeted survey and no significant impacts to Species Credit fauna species is likely. No specific offset for species credit threatened fauna species is therefore proposed. Offset areas, by virtue of the vegetation types requiring to be offset and associated habitat, are likely to have a similar likelihood of occurrence for Species Credit fauna species as the project area. Therefore offsets may include areas of habitat for species credit species, despite such habitat not being targeted for inclusion within the offset.

Table 33. Species Credit fauna species with a moderate likelihood of occurrence within the project area.

Scientific name	Common name	TSC Act	EPBC Act	Offset requirement
Litoria raniformis	Southern Bell Frog	E	V	Not recorded during survey therefore no specific offset requirement
Pseudomys bolami	Bolam's Mouse	E	-	Not recorded during survey therefore no specific offset requirement
Cercartetus concinnus	Western Pygmy Possum	E	-	Not recorded during survey therefore no specific offset requirement
Echiopsis curta	Bardick	E	-	Not recorded during survey therefore no specific offset requirement

7.3.2 Offsetting impacts to the Southern Mallee Conservation Areas

The Balranald Project will result in impacts to parcels of land that have been set aside as a form of environmental conservation reserve for the clearing of vegetation in the development of farming land for the purposes of cultivation. These conservation reserves are known as SMCAs (section 5.7).

Importantly, the SMCAs reserve like for like vegetation types typically at maximum ratios of 1:1, with the exception to this being for the reservation of Chenopod Mallee at ratios of 1:2.28 (see Southern Mallee Regional Planning Committee 2000). There is however considerable flexibility in the make-up of any SMCA and the relevant cultivation agreements that set out the terms and conditions of the SMCA are not publically available. Title conditions for SMCA lands typically require the following:

1. Erection and maintenance of stock-proof fencing and ensuring that the conservation area remains ungrazed by stock and feral animals.
2. No clearing of vegetation or removal of any timber.
3. Management of the area in accordance with the best management practices outlined in the "Southern mallee Regional Guidelines for the Development of Land Use Agreements".

There are three SMCA's within the West Balranald and Nepean mine areas (Figure 1) parts of which would be impacted by the development of Balranald Project. These areas were assessed as part of the flora and fauna field surveys for the Balranald Project and while the areas remain un-cleared, both of the areas were found to contain high numbers of feral animals (goats, foxes, rabbits and pigs) which continue to impact the native biodiversity values within these areas.

Negotiation and agreement between NSW DP&E, NSW OEH and the Commonwealth DoE in regard to additional offsets for clearing of SMCA areas has been reached. Iluka has agreed to add a stated amount of hectares corresponding to the vegetation communities impacted (within the SMCAs) to its overall offset credit liability as per the table below. This agreement has been incorporated into the NSW development consent for the Balranald Project (DP&E 2016a).

Table 34. NSW offset liability as per the development consent for the Balranald project including additional offset requirements in hectares for clearing of SMCA areas (reproduced from DP&E 2016a).

Vegetation Community	Code (BVT)	Credits Required	
		West Balranald Mine	Nepean Mine
Black Bluebush Low Open Shrubland	LM 102	10,014	-
Black Box Grassy Chenopod Open Woodland	LM 105	276	-
Belah – Pearl Bluebush Woodland	LM 107	5,366	272
Belah – Chenopod Woodland	LM 108	9,694	13,863
		-	207 hectares
Bladder Saltbush Low Open Shrubland	LM 110	14,929	-
Chenopod Sandplain/Swale Mallee Woodland	LM 116	89,097	7,152
		1424 hectares	139 hectares
Flat Open Claypan / Derived Sparse Shrubland/Grassland	LM 124	2,412	-
Old Man Saltbush Shrubland	LM 137	831	-
Pearl Bluebush	LM 138	39,452	-
Spinifex Dune Mallee Woodland	LM 130	15,239	8,194
		167 hectares	104 hectares

7.3.3 EPBC Act Offsets

Within this assessment it has been determined that the Balranald Project is likely to have a significant impact on one MNES being the Malleefowl (listed as Vulnerable). The conclusion of a significant impact for this MNES means that offsetting is required under the EPBC Act.

Since submission of the draft biodiversity assessment (Niche 2015) the DoE has confirmed their determination in relation to significantly impacted MNES. Consequently, biodiversity offsets will be required to compensate for significant impacts on two MNES - both threatened species listed as vulnerable. Those species are:

- Malleefowl (*Leipoa ocellata*), as identified in this Biodiversity Assessment (Niche 2015); and
- Corben's Long-eared Bat (*Nyctophilus corbeni*), which although not identified as significantly impacted within the Biodiversity Assessment, was added by DoE as a significantly impacted species after consideration of impacts to the species outlined within the draft Biodiversity Assessment (Niche 2015).

Initial investigations into numerous candidate offset properties has occurred with one specific offset site developed to satisfy all of the Commonwealth offset requirement for significant impacts to Malleefowl and Corben's Long-eared Bat (hereafter referred to as the subject offset site). Aspects of the subject offset site are described below and in further detail within the addendum to this report titled *Balranald Mineral Sands Project EPBC Act Biodiversity Offset Package* (Niche 2016). The offset site will be secured via a BioBanking agreement.

Specific details on the location of the subject offset property have not been included due to privacy restrictions, however its characteristics in regard to biodiversity values (particularly in relation to Malleefowl and Corben's Long-eared Bat) are presented below along with an assessment of its suitability and capacity to meet EPBC Act offset requirements. Specific details (i.e. location, habitat information, spatial results of field surveys and vegetation mapping) of the subject offset site have been provided to DoE in-confidence to allow for a full consideration of the adequacy and appropriateness of the site.

Table 35. Description of the currently subject offset site

Criteria	Values/characteristics
Size	A maximum of 10,900 hectares of the property is available for offsetting and therefore the property is a good prospective site representing a large consolidated offset with extensive patch size.
Vegetation types and condition	Vegetation is predominantly Chenopod Sandplain/Swale Mallee Woodland with significant areas of Spinifex Dune Mallee Woodland interspersed between the Chenopod Mallee. These are key vegetation types for Malleefowl and the prevailing habitat of impact for Malleefowl within the development area. Smaller areas of Belah – Chenopod Woodland and *Acacia melvillei* Woodland (listed as an EEC under the State TSC Act) also occur. Prevailing vegetation condition within the property is similar to better quality parts of the project area. The property is largely ungrazed by domestic livestock, however goats are common. There is significant room for improvement in regard

	to vegetation condition via management of goats and other feral animals.
Malleefowl habitat	The property has confirmed records of Malleefowl with numerous mounds having been identified within the property over the last two decades. Confirmation of recently active mounds and current Malleefowl activity (via footprints) occurred during field survey of the property between November 2015 and March 2016 as detailed within Niche 2016. Mound density within the subject site is similar or higher to mound densities within the West Balranald mine area. Mound density is much higher than the Nepean mine area.
Corben's Long-eared Bat habitat	Recent survey has confirmed the presence of Corben's Long-eared Bat within the offset site which is expected to occur within all woodland vegetation types throughout the site. A similar survey effort undertaken within the subject offset site in regard to harp trapping for the species yielded seven individuals of the species captured from three sites (Niche 2016).
Proximity to development area	The subject offset site is within 100 km from the Balranald Project site. Malleefowl and Corben's Long-eared Bat habitat within the subject offset site has connectivity with a large proportion of the habitat to be impacted from the Balranald Project, with habitat between the two areas being predominantly native vegetation. Vegetated corridors are restricted in some areas to approximately 800m (Malleefowl are known to use even narrow corridors including linear roadside strips of vegetation from time to time). Overall there is expected to be some migration of Malleefowl individuals (albeit potentially infrequent) and Corben's Long-eared Bat between the development and subject offset site.
Proposed offsetting mechanism	A NSW Biobanking agreement is currently the preferred mechanism for offsetting of the property.
Other threatened biodiversity values	The following threatened species have been recorded at the property: • Chestnut Quail-thrush (TSC Act – confirmed during recent field survey) • Corbens Long-eared Bat (TSC Act and EPBC Act – confirmed during recent field survey) • Gilbert's Whistler (TSC Act – confirmed during recent field survey) • Hooded Robin (south-eastern form) • Inland Forest Bat (TSC Act – confirmed during recent field survey) • Little Pied Bat (TSC Act) • Major Mitchell's Cockatoo (TSC Act) • Mallee Worm-lizard (TSC Act) • Regent Parrot - eastern subspecies (TSC Act and EPBC Act – note foraging habitat only) • Varied Sittella (TSC Act) • Western Pygmy Possum (TSC Act) • *Acacia melvillei* shrubland (TSC Act)

In order to quantify the offset requirement for the Malleefowl and Corben's Long-eared Bat, the EPBC Act Offset Assessment Guide (hereafter referred to as the EPBC offset calculator) was applied by both Niche (on behalf of Iluka) within the draft of this Biodiversity Assessment and subsequently by DoE. Scoring used within the EPBC Act calculator by both parties and the justification behind initial offset calculations by Niche is presented within *Balranald Mineral Sands Project EPBC Act Biodiversity Offset Package* (Niche 2016).

The original scoring performed by Niche and presented to DoE within the draft Biodiversity Assessment report (Niche 2015) is considered to be a correct and reasonable interpretation of the DoE offsets assessments guide. However it is acknowledged that operation of the guide has a certain level of subjectivity and that the scoring by DoE has generated a different outcome in regard to the total offset required (partly in seeking to maintain a consistent application of the tool between projects). The scoring by DoE has therefore been agreed to as a basis for determining the overall Commonwealth offset requirement for both Malleefowl and Corben's Long-eared Bat in order to progress determination of the project.

The final offset requirement as calculated by DoE is presented below and accepted as the basis for project approval. The requirement is separated into two stages to reflect the stages of the proposed development as discussed in Section 7.4.3. Habitat within the offset area as presented to DoE has been given a quality score of 7 out of 10 for both Malleefowl and Corben's Long-eared Bat. Other scoring parameters used by DoE can be found in Appendix 1 of *Balranald Mineral Sands Project EPBC Act Biodiversity Offset Package* (Niche 2016).

Table 36. Staged offset requirement calculated by DoE for the Balranald Project using the offsets assessment guide

Species/Habitat Class	Development area total (ha)	Balranald mine (stage 1) area (ha)	Nepean mine (stage 2) area (ha)	Total (100%) DoE Offset Requirement (ha)	Stage 1 offset requirement (ha)	Stage 2 offset requirement (ha)
Malleefowl High/Very High	1,571	1,218	353	5,250	4,070	1,180
Malleefowl Low/Moderate	973	521	452	1,850	991	859
Combined Malleefowl	2,544	1,739	805	7,100	5,061	2,039
Corben's Long-eared Bat	3,143	2,338	805	10,430	6,052	2,898

It has been communicated to Iluka that (consistent with DoE policy) the offset requirement can be satisfied through either a 100% direct offset arrangement or a 90% direct offset and 10% indirect offset arrangement. Iluka opts to satisfy 100% of the offset requirement through the establishment of a direct offset (the subject offset site).

7.4 Proposed offset strategy

As described above this document presents the offset strategy that will guide the development of the offset package prior to the commencement of the Balranald Project. The approach to the development and finalisation of the biodiversity offset package is presented below.

7.4.1 One offset package to satisfy the NSW and EPBC Offset Requirements

The offset package is designed to satisfy both the NSW and EPBC offset requirements concurrently within the same offset site(s). Accordingly, Table 37 outlines the approach that will be taken by Iluka to develop a suitable biodiversity offset in accordance with the key offsetting policy principles at both the NSW and Commonwealth levels.

Table 37. Principles for developing biodiversity offsets under NSW and Commonwealth legislation

Offsetting principle	How principle is addressed in the offset package
NSW Biodiversity Offsets Policy for Major Projects	
Principle 1: Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.	Impacts have been avoided where possible during the design of the Balranald Project. Management and mitigation measures for biodiversity values have been proposed for the Balranald Project. Impact avoidance, management and mitigation Section 6.
Principle 2: Offset requirements should be based on a reliable and transparent assessment of losses and gains.	BioBanking plot data and threatened species surveys within the project area and subject offset site have been undertaken in accordance with the BioBanking Assessment Methodology (which is consistent with the FBA). The methodology utilised in this assessment is detailed in Section 3. The latest version of the BBCC (major projects) has been used to determine the credits required to offset the impacts of the Balranald Project. Accredited BioBanking assessors have conducted the calculations. The offset package have been developed in accordance with the requirements of the FBA, and application of the BBCC for potential offset sites to determine the suitability and quantum of offsets.
Principle 3: Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.	In the first instance, the offset package proposed will be a like-for-like offset. Should like for like vegetation types not be located, the package will be of a similar vegetation type or one of higher conservation priority in accordance with the variation rules under the FBA, or funds directed to offsetting will be directed to appropriate projects as determined by NSW OEH.
Principle 4: Offsets must be additional to other legal requirements.	Proposed offset measures within subject offset sites will be/are additional to other legal obligations that the subject offset site have.
Principle 5: Offsets must be enduring, enforceable and auditable.	The final biodiversity offset package will be secured in accordance with the permissible offset mechanisms under the transitional provisions of the NSW Biodiversity Offsets Policy for Major Project (see Section 7.2.2). Application of this policy will ensure that there is adequate funding available for current and future landowners to manage the offset site(s) and that offset sites will be subject to monitoring and reporting requirements.
Principle 6: Supplementary measures can be used in lieu of offsets.	In the first instance, a like-for-like offset package is proposed, using variation rules under the FBA. Should appropriate offset sites not be found, funds for supplementary measures will be proposed. Supplementary measures may include research and actions or funding that contribute to recovery planning actions for impacted threatened species.

Offsetting principle	How principle is addressed in the offset package
EPBC Act Environmental Offsets Policy	
Deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The offset package will deliver an overall conservation outcome that improves or maintains the viability of the protected matters that will be significantly impacted by the Balranald Project. The offset requirements have been calculated using the EPBC offset policy calculator and through consultation with DoE. Offset sites will be managed appropriately to improve the condition of the protected matter. Details of management of the subject offset site are contained within the *Balranald Mineral SandsEPBC Act Offset Package* (Niche 2016).
Be built around direct offsets but may include other compensatory measures	It has been elected to satisfy the entire EPBC Act offset requirement through direct offsets.
Be in proportion to the level of statutory protection that applies to the protected matter.	The application of the EPBC offset policy calculator ensures that the final offset packages is adequately proportioned to account for the level of statutory protection that applies to the protected matters that will be significantly impacted by the Balranald Project.
Be of a size and scale proportionate to the residual impacts on the protected matter.	The application of the EPBC offset calculator ensures that the final offset package adequately offsets the size and scale of the impacts of the Balranald Project on the protected matters.
Effectively account for and manage the risks of the offset not succeeding.	Offsets will be audited, monitored and managed appropriately to ensure success in compensating for the residual impacts of the action over a period of time.
Be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs.	The subject offset site will be additional to other legal obligations that the subject offset site has.
Be efficient, effective, timely, transparent, scientifically robust and reasonable.	The acquisition and protection of the subject offset site will be staged in line with the staging of the action. The adequacy of the offsets has been determined using the EPBC offset policy calculator and through consultation with DoE. Details of the offset site are documented in the *Balranald Mineral SandsEPBC Act Offset Package* (Niche 2016).
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	The proposed offset package will be subject to an offset management plan. The management plan will include prescribed monitoring and auditing commitments. The management plan will be developed through further consultation with the DoE and OEH.
In assessing the suitability of an offset, government decision-making will be: Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty.	The adequacy of the subject offset site has been determined using the EPBC offset calculator as detailed in the *Balranald Mineral Sands EPBC Act Offset Package* (Niche 2016).
In assessing the suitability of an offset, government decision-making will be: Conducted in a consistent and transparent manner.	The EPBC offset calculator and consultation with DoE has determined the offsets required, partly based on acknowledgement of previous offsetting requirements for projects in the same region.

7.4.2 Consultation with NSW and Commonwealth Regulators

Section 1.6 of this report outlines the consultation undertaken to date for the biodiversity assessment for the Balranald Project. Consultation with OEH and DoE to date has been wide ranging but has included seeking and being provided with specific advice on the development of the biodiversity offset package. Although not presented in this report, specific advice has been sought and provided on the approach taken to date to assess the offset liability for the project and also on the suitability of the approach and outcomes

of the process Iluka has undertaken to date in the development of the biodiversity offset package. The offset requirements under the EPBC Act have been agreed to with DoE after extensive consultation and the provision of reporting with a detailed explanation of the offsetting process and characteristics of the offset site within the *Balranald Mineral Sands EPBC Act Offset Package* (Niche 2016).

Iluka is committed to developing a suitable and appropriate biodiversity offset for the Balranald Project. Ongoing consultation with OEH and DoE will continue to take place to finalise the overall offset package.

7.4.3 Staged approach to securing the biodiversity offset package

Iluka will secure the biodiversity offset package in two main stages with different timing requirements relating to each stage depending on the requirements of the NSW TSC Act, the Commonwealth EPBC Act and development consent conditions for the project.

The first stage of the offset will cater for all offsetting requirements for development of the West Balranald mine and associated infrastructure while the second stage will address offset requirements associated with development of the Nepean mine. Details of work done to date for Stage one of the offset package in relation to the EPBC Act offset requirements are detailed within the *Balranald Mineral Sands EPBC Act Offset Package* (Niche 2016) summarised in section 7.3.3.of this report.

It is required by DoE that the EPBC Act offsets for stage one are in place prior to development of the West Balranald mine and likewise that the offsets for stage two be in place prior to development of the Nepean mine.

The timeline for securing the NSW based offsets has been agreed to with the NSW Department of Planning in response to the evolving offset mechanisms in NSW. Offset credits for the West Balranald mine must be retired within 3 years of the commencement of construction of the West Balranald mine, while for the Nepean mine the credits must be retired prior to the commencement of construction of the Nepean mine.

7.4.4 Identification of suitable offset sites

Currently, a single offset site to address all Commonwealth offset requirements and part of the NSW offset requirement has been subject to detailed assessment (see Niche 2016). Further detailed assessment will be required to finalise the NSW offset requirement. Considerable effort went into identifying the subject offset site and other suitable future offset sites. Site identification was accompanied by consultation with landholders, and government regulators (OEH, NPWS and DoE) to ensure the suitability of offset sites.

Works undertaken to identify suitable biodiversity offset sites for the Balranald Project included:

1. Phase 1: Regional desktop investigations using GIS analysis to identify potential offset sites by scoring the sites against a series of criteria identified as desirable for potential offset sites including:
    a. Absence of existing National Park tenure or long-term conservation covenant.
    b. Absence of mining tenements.
    c. Regional vegetation types and formations consistent with vegetation types and formations to be removed within the development area and therefore requiring offsets.
    d. Proximity to National Parks.
    e. Proximity to the project area.
    f. Known records for threatened species.
    g. The size of the potential biodiversity offset area.
    h. The shape of the proposed biodiversity offset area in relation to the spatial arrangement of existing vegetation in the landscape.

Phase 1 of the analysis resulted in the identification of approximately 430,000 hectares of vegetation on a total of 21 candidate properties which may be considered as potential offset sites.

2. Phase 2 involved rapid ground reconnaissance of the 21 candidate properties (public access and public vantage points only) to validate the desktop GIS exercise in phase 1.
3. Phase 3 involved the refinement of the 21 candidate sites into a shortlist of 10 properties with a collective vegetated area of approximately 273,000 hectares of vegetation.
4. Phase 4 involved preliminary field investigations of the shortlisted 10 potential offset properties to further refine the vegetation mapping and condition assessment of the sites prior to undertaking further detailed assessments of the potential offset sites for the development of the final offset package.

Works undertaken to date have identified that suitable offsets exist, both in quantum and type, within the vicinity of the Balranald Project to satisfactorily cover the offset requirement remaining after securing the subject offset site (see Niche 2016). Early and regular consultation with landholders of properties containing the potential offset sites has indicated that they are willing to pursue offset site development negotiations.

7.4.5 Targeting ecological gains in the offsets package

The final offset package will meet the standard identified in the SEARs which is to ensure that the biodiversity values impacted by the Balranald Project will be maintained and improved in the long-term. The application of the NSW Biodiversity Offsets Policy for Major Projects and the Commonwealth EPBC Act Offsets Policy will result in a maintain or improve scenario for biodiversity values as a result of the Balranald Project. The following benefits will be achieved through the application of the proposed offset strategy:

1. The addition of significant areas of managed offset areas to the already existing reserve and conservation network will enhance conservation outcomes for the wider region.
2. Management of the offset sites for conservation will result in grazing pressures from feral animal species being significantly reduced and lead to improved biodiversity values.
3. The subject offset site and future offsets will contain similar vegetation types and fauna habitat to that occurring within the project area however the area of conserved vegetation will be greatly increased.

7.4.6 Securing suitable offset sites

Section 7.2 of this report outlines the mechanisms available to secure suitable offset sites under both the NSW and Commonwealth offsetting policies. Given the nature of the potential offset package, i.e. multiple sites on several properties, it is possible that the final offset package may use several mechanisms to secure the final biodiversity offset for the Balranald Project. The offset mechanism used for the subject offset site (Niche 2016) will be a NSW BioBanking agreement.

7.5 Finalising the Biodiversity Offset Package

The nominated offset site detailed in the *Balranald Mineral Sands Project EPBC Act Offset Package* (Niche 2016) will satisfy the requirements to offset impacts under the EPBC Act. This offset site also contributes significantly to the NSW Offset requirements but will not fully meet the NSW offset requirement.

Future work listed below will be completed before the final offsetting package to address NSW offset requirements is completed:

1. Analysis of options regarding offsetting mechanisms and options for property purchase/transfer.
2. Final discussions with landholders to secure the subject offset site and future proposed offset sites.
3. Consultation with OEH regarding:

- Offset policy and clarification around potential to depart from 'like for like' offsets in regard to vegetation types (e.g. Mallee communities that may have better conservation values instead of Chenopod communities).
- Ability to pay into an established offset fund.
- Minimum connectivity requirements for identified offset packages.

Preparation of cost estimates for likely management actions for offset packages will be done in consultation with NSW OEH, NSW LLS and NSW NPWS (as applicable).

8. Conclusions

This report provides a biodiversity assessment to address the potential impacts associated with the Balranald Project.

The Balranald Project will result in the disturbance to approximately 5,160.4 ha of native vegetation. A further 186.1 has ha of exotic pasture and existing cleared land will be developed as a result of the Balranald Project. The total of the disturbance is 5,346.6 ha. Indirect impacts including dust, noise, erosion and sedimentation in adjacent bushland and weed invasion are also predicted.

Eleven BioMetric Vegetation Types were identified within the project area with two additional vegetation types created to recognise highly modified vegetation communities. None of the vegetation types within the disturbance area are listed as TECs under the TSC Act or EPBC Act. As such, no significant impact to any TEC will occur as a result of the prosed development.

No threatened flora listed by either the TSC Act or EPBC Act were recorded within the project area. Based on the results of the field survey and literature review, seven threatened flora with a moderate to high likelihood of occurrence within the project area include the following: *Brachyscome papillosa, Lepidium monoplocoides, Maireana cheelii, Pterostylis cobarensis, Santalum murrayanum, Swainsona murrayana,* and *Swainsona pyrophila.* Assessments of Significance were conducted for the species and concluded that the Balranald Project will not have a significant impact on any threatened flora.

Twenty species of threatened fauna were detected during field-survey. All of these species are listed under the TSC Act and three species are also listed under the EPBC Act. Twenty-six fauna species have the potential to be impacted by the Balranald Mineral Sands Project. All of the affected species are listed under the TSC Act while eight species are also listed under the EPBC Act.

Six threatened fauna species listed under the TSC Act could be or are likely to be significantly impacted such that a viable local population could be placed at risk of extinction. These species are: Grey-crowned Babbler; Malleefowl; Little Pied Bat; Jewelled Gecko; Mallee Worm-lizard and Western Blue-tongued Lizard.

The significant impact criteria under the EPBC Act, were addressed for each of the five affected threatened species listed under the EPBC Act, and highlighted that one threatened species (the Malleefowl) would be significantly impacted. No migratory species would be significantly impacted.

No critical habitat listed under the TSC Act or EPBC Act will be impacted by the Balranald Project.

Mitigation measures associated with indirect impacts have been proposed through the preparation and implementation of management plans.

A Biodiversity Offset Strategy for the overall Balranald Project has been included in this assessment and detailed investigation of a nominated offset site for the EPBC Act offset requirement detailed within an addendum to this report (Niche 2016). Further work on the Biodiversity Offset Package is currently being undertaken in consultation with Office of Environment and Heritage, Department of Environment and other relevant stakeholders to offset the disturbance to vegetation and threatened biodiversity habitat.

Through the implementation of avoidance measures, mitigation measures and the biodiversity offset strategy, biodiversity values in the surrounding region and the viability of threatened species and communities that are impacted by the Balranald Project will be maintained or improved over the medium to long term. The project has been granted consent by the NSW Department of Planning and it has been

concluded that “Overall, the Department and OEH are satisfied that the potential impacts on fauna species are able to be avoided, mitigated and/or at least offset such that the project would maintain or enhance biodiversity values in the area over the medium to long term” (DP&E 2016b).

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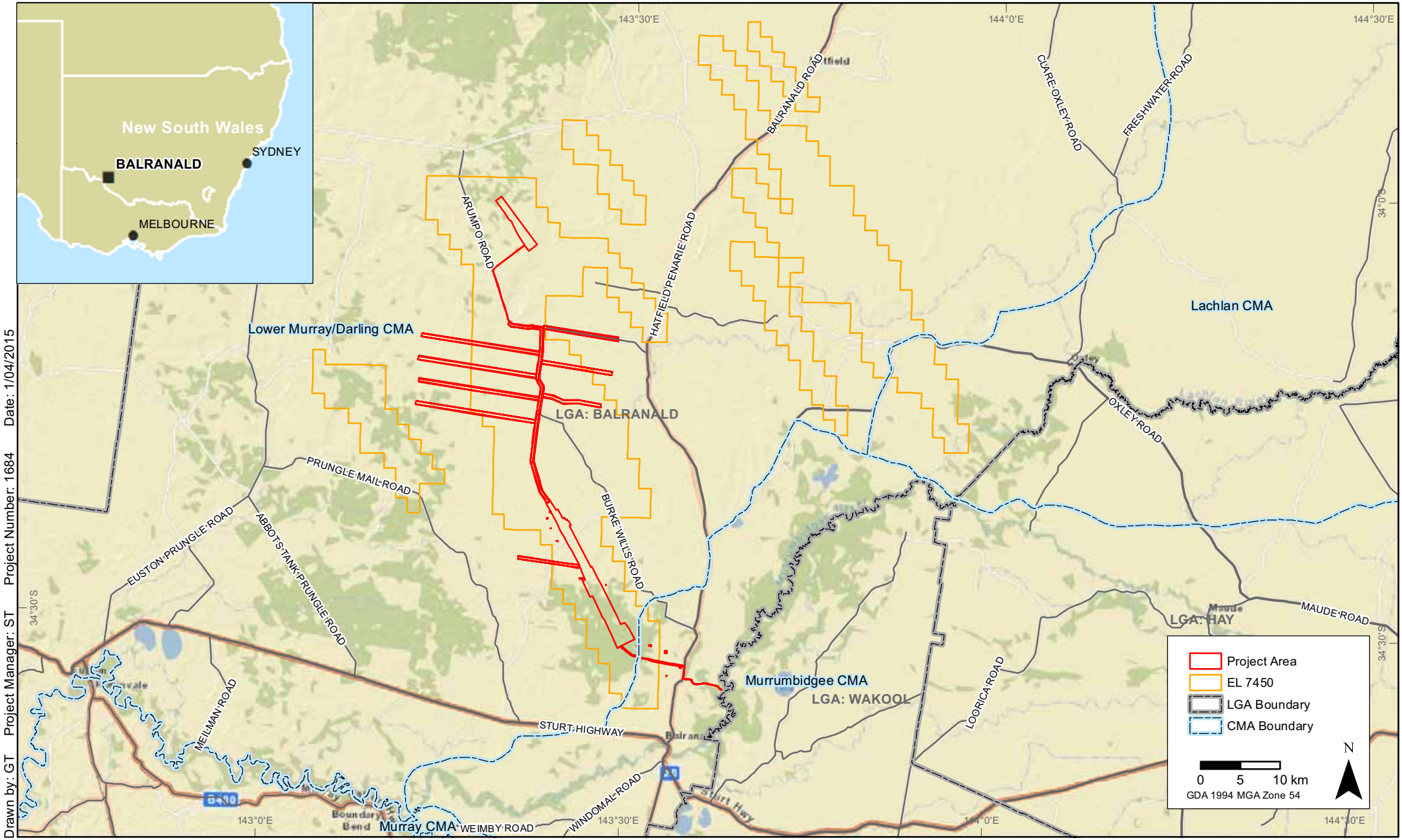
FIGURES



Locality of the Balranald Mineral Sands Project

Balranald Project - Biodiversity Assessment

FIGURE 1

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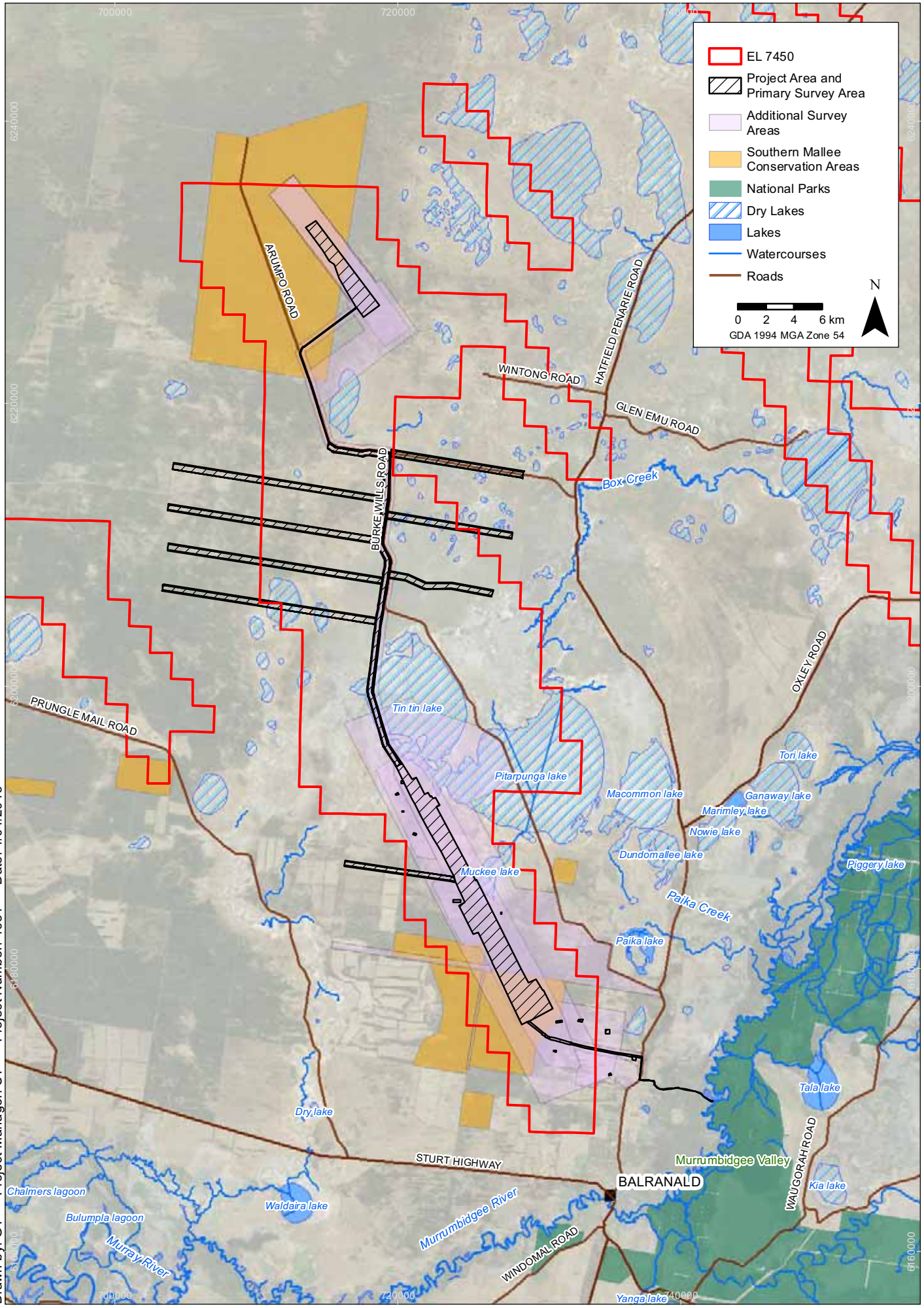

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Land Use and Ecological Study Area for the Balranald Project

Balranald Project - Biodiversity Assessment

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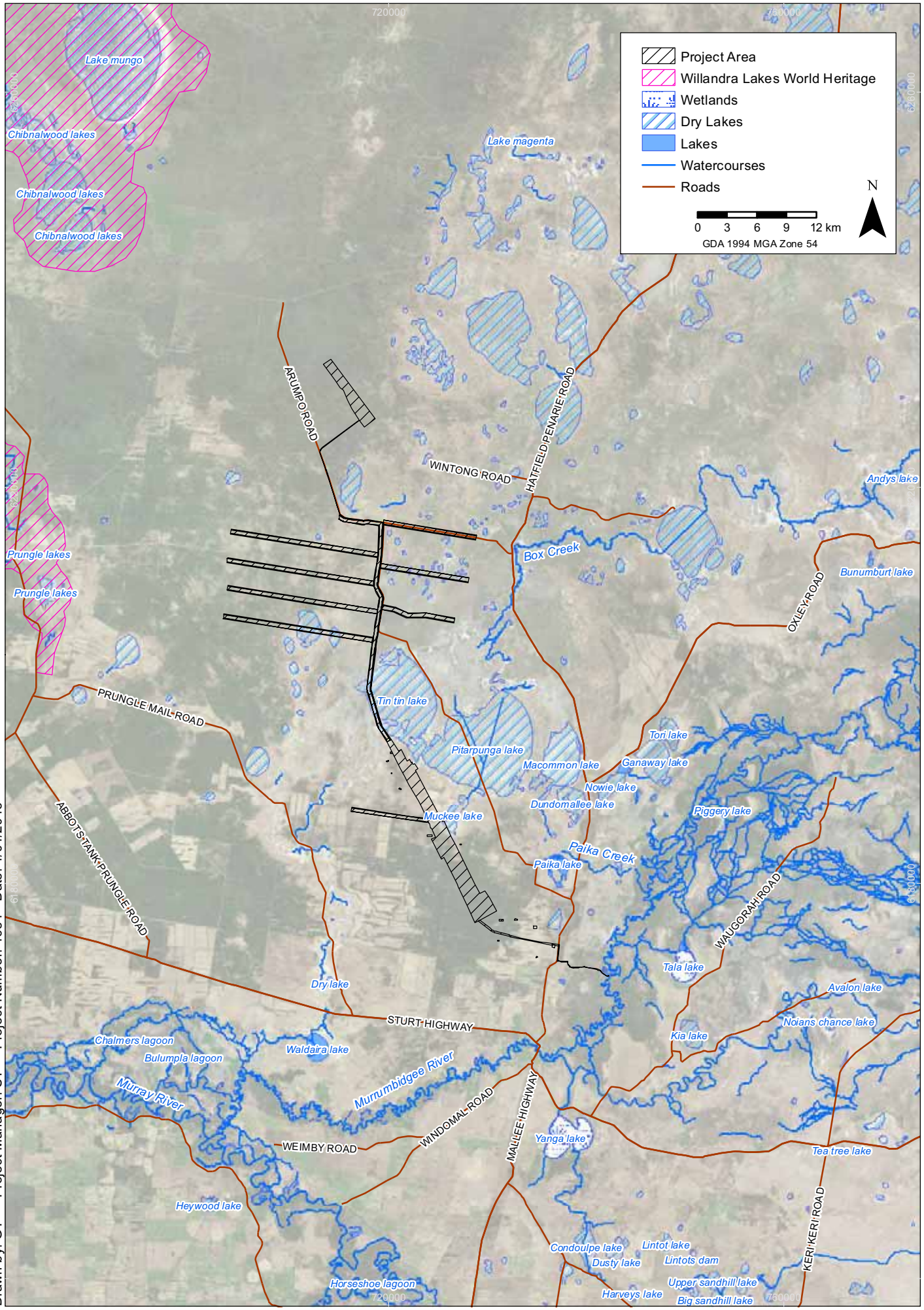
FIGURE 2

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_2_SiteMap2.mxd

Imagery: (c) Iluka Resources



Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

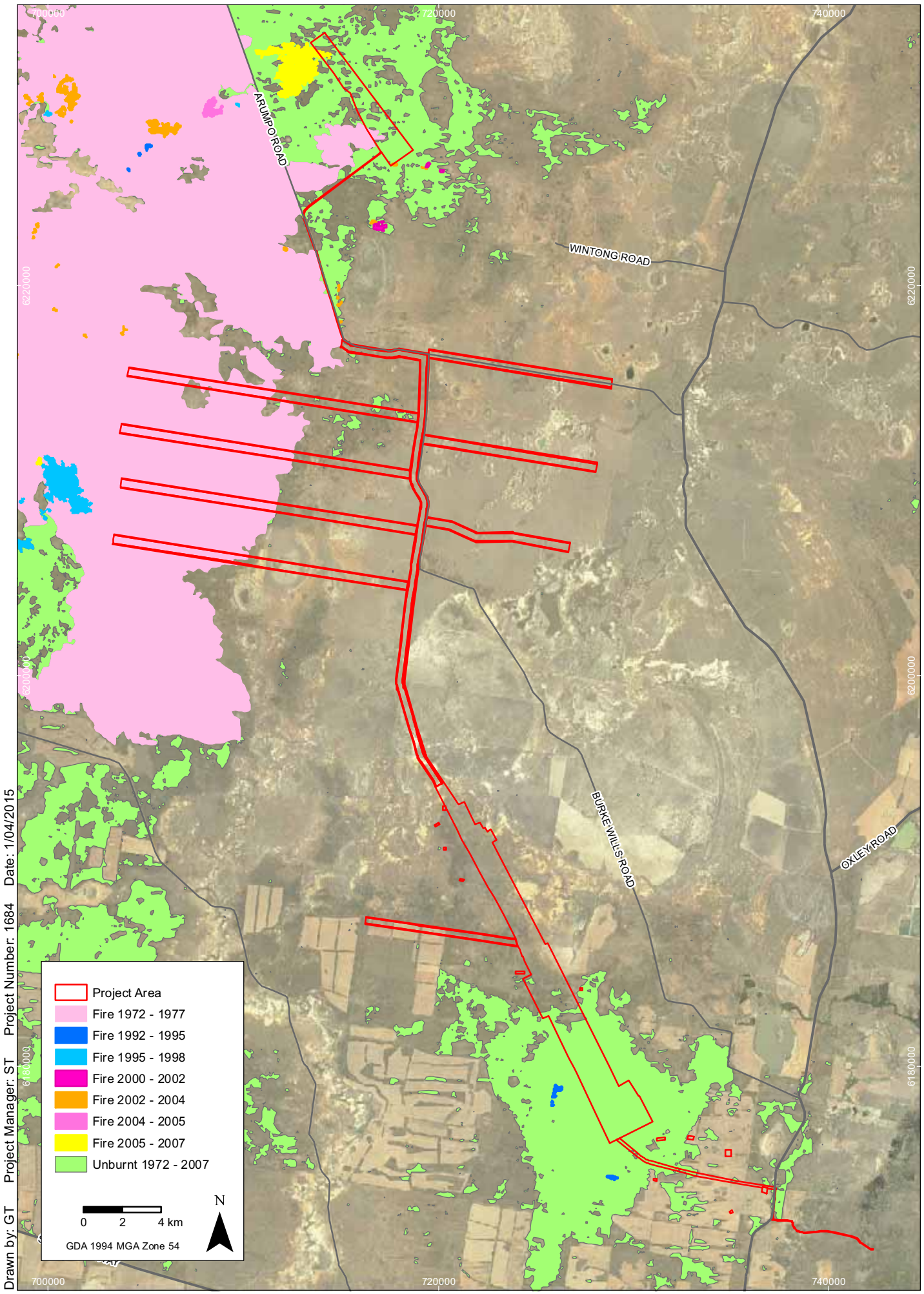
Watercourses within the Balranald Project Locality

Balranald Project - Biodiversity Assessment

FIGURE 3

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_3_Hydro.mxd



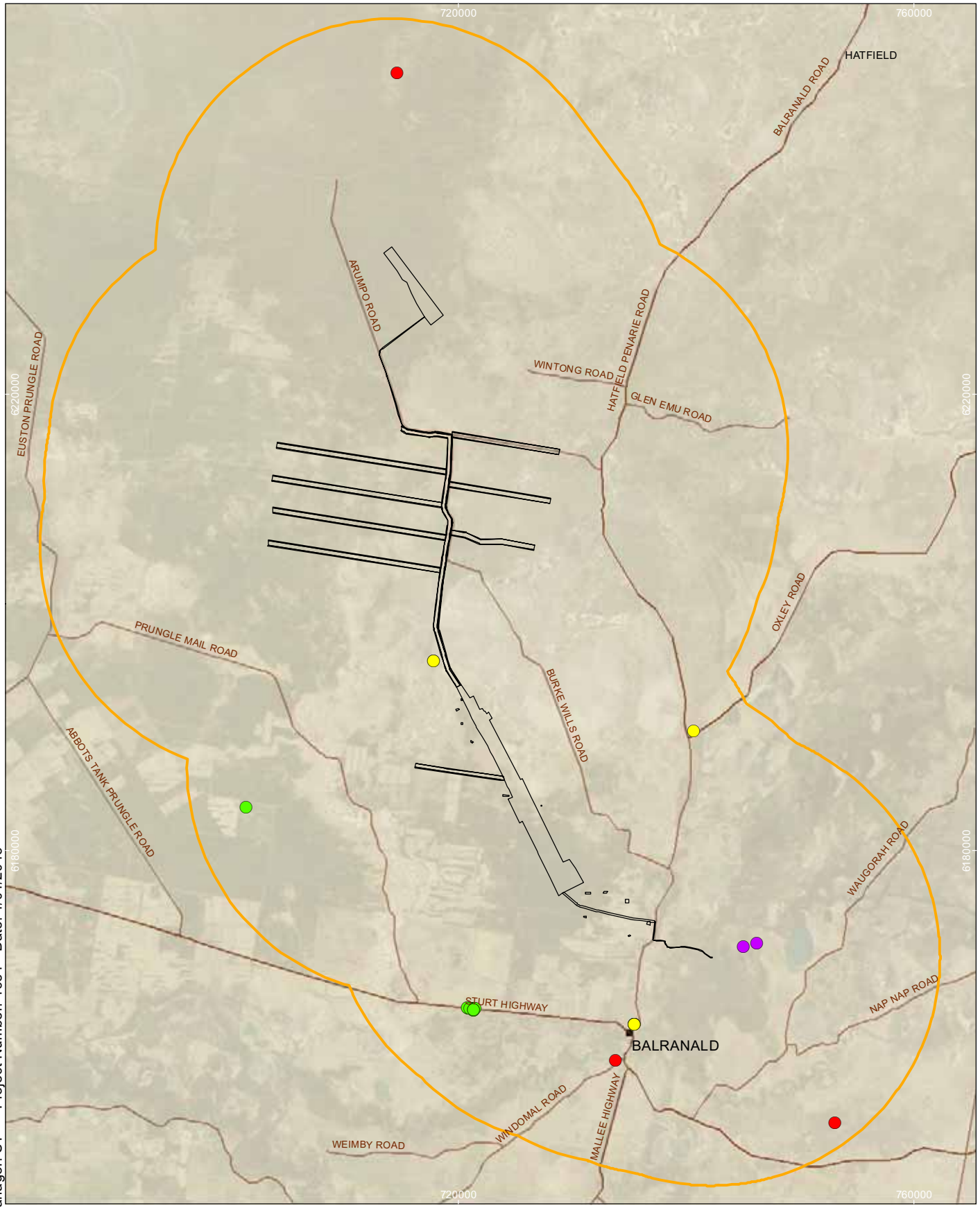
Balranald Fire History

Balranald Project - Biodiversity Assessment

FIGURE 4

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_4_ FireHistory.mxd



Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

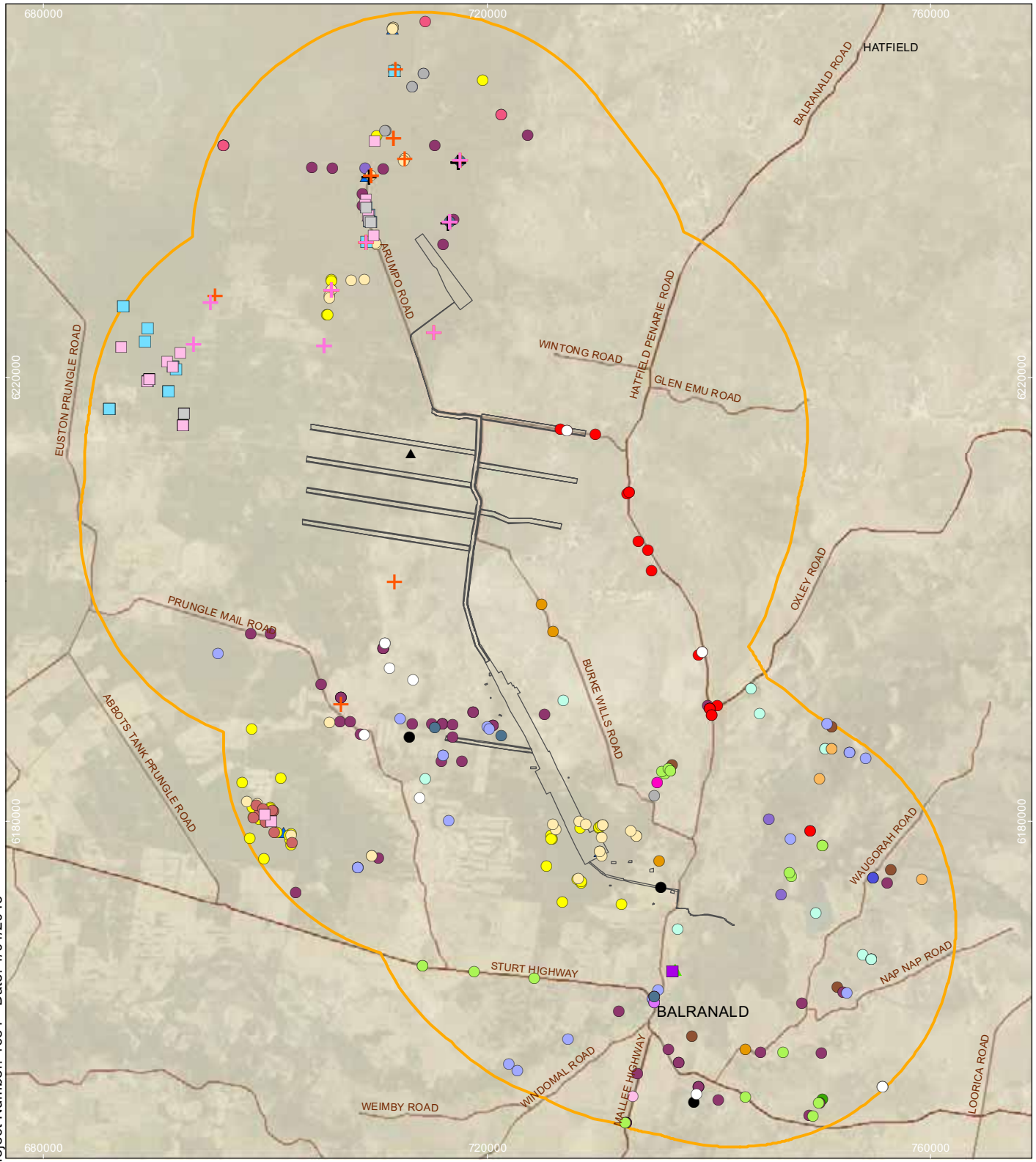
Threatened Flora Previously Recorded within 20 km of the Balranald Project Area (NSW Wildlife Atlas Records)

Balranald Project - Biodiversity Assessment

FIGURE 5

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_5_ThreatFlora.mxd



Project Number: 1684 Date: 1/04/2015

Project Manager: ST

Drawn by: GT

Project Area
20 km search area

Threatened Fauna

- Australasian Bittern
- Australian Painted Snipe
- Bardick
- Black Falcon
- Blue-billed Duck
- Bolam's Mouse
- Brown Treecreeper (eastern subspecies)
- Bush Stone-curlew
- Chestnut Quail-thrush
- Corben's Long-eared Bat
- Freckled Duck
- Gilbert's Whistler
- Grey-crowned Babbler (eastern subspecies)
- Hooded Robin (south-eastern form)
- Inland Forest Bat
- Jewelled Gecko
- Little Eagle
- Little Pied Bat
- Major Mitchell's Cockatoo
- Mallee Worm-lizard
- Malleefowl
- Painted Honeyeater
- Pied Honeyeater
- Purple-gaped Honeyeater
- Redthroat
- Regent Parrot (eastern subspecies)
- Southern Bell Frog
- Southern Ningaui
- Spotted Harrier
- Spotted-tailed Quoll
- Varied Sittella
- Western Pygmy Possum
- White-fronted Chat

N

0 5 10 km

GDA 1994 MGA Zone 54

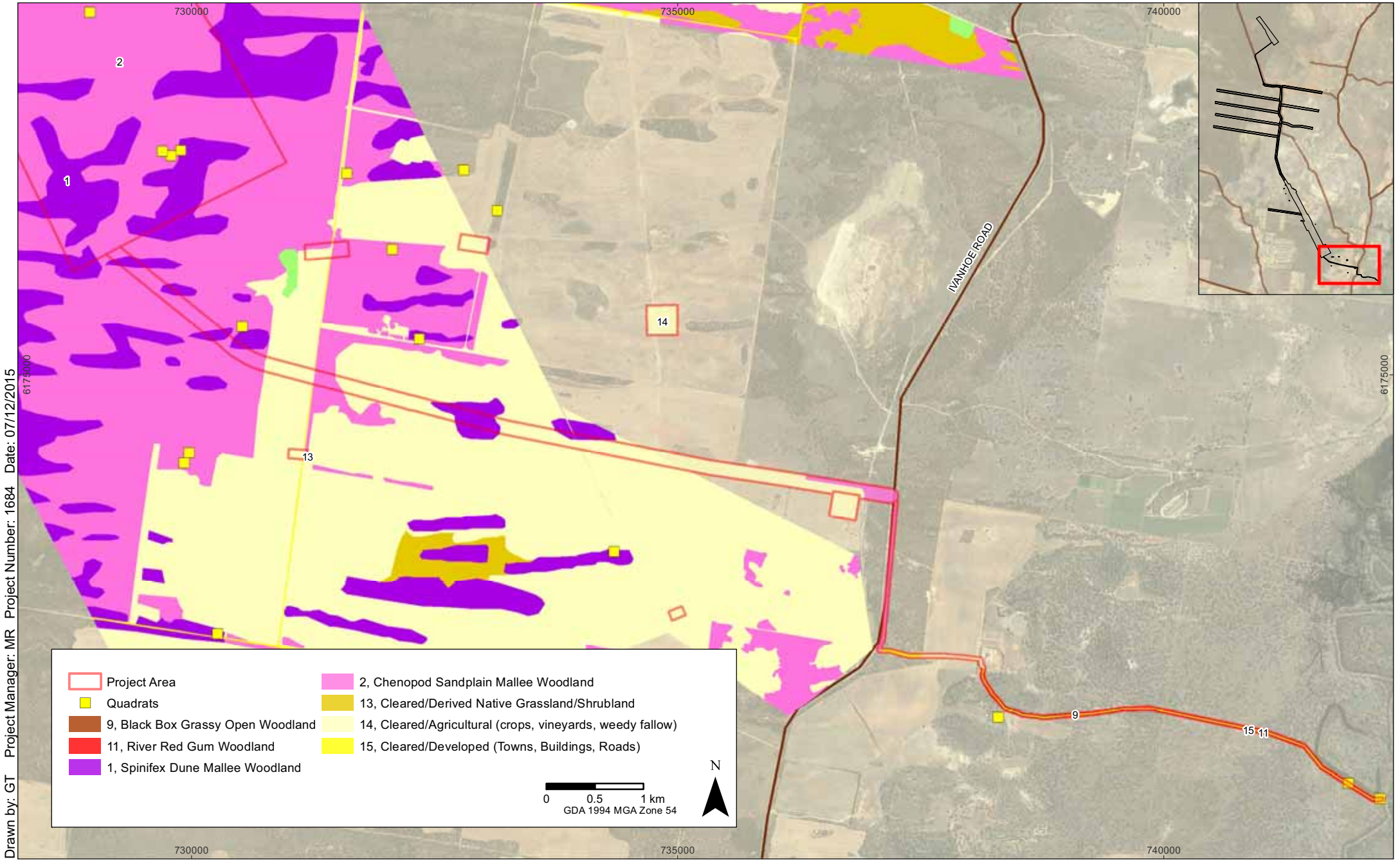
Threatened Fauna Previously Recorded within 20 km of the Balranald Project Area (NSW Wildlife Atlas Records)

Balranald Project - Biodiversity Assessment

FIGURE 6

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_6_ThreatFauna.mxd



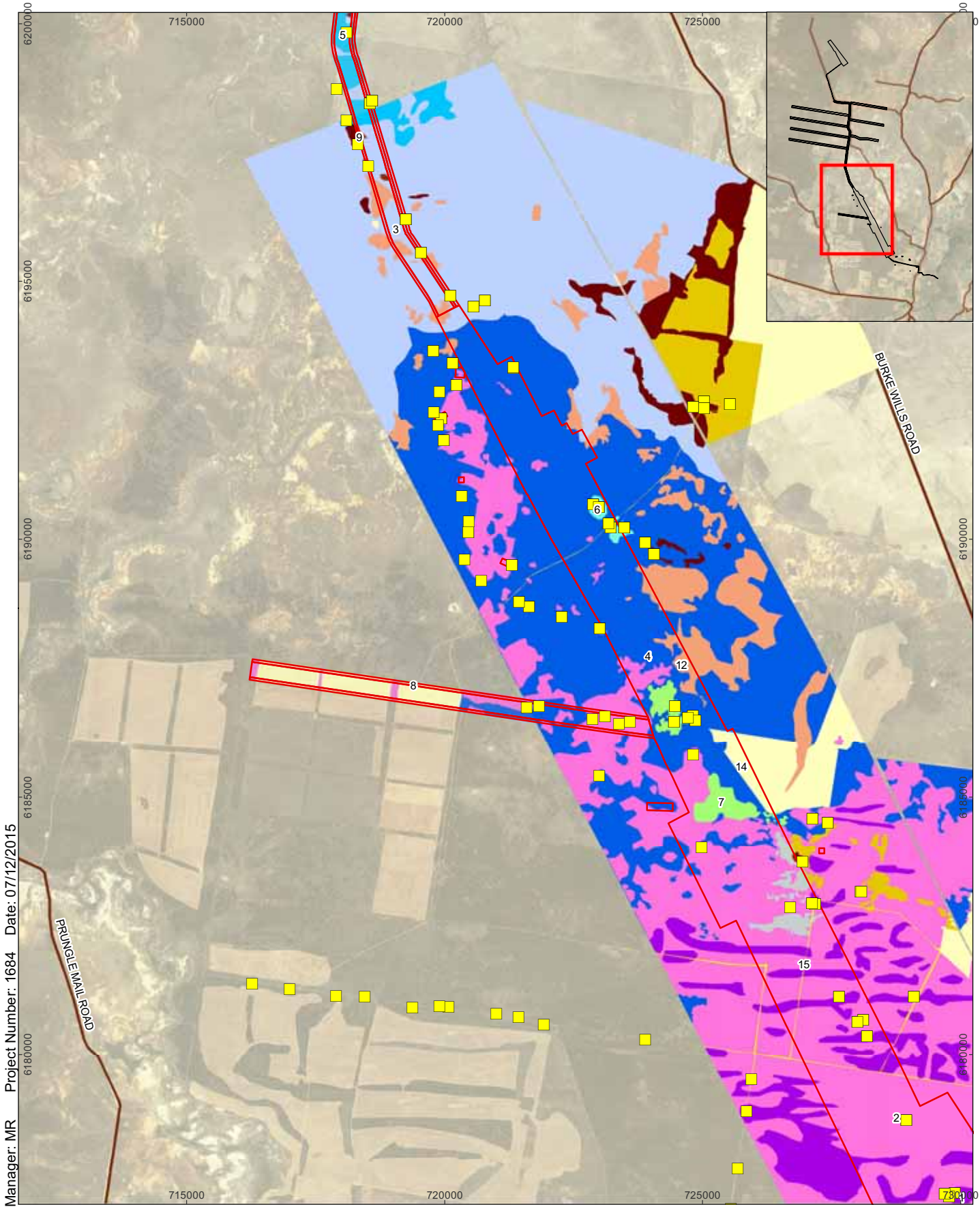
Vegetation community deliniation and Biometric plot locations for the Balranald Project (water supply pipeline area)

Balranald Project - Biodiversity Assessment

FIGURE 7a

Path: T:\SpatialWorking\st\1684 Balranald\1684_Figure_7a_Vegetation.mxd

Imagery: (c) Iluka Resources



Drawn by: GT Project Manager: MR Project Number: 1684 Date: 07/12/2015

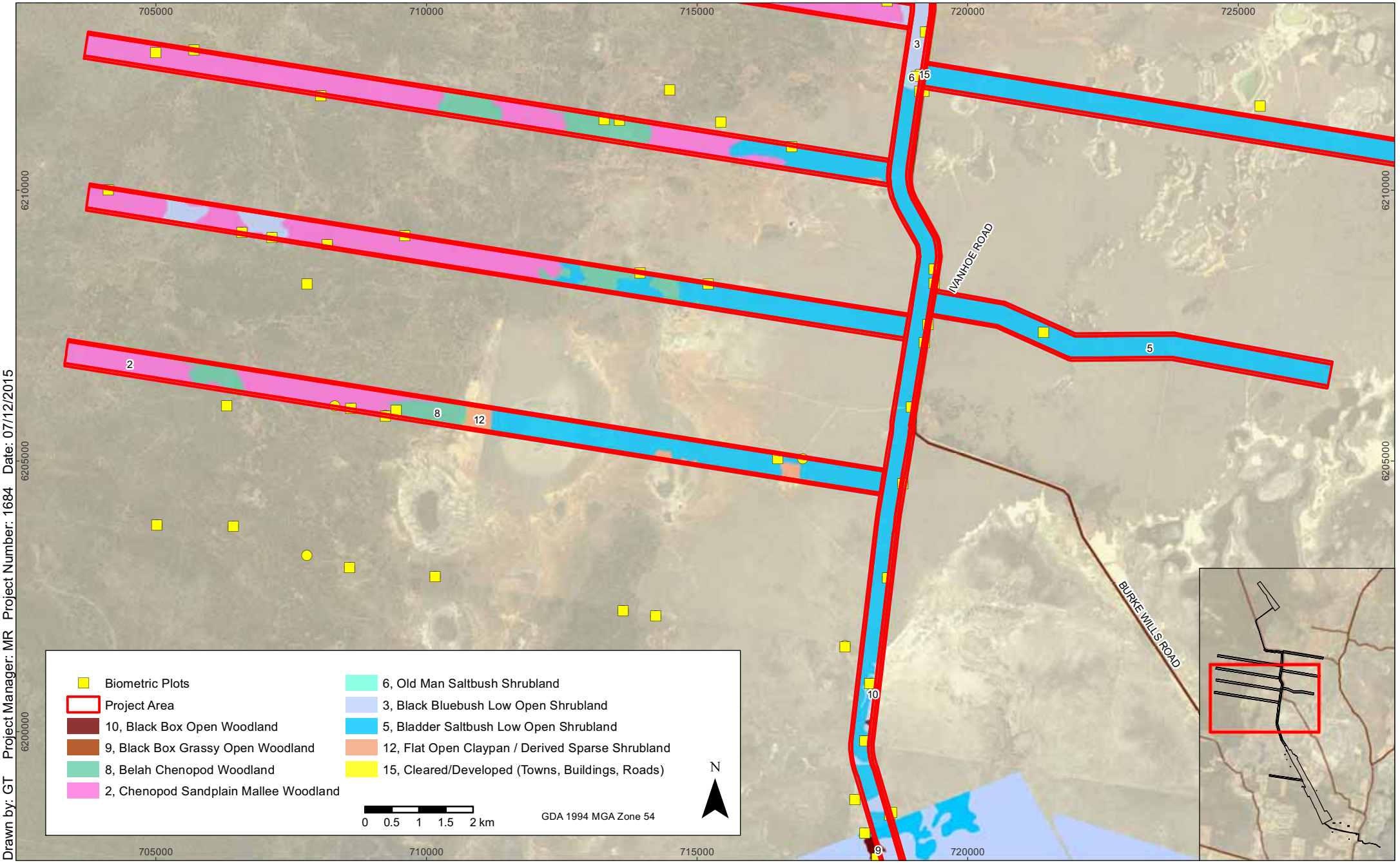
Vegetation community deliniation and Biometric plot locations for the Balranald Project (West Balranald area)

Balranald Project - Biodiversity Assessment

FIGURE 7b

Path: T:\SpatialWorking\st\1684 Balranald\1684_Figure_7e_Vegetation.mxd

Imagery: (c) Iluka Resources



Drawn by: GT Project Manager: MR Project Number: 1684 Date: 07/12/2015

Vegetation community deliniation and Biometric plot locations for the Balranald Project (Nepean access road and injection borefields)

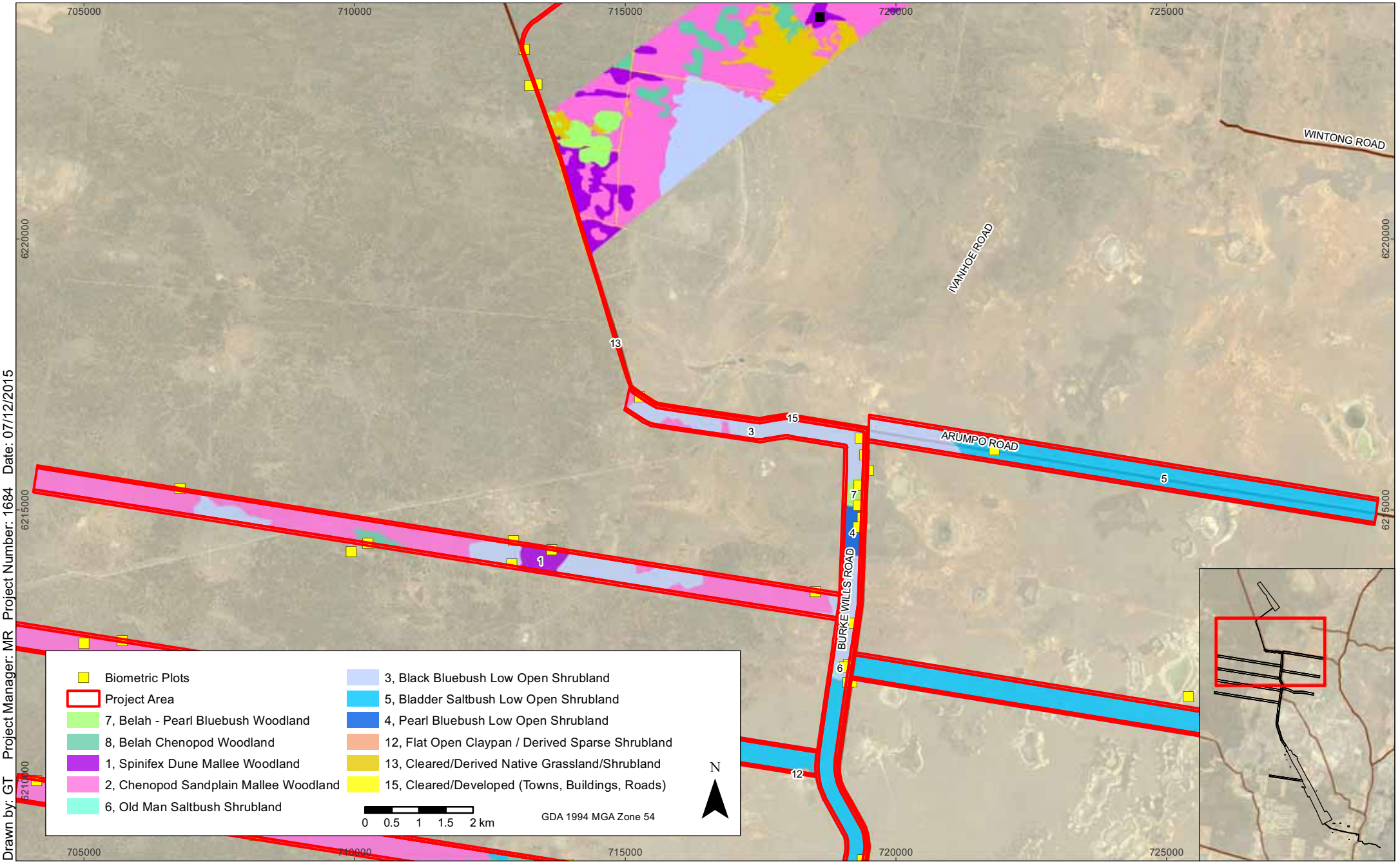
Balranald Project - Biodiversity Assessment

FIGURE 7c

niche Environment and Heritage

Path: T:\SpatialWorking\st\1684 Balranald\1684_Figure_7a_Vegetation.mxd

Imagery: (c) Iluka Resources



Drawn by: GT Project Manager: MR Project Number: 1684 Date: 07/12/2015

Vegetation community deliniation and Biometric plot locations for the Balranald Project (Nepean access road and injection borefields)

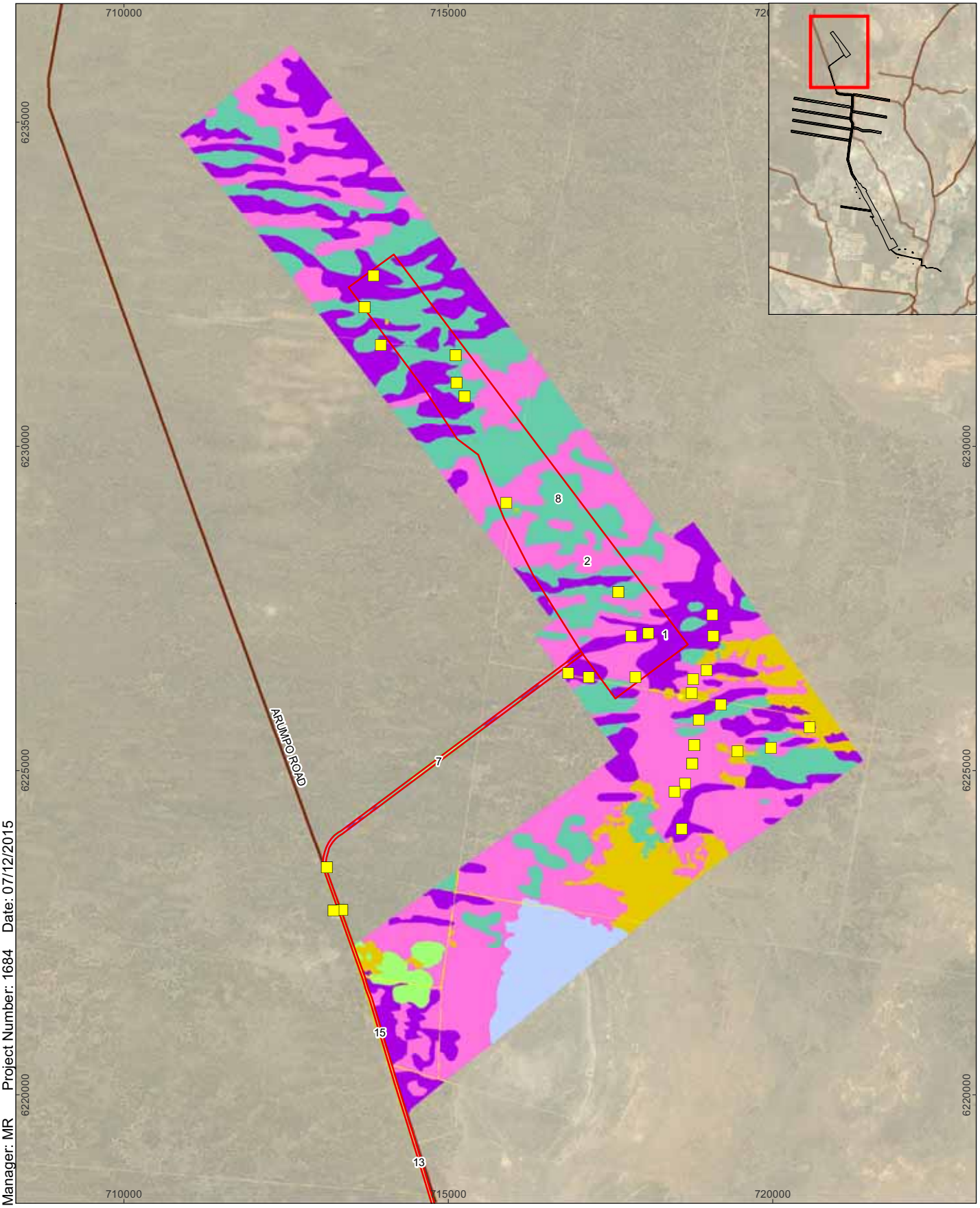
Balranald Project - Biodiversity Assessment

FIGURE 7d

niche Environment and Heritage

Path: T:\SpatialWorking\st\1684 Balranald\1684_Figure_7a_Vegetation.mxd

Imagery: (c) Iluka Resources



Project Manager: MR Project Number: 1684 Date: 07/12/2015

Drawn by: GT

Project Area
Biometric Plots
7, Belah - Pearl Bluebush Woodland
8, Belah Chenopod Woodland
1, Spinifex Dune Mallee Woodland
2, Chenopod Sandplain Mallee Woodland
13, Cleared/Derived Native Grassland/Shrubland
15, Cleared/Developed (Towns, Buildings, Roads)

N

0 0.5 1 1.5 2 2.5 km

GDA 1994 MGA Zone 54

Vegetation community deliniation and Biometric plot locations for the Balranald Project (Nepean mine area)

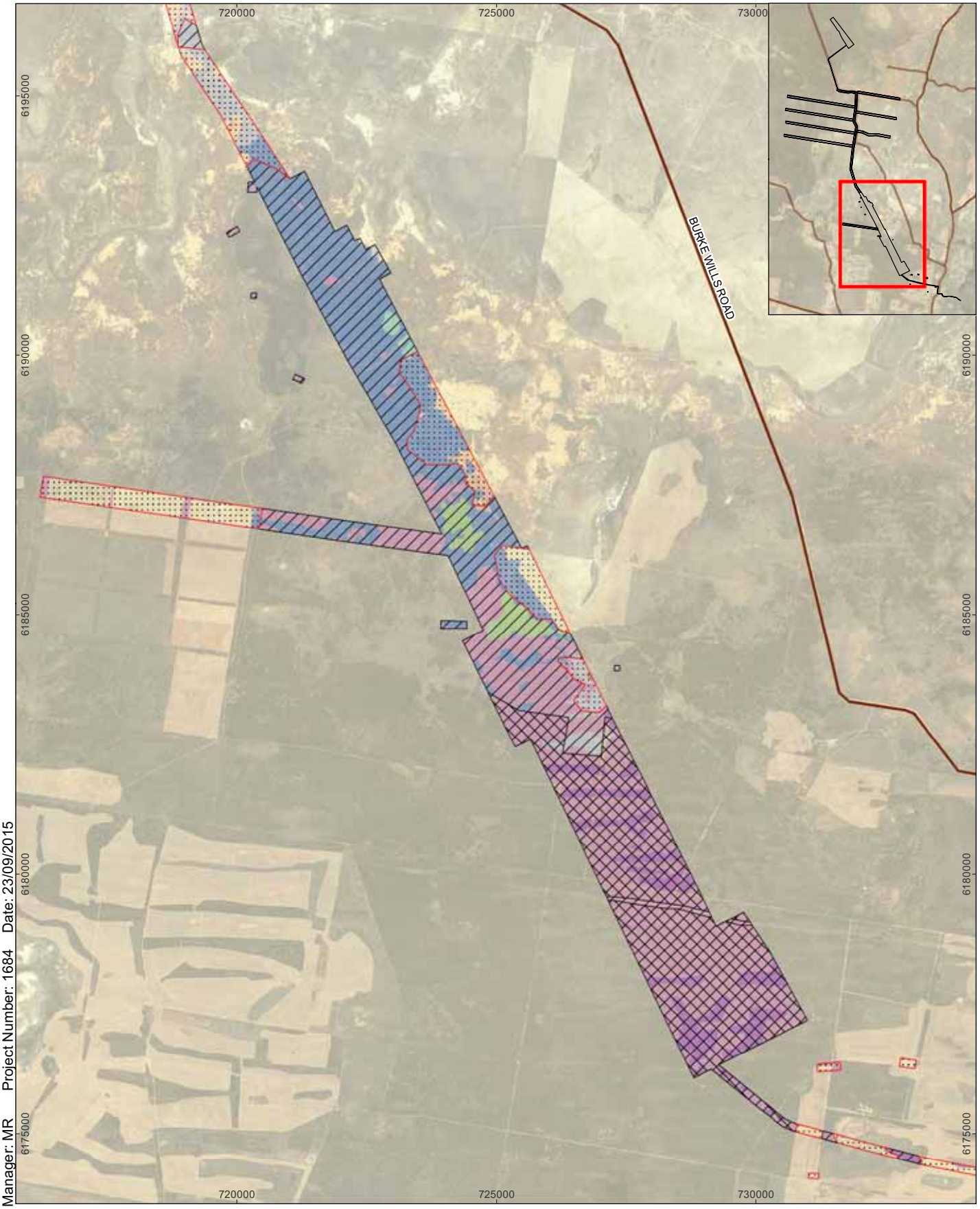
Balranald Project - Biodiversity Assessment

niche Environment and Heritage

FIGURE 7e

Path: T:\SpatialWorking\st\1684 Balranald\1684_Figure_7e_Vegetation.mxd

Imagery: (c) Iluka Resources



Drawn by: GT Project Manager: MR Project Number: 1684 Date: 23/09/2015

Vegetation Condition

- Good
- Moderate
- Poor

Vegetation Communities

- 9, Black Box Grassy Open Woodland
- 7, Belah - Pearl Bluebush Woodland
- 8, Belah Chenopod Woodland
- 1, Spinifex Dune Mallee Woodland
- 2, Chenopod Sandplain Mallee Woodland
- 6, Old Man Saltbush Shrubland
- 3, Black Bluebush Low Open Shrubland
- 4, Pearl Bluebush Low Open Shrubland
- 12, Flat Open Claypan / Derived Sparse Shrubland
- 13, Cleared/Derived Native Grassland/Shrubland
- 14, Cleared/Agricultural (crops, vineyards, weedy fallow)
- 15, Cleared/Developed (Towns, Buildings, Roads)

N

GDA 1994 MGA Zone 54

0 2.5 km

Vegetation communities and condition for the Balranald Project (north)

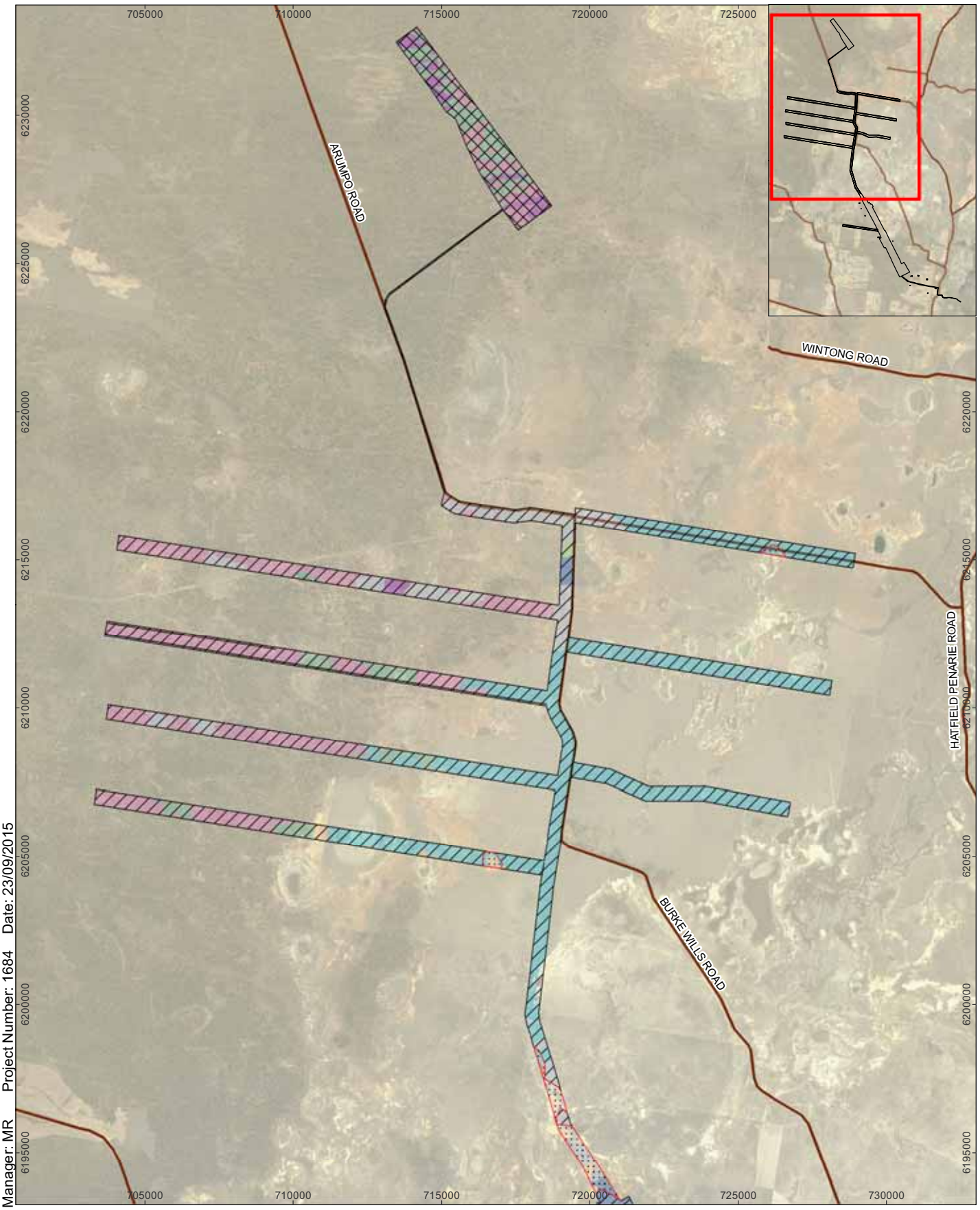
Balranald Project - Biodiversity Assessment

niche Environment and Heritage

FIGURE 8a

Path: T:\SpatialWorking\st\2589 Balranald\Maps\Condition Mapping_maps.mxd

Imagery: (c) Iluka Resources



Project Manager: MR Project Number: 1684 Date: 23/09/2015

Drawn by: GT

Vegetation Condition

- Good
- Moderate
- Poor

Vegetation Communities

- 10, Black Box Open Woodland
- 9, Black Box Grassy Open Woodland
- 7, Belah - Pearl Bluebush Woodland
- 8, Belah Chenopod Woodland
- 1, Spinifex Dune Mallee Woodland
- 2, Chenopod Sandplain Mallee Woodland
- 6, Old Man Saltbush Shrubland
- 3, Black Bluebush Low Open Shrubland
- 5, Bladder Saltbush Low Open Shrubland
- 4, Pearl Bluebush Low Open Shrubland
- 12, Flat Open Claypan / Derived Sparse Shrubland
- 13, Cleared/Derived Native Grassland/Shrubland
- 15, Cleared/Developed (Towns, Buildings, Roads)

N

GDA 1994 MGA Zone 54

0 2.5 5 km

Vegetation communities and condition for the Balranald Project (north)

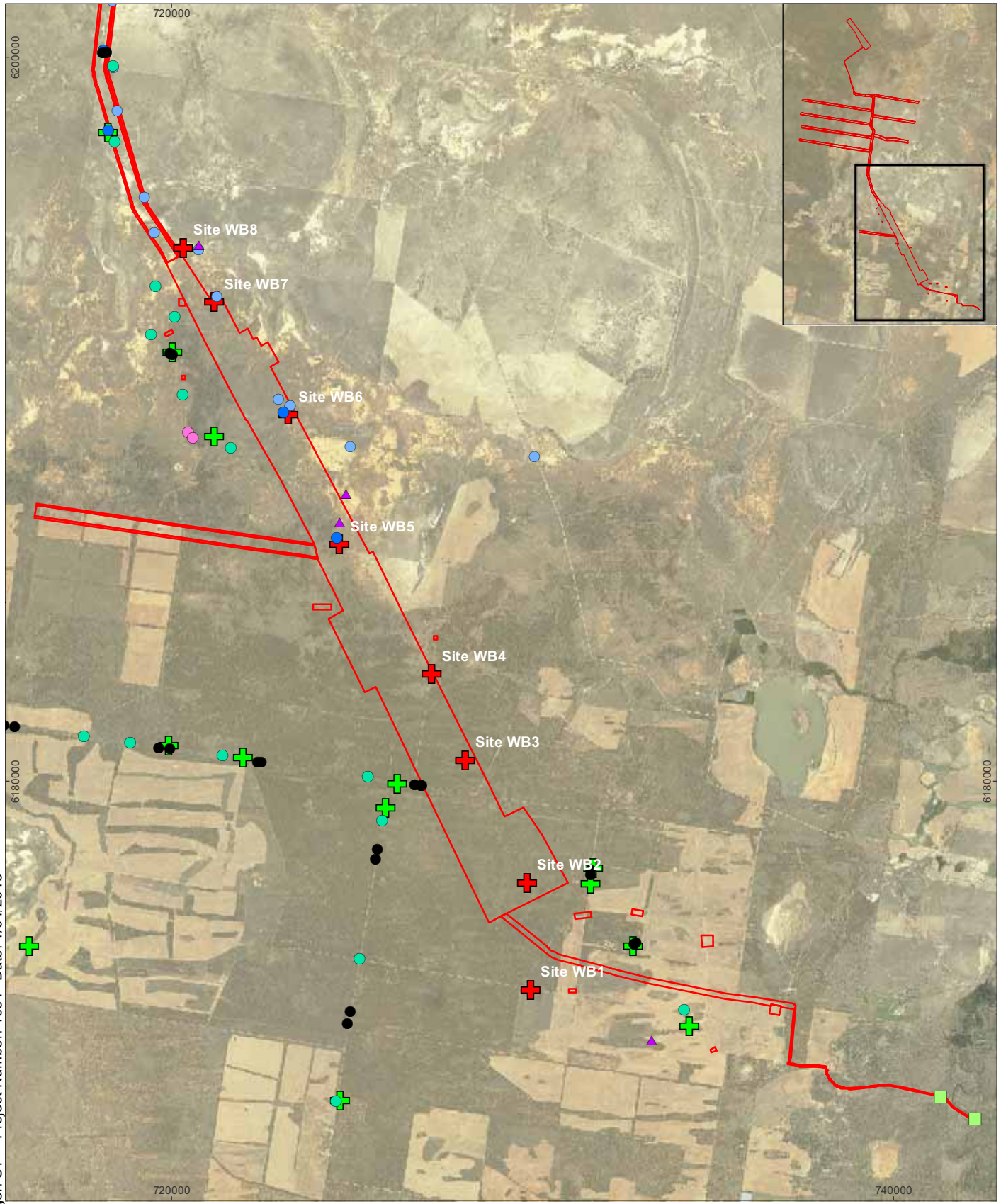
Balranald Project - Biodiversity Assessment

FIGURE 8b

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\Condition Mapping_maps.mxd

Imagery: (c) Iluka Resources



Project Area

Primary fauna survey sites

- Primary Fauna Survey Site (Ecotone)
- Primary Fauna Survey Site (Niche)

Additional fauna survey sites

- Bat Recorder
- Bird Survey
- Diurnal Bird Call Playback
- Harp Trap
- Frog Survey
- Harp Traps, Bat Recorders and Bird Survey
- Nocturnal Bird Call Playback

0 1 2 3 km

GDA 1994 MGA Zone 54

N

Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

Fauna Survey Methods (West Balranald)

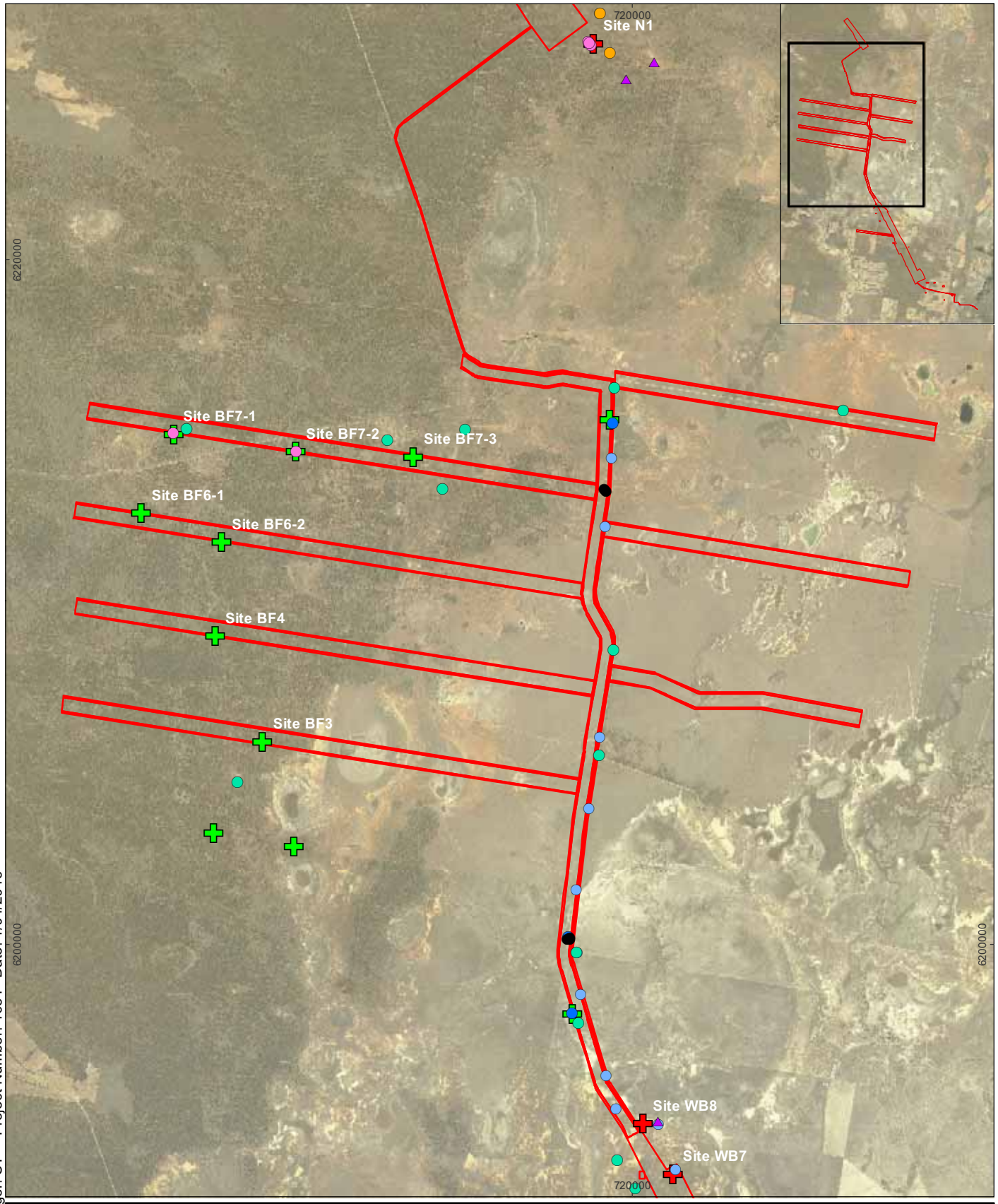
Balranald Project - Biodiversity Assessment

FIGURE 9a

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_8a_CombinedFaunaSurvey.mxd

Imagery: (c) Iluka Resources



Project Area

Primary fauna survey sites

- Primary Fauna Survey Site (Ecotone)
- Primary Fauna Survey Site (Niche)

Additional fauna survey sites

- Bat Recorder
- Bird Survey
- Diurnal Bird Call Playback
- Diurnal Targeted Reptile Searches
- Harp Trap
- Harp Traps, Bat Recorders and Bird Survey
- Nocturnal Bird Call Playback

N

0 1 2 3 4 km

GDA 1994 MGA Zone 54

Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

Fauna Survey Methods (Haul roads and injection borefields)

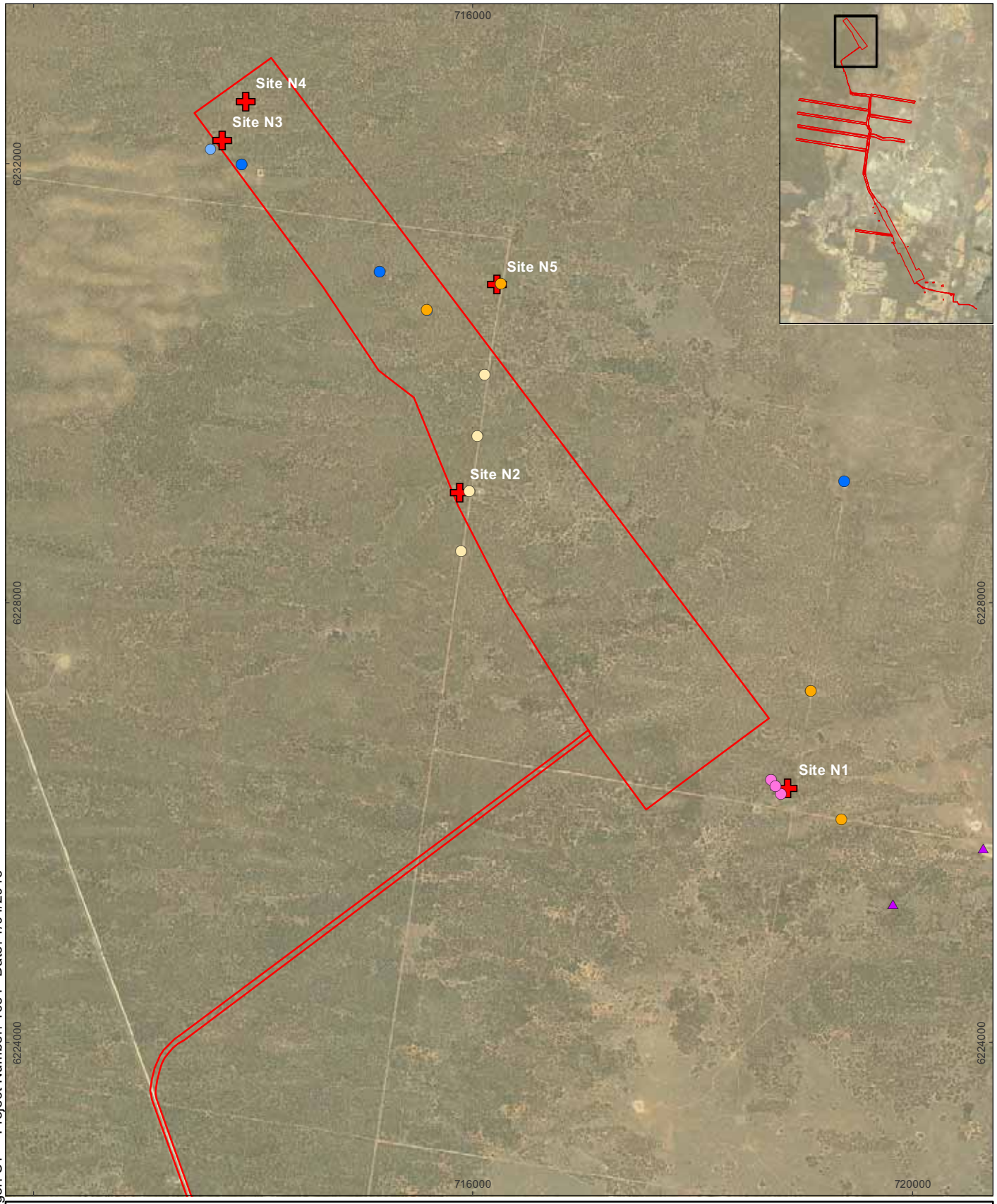
Balranald Project - Biodiversity Assessment

FIGURE 9b

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_8b_CombinedFaunaSurvey.mxd

Imagery: (c) Iluka Resources



Project Area

Primary fauna survey sites

Primary Fauna Survey Site (Ecotone)

Additional fauna survey sites

Bat Recorder

Diurnal Bird Call Playback

Diurnal Targeted Reptile Searches

Harp Trap

Nocturnal Bird Call Playback

Sand Pad

N

0 0.5 1 km

GDA 1994 MGA Zone 54

Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

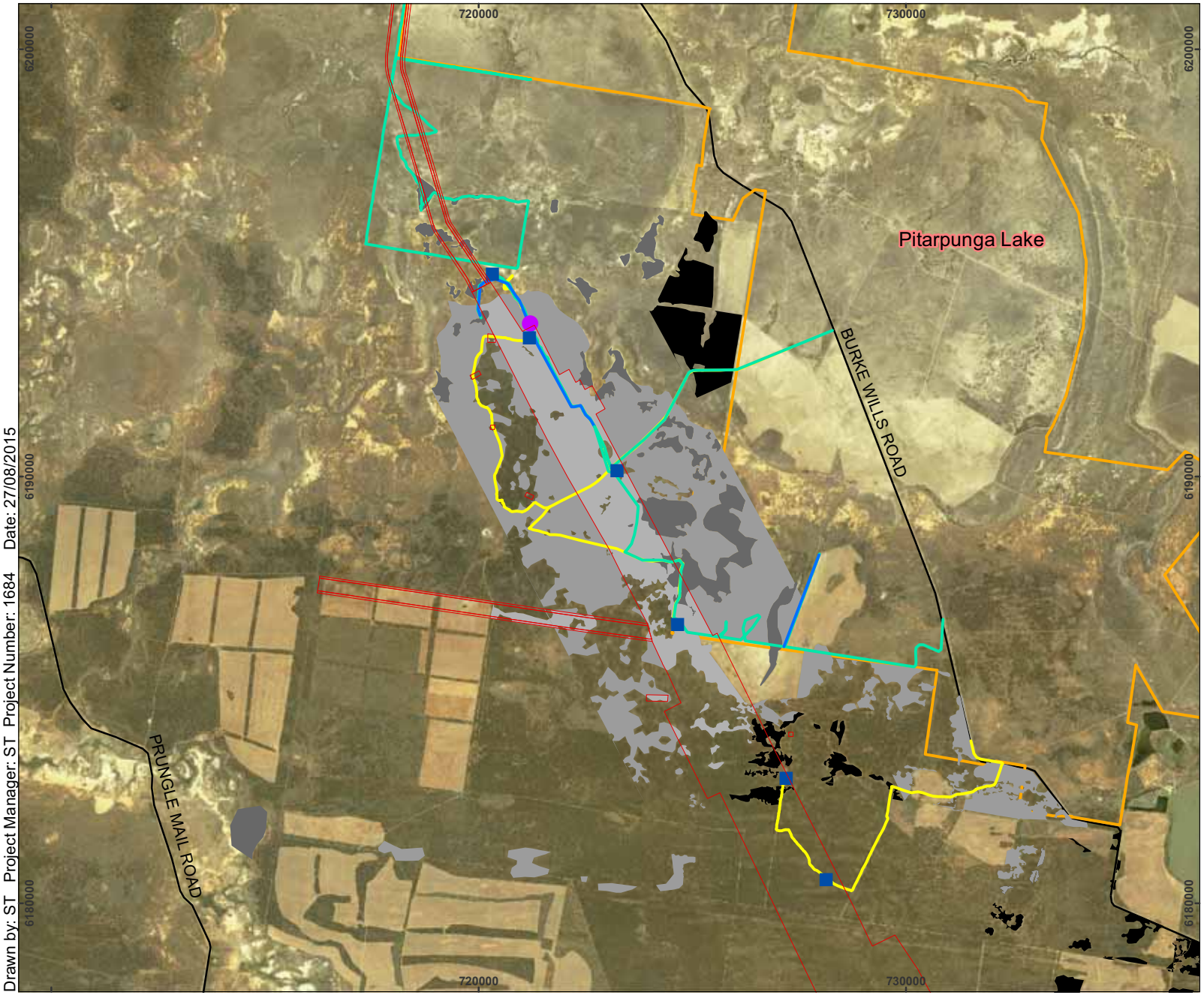
Fauna Survey Methods (Nepean)

Balranald Project - Biodiversity Assessment

FIGURE 9c

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_8c_CombinedFaunaSurvey.mxd

Imagery: (c) Iluka Resources



Drawn by: ST Project Manager: ST Project Number: 1684 Date: 27/08/2015

Roads
- Minor Road

MNES Species Plains Wanderer

Records
- Plains Wanderer?

Survey Methods
- Nocturnal Driven Spotlight Search
- Plains Wanderer Transects
- Plains Wanderer Transects
- Primary Fauna Survey Site_Ecote

Vegetation Type
- Flat Open Claypan / Derived Sparse Shrubland
- Pearl Bluebush Low Open S'land (marginal)

Vegetation Type
- Cleared/Derived Native Grassland/Shrubland
- Flat Open Claypan / Derived Sparse Shrubland
- Pearl Bluebush Low Open S'land (marginal)
- Project Area
- Tin Tin Property

N

0 2 4 km

GDA 1994 MGA Zone 54

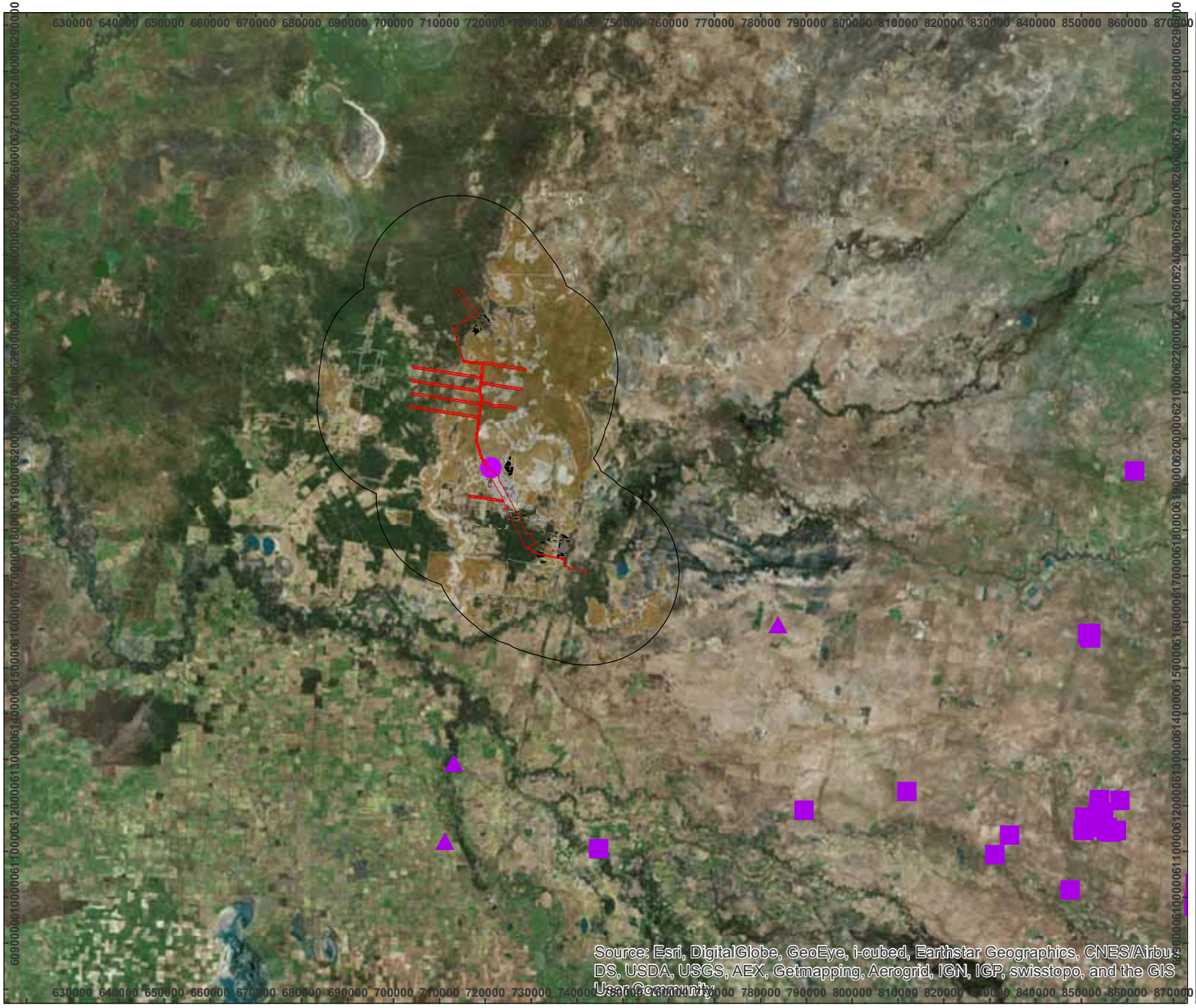
Plains Wanderer Records, Survey Effort and Preferred Habitat Types within the Balranald Mine Project Area

Balranald Mineral Sands Project

FIGURE 10a

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\MNES Threatened Spp updates_PW_Project_Areav2.mxd



Field Survey Records Records
(Balranald Project Field Surveys)
Plains Wanderer?

Wildlife Atlas Pre 1980
Plains-wanderer

Wildlife Atlas Records (post 1980 - present)
Plains-wanderer

Preferred Habitat Types (Plains Wanderer)

Vegetation Type
Cleared/Derived Native Grassland/Shrubland
Flat Open Claypan / Derived Sparse Shrubland
Pearl Bluebush Low Open Shrubland

Vegetation Type
Cleared/Derived Native Grassland/Shrubland
Flat Open Claypan / Derived Sparse Shrubland
Pearl Bluebush Low Open Shrubland

Possible habitat outside survey areas
Potential
Project Area

N

0 25 50 km

GDA 1994 MGA Zone 54

Drawn by: ST Project Manager: ST Project Number: 1684 Date: 27/08/2015

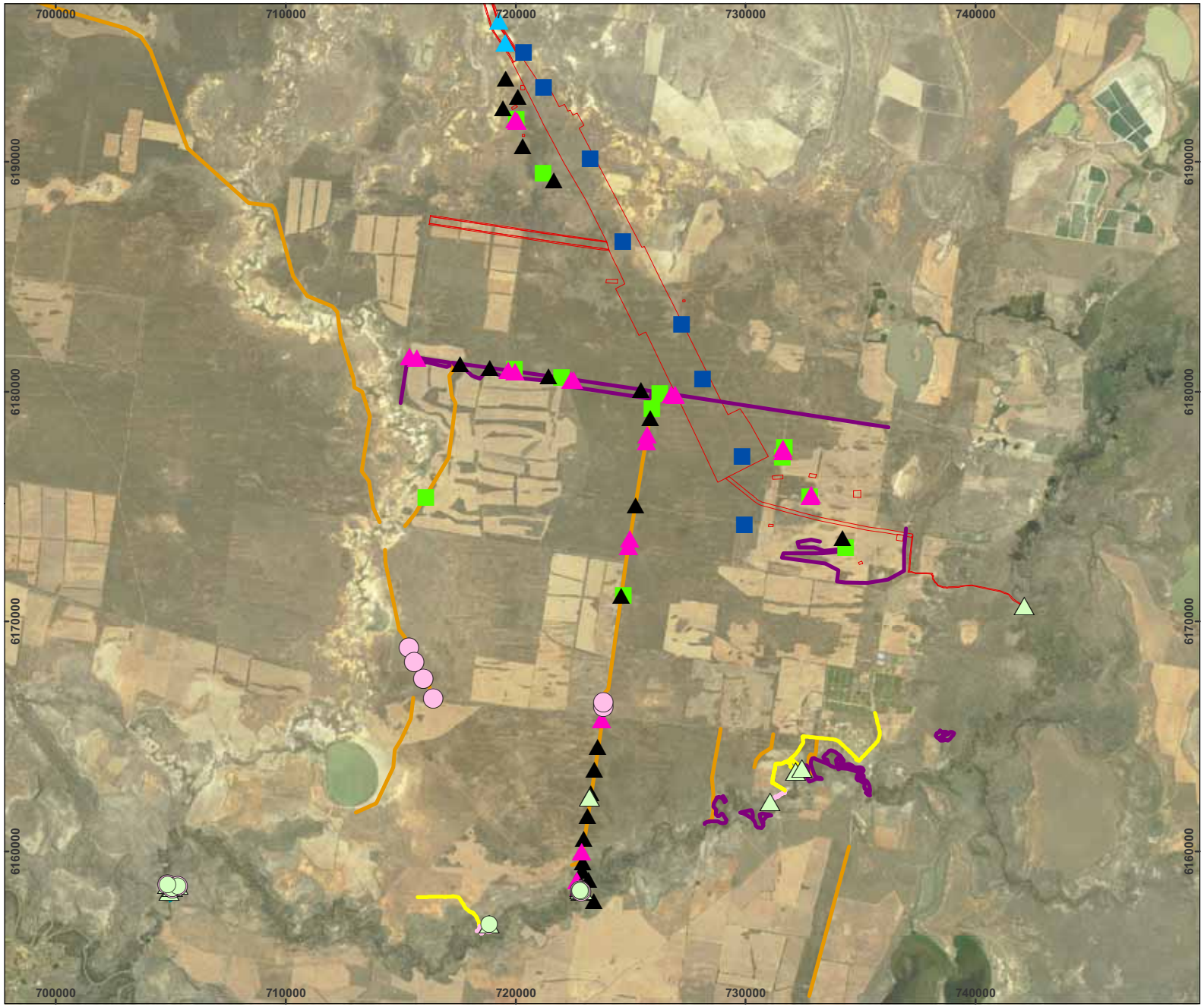
Plains Wanderer Records within the Balranald Mine Project Region

Balranald Mineral Sands Project

FIGURE 10b

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\MNES Threatened Spp updates_PW_Project_Area.mxd



Regent Parrot Records Sept-Oct 2014
- Regent Parrot

Regent Parrot Records Nov-Dec 2013
- Regent Parrot

Regent Parrot Survey Sept-Oct 2014
- Regent Parrot Extended Point Survey

Bat and Bird Survey Nov/Dec 2013
- Bird Survey
- Bird Survey (including call playback)
- Harp Traps, Bat Recorders and Bird Survey

Transect Survey Sept/Oct 2014
- <all other values>
- Driven Transect
- Walked Transect
- Regent Parrot Walked Transects Nov-Dec 2013
- Regent Parrot Driven Surveys Nov/Dec 2013
- Primary Fauna Survey Site Niche
- Primary Fauna Survey Site Ecotone
- Project Area

0 2 4 6 8 10 km

GDA 1994 MGA Zone 54

N

Drawn by: ST Project Manager: ST Project Number: 1684 Date: 25/09/2015

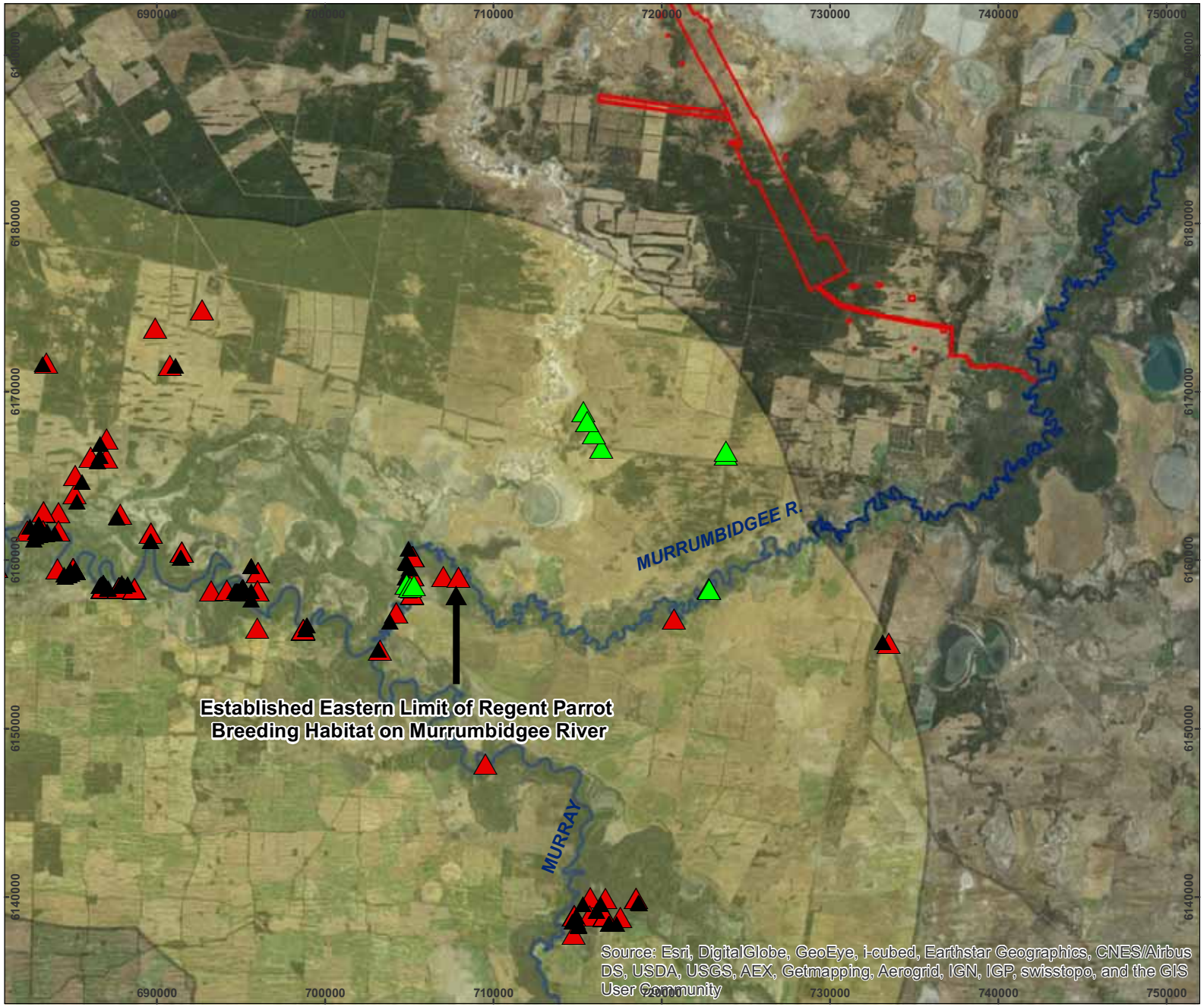
Regent Parrot Survey Methods/Effort and Records

Balranald Mineral Sands Project

FIGURE 10c

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\Regent Parrot Methods.mxd



Regent Parrot Field Survey Records (Niche)

Regent Parrot

Wildlife Atlas Records (post 1980 - present)

Regent Parrot (eastern subspecies)

Wildlife Atlas Pre 1980

Regent Parrot (eastern subspecies)

Breeding habitat 20km buffer (Preferred Habitat)

Project Area

0 5 10 km

GDA 1994 MGA Zone 54

N

Drawn by: ST Project Manager: ST Project Number: 1684 Date: 02/12/2015

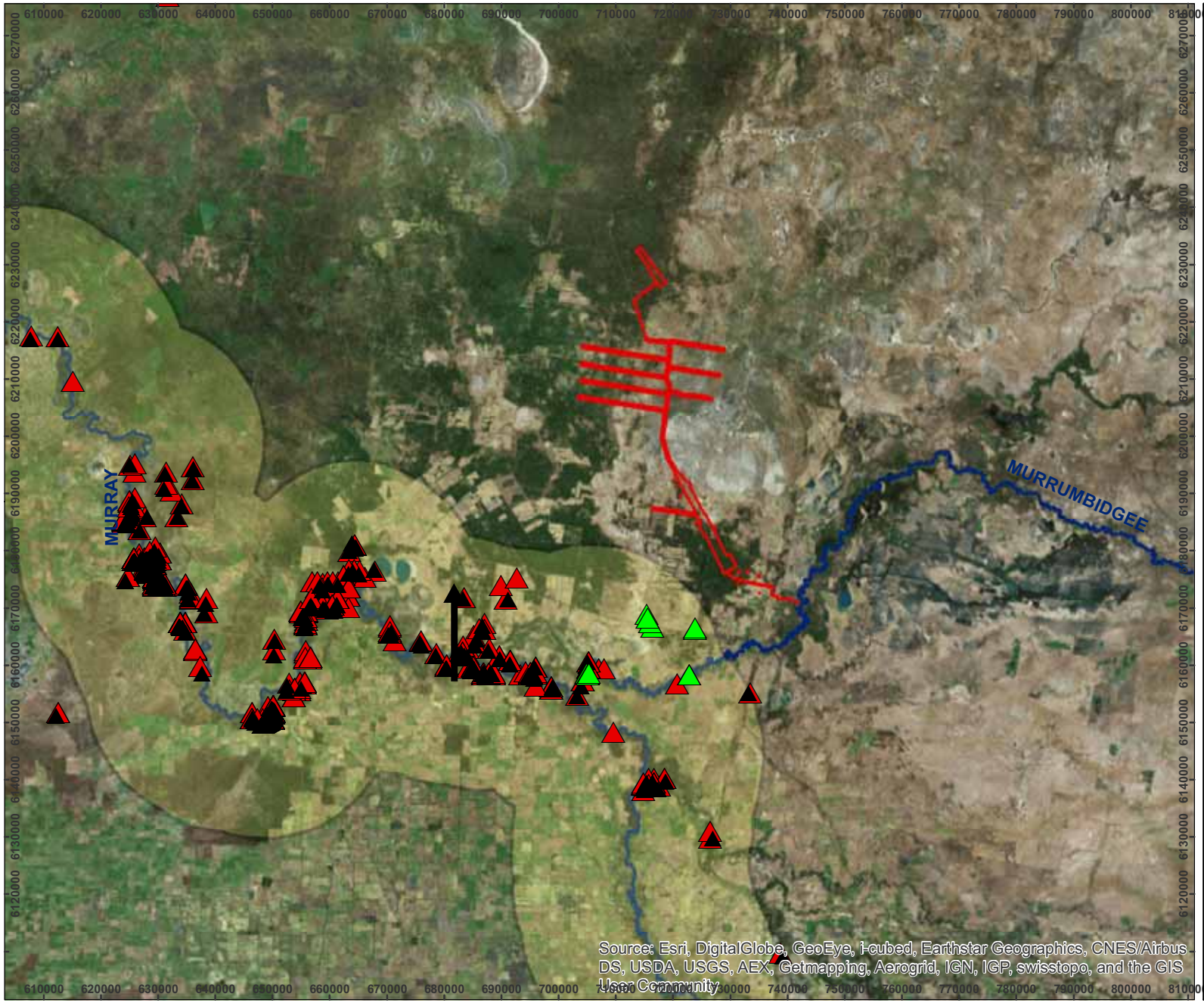
Regent Parrot Records from the Balranald Project Area Locality

Balranald Mineral Sands Project

FIGURE 10d

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\MNES Threatened Spp updates_Regent Parrot_Project_Area.mxd



Regent Parrot Field Survey Records (Niche)

Regent Parrot

Wildlife Atlas Records (post 1980 - present)

Regent Parrot (eastern subspecies)

Wildlife Atlas Pre 1980

Regent Parrot (eastern subspecies)

Breeding habitat 20km buffer (Preferred Habitat)

Project Area

N

0 5 10 15 20 25 30 km

GDA 1994 MGA Zone 54

Drawn by: ST Project Manager: ST Project Number: 1684 Date: 14/12/2015

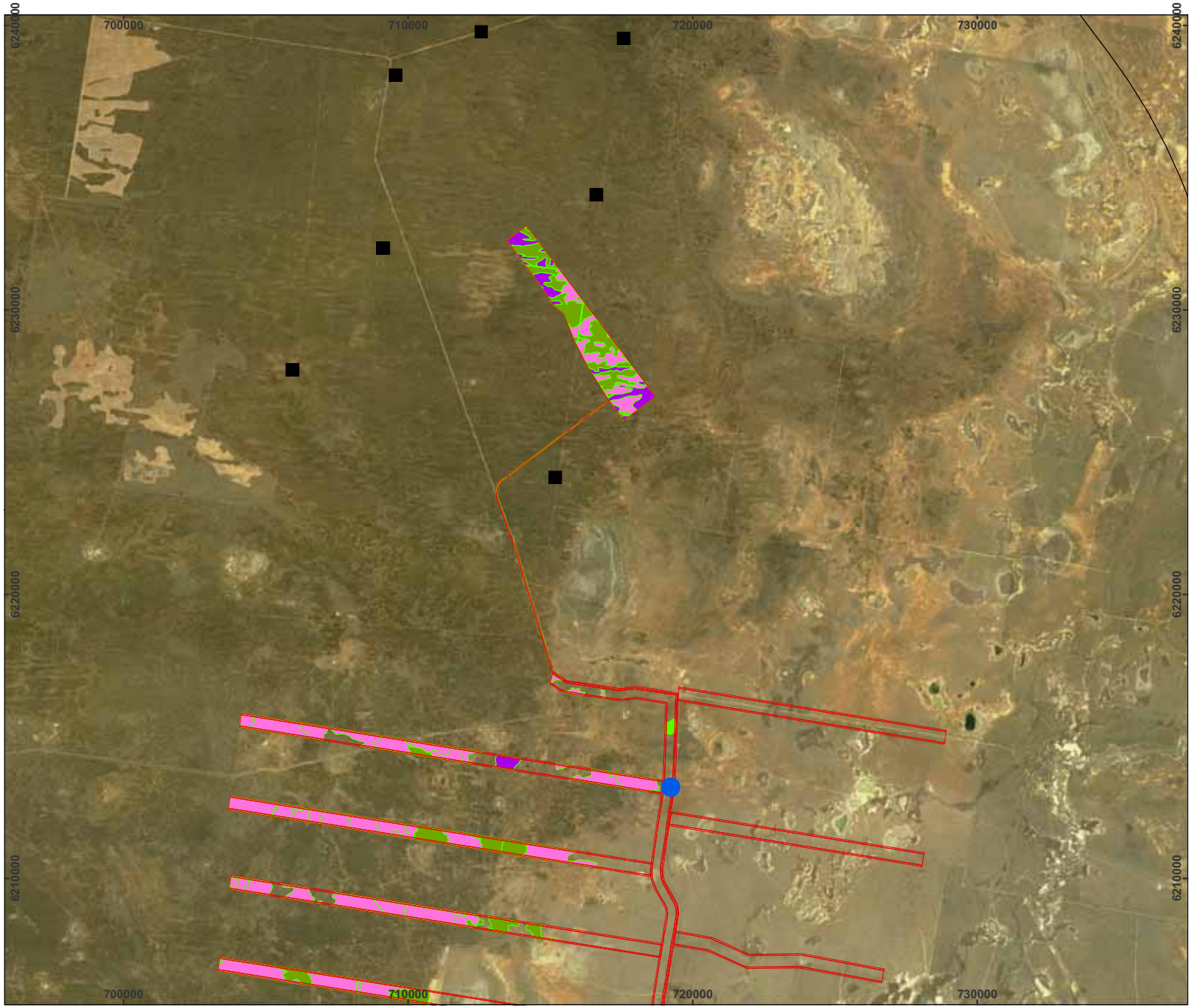
Regent Parrot Records from the Balranald Project Area Region

Balranald Mineral Sands Project

FIGURE 10e

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\MNES Threatened Spp updates_Regent Parrot_Region.mxd



Affected MNES Field Survey Records
- Corben's Long-eared Bat

Wildlife Atlas Records (post 1980 - present)
- Corben's Long-eared Bat

Preferred Habitat Corben's Long-eared Bat
- Breeding/Foraging (Belah)
- Breeding/Foraging (Belah)
- Breeding (Mallee)
- Foraging (Mallee)
- Project Area
- 20 km Project Area Buffer 2015

0 2 4 km

GDA 1994 MGA Zone 54

N

Drawn by: ST Project Manager: ST Project Number: 1684 Date: 14/12/2015

Corben's Long-eared Bat Records and Preferred Habitat within the Balranald Mine Project Area Locality

Balranald Mineral Sands Project

FIGURE 10f (north)

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\MNES Threatened Spp updates_RP_MF_LEB_Project_Area.mxd

Affected MNES Field Survey Records

- Corben's Long-eared Bat

Wildlife Atlas Records (post 1980 - present)

- Corben's Long-eared Bat

Preferred Habitat Corben's Long-eared Bat

- Breeding/Foraging (Belah)
- Breeding/Foraging (Belah)
- Breeding/Foraging (Black Box)
- Breeding/Foraging (Black Box)
- Breeding (Mallee)
- Foraging (Mallee)
- Breeding/Foraging (River Red Gum)
- Project Area
- 20 km Project Area Buffer 2015

N

0 2 4 km

GDA 1994 MGA Zone 54

Drawn by: ST Project Manager: ST Project Number: 1684 Date: 14/12/2015

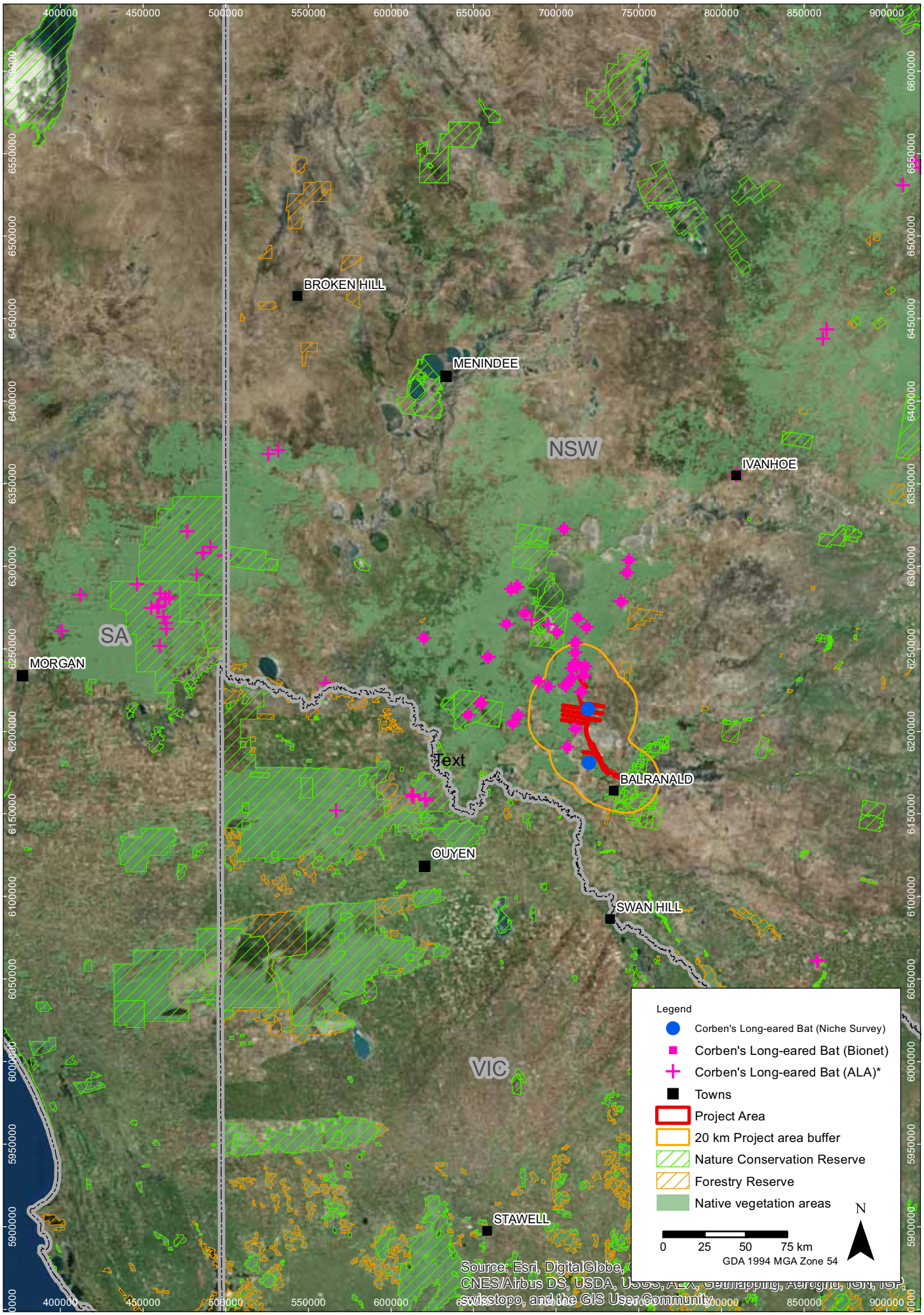
Corben's Long-eared Bat Records and Preferred Habitat within the Balranald Mine Project Area Locality

Balranald Mineral Sands Project

FIGURE 10g (south)

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\MNES Threatened Spp updates_RP_MF_LEB_Project_Area.mxd



Drawn by: RJ Project Manager: ST Project Number: 2589 Date: 17/12/2015

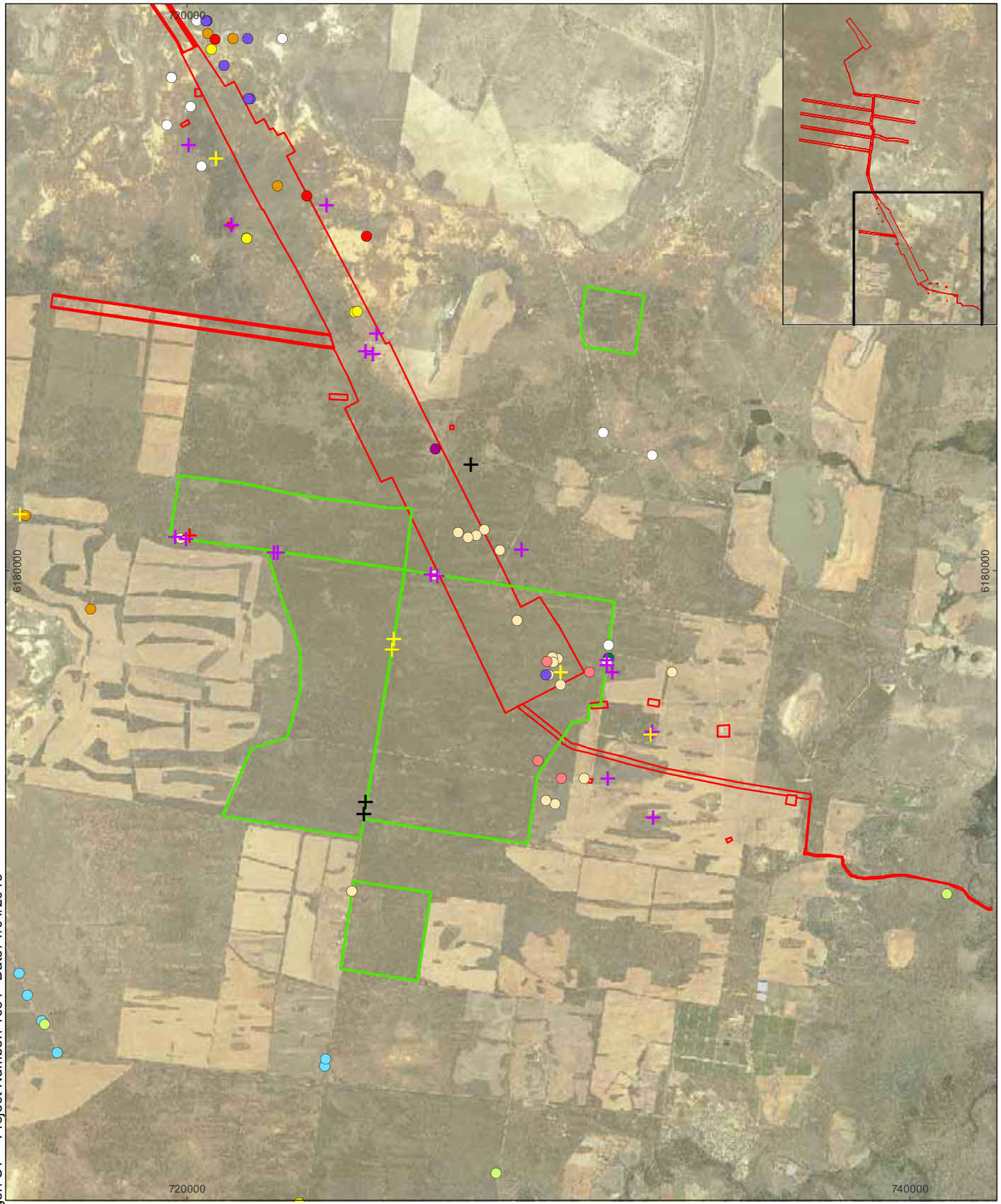
Local and regional distribution of Corben's Long-eared Bat *(Nyctophilus corbeni)*

Balranald Mineral Sands Project

FIGURE 10h

Path: T:\SpatialWorking\st\2589 Balranald\Maps\2589_Figure_10g_Corbens Regional.mxd

* ALA = Atlas of Living Australia (1980 - present records)



Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

Threatened Fauna Recorded during Field Survey, excluding Malleefowl (West Balranald)

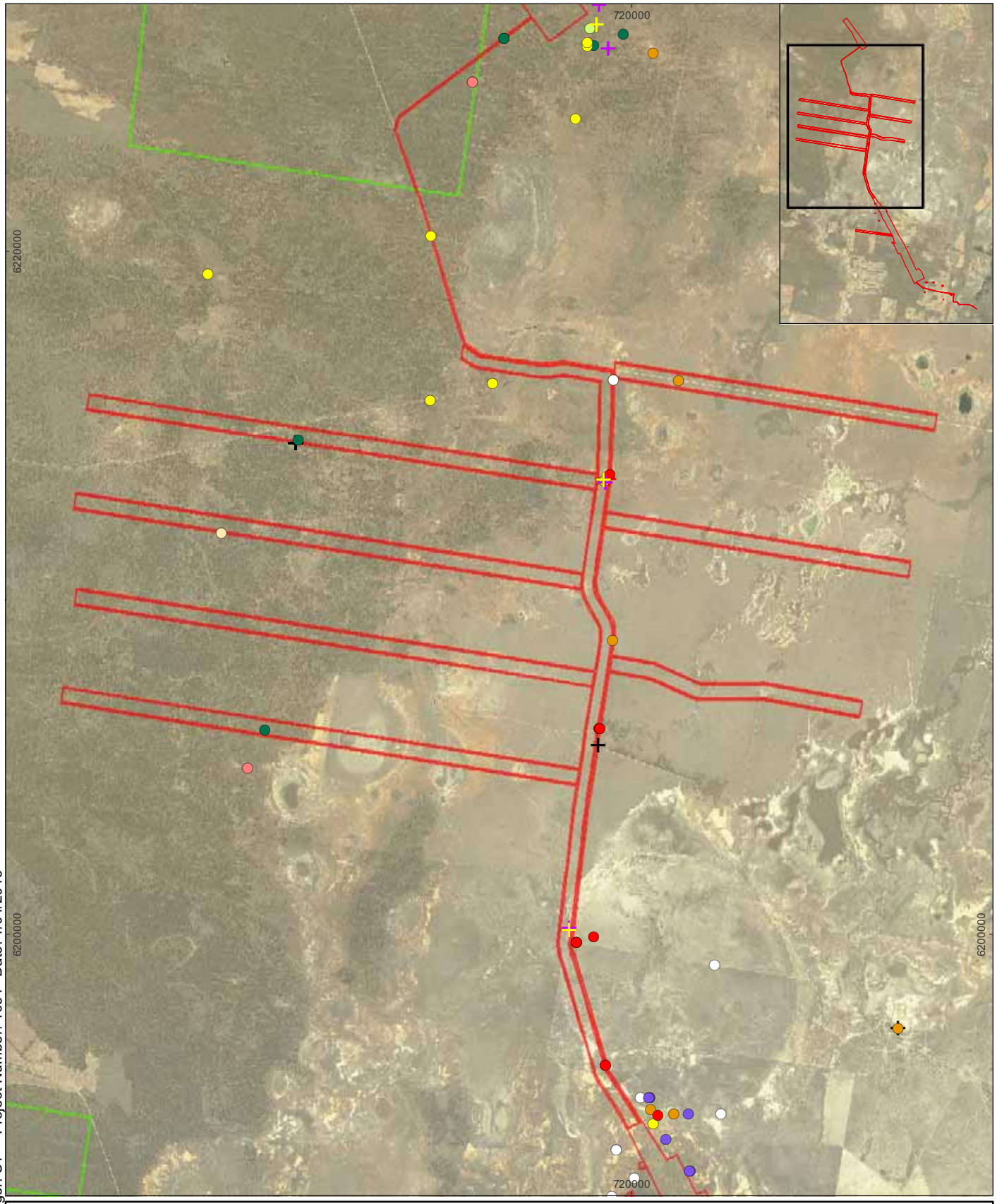
Balranald Project - Biodiversity Assessment

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_9a_TFaunaSurvey.mxd

FIGURE 11a

Imagery: (c) Iluka Resources



Project Area
Southern Mallee Conservation Areas
Threatened Fauna
Chestnut Quail-Thrush
Greater Long-eared Bat
Grey-crowned Babbler
Hooded Robin
Inland Forest Bat
Little Eagle
Little Pied Bat
Major Mitchell's Cockatoo
Redthroat
Spotted Harrier
Varied Sittella
White-fronted Chat
Yellow-bellied Sheathtail Bat

N

0 1 2 3 4 km

GDA 1994 MGA Zone 54

Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

Threatened Fauna Recorded during Field Survey, excluding Malleefowl (Haul roads and injection borefields)

Balranald Project - Biodiversity Assessment

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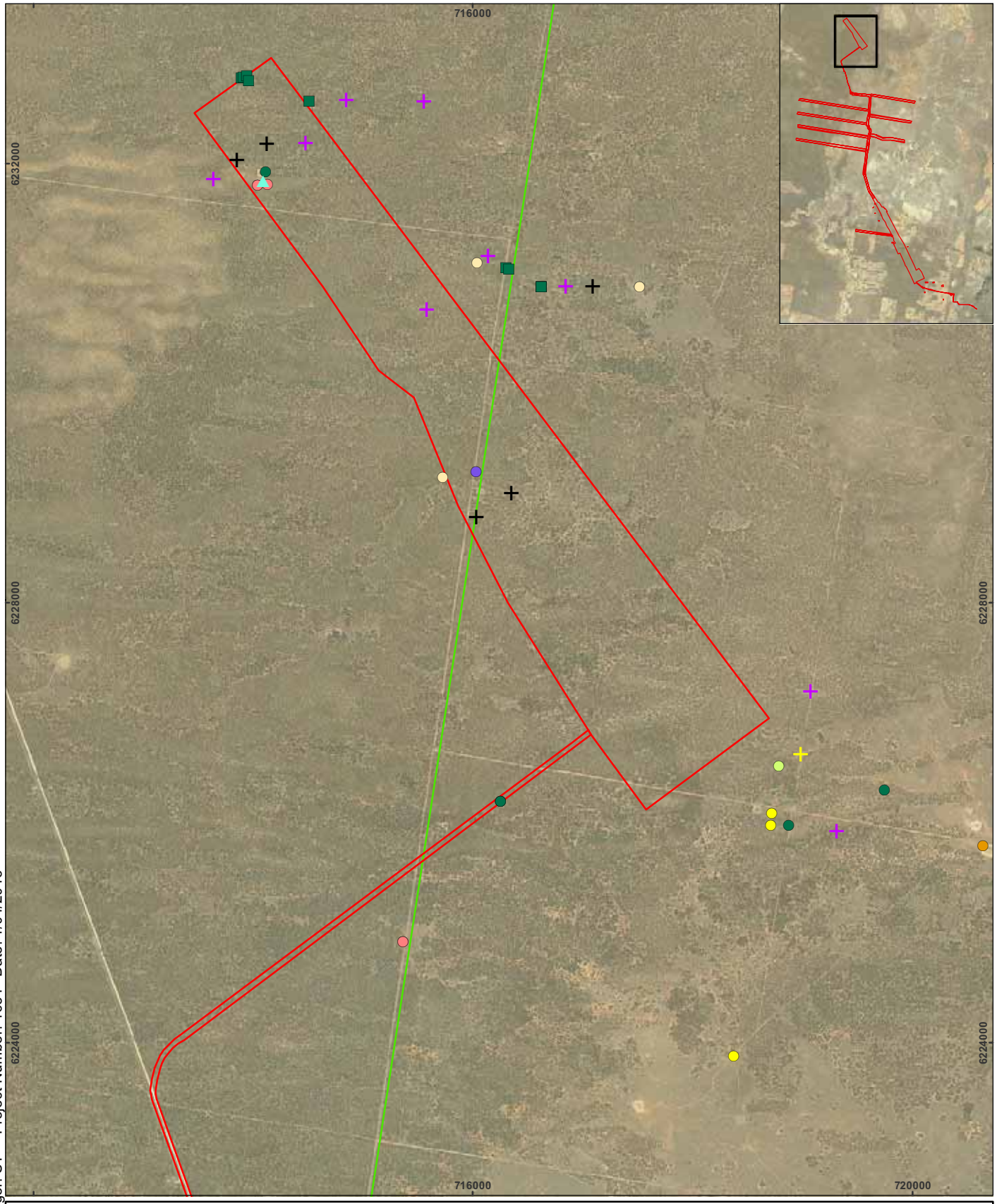
Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_9b_TFaunaSurvey.mxd

FIGURE 11b

Imagery: (c) Iluka Resources



Threatened Fauna Recorded during Field Survey, excluding Malleefowl (Nepean)

Balranald Project - Biodiversity Assessment

FIGURE 11c

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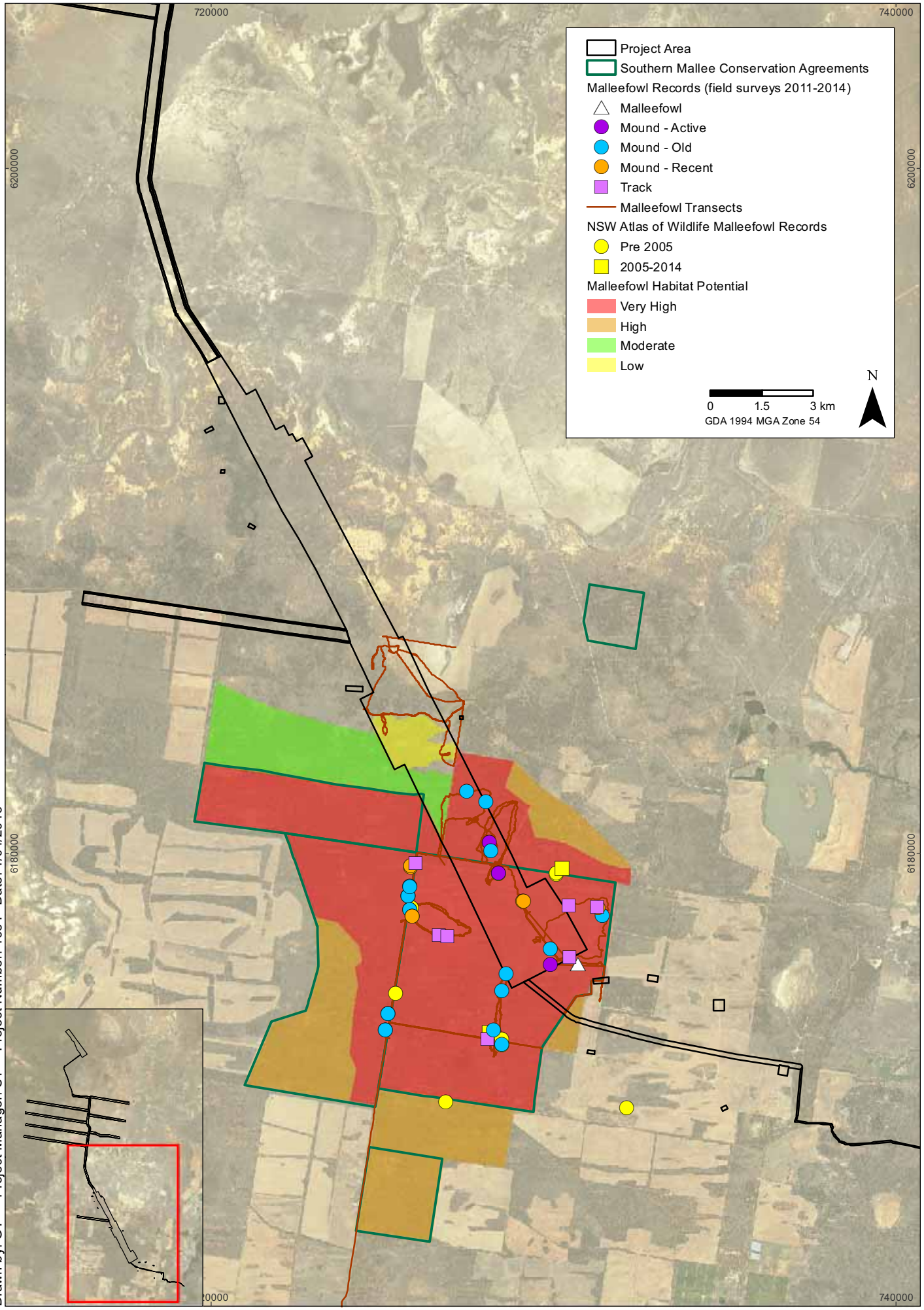
Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_9c_TFaunaSurvey.mxd

Imagery: (c) Iluka Resources



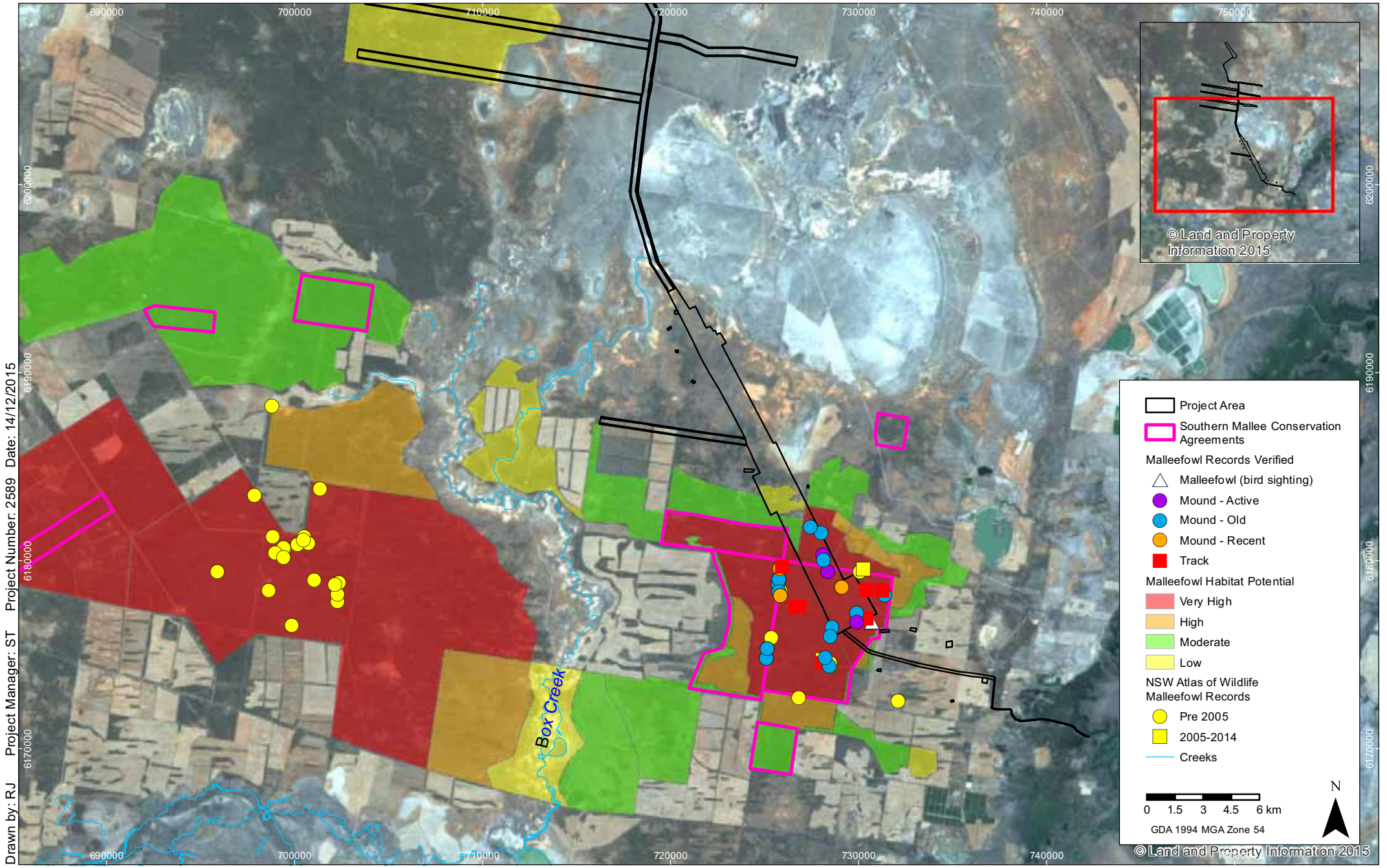
Malleefowl records and potential habitat (West Balranald)

Balranald Project - Biodiversity Assessment

FIGURE 12a

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_10a_Malleefowl.mxd

Imagery: (c) Iluka Resources



Malleefowl records and potential habitat within the Balranald Project locality (south) showing the West Balranald Malleefowl sub-population area

Balranald Project - Biodiversity Assessment

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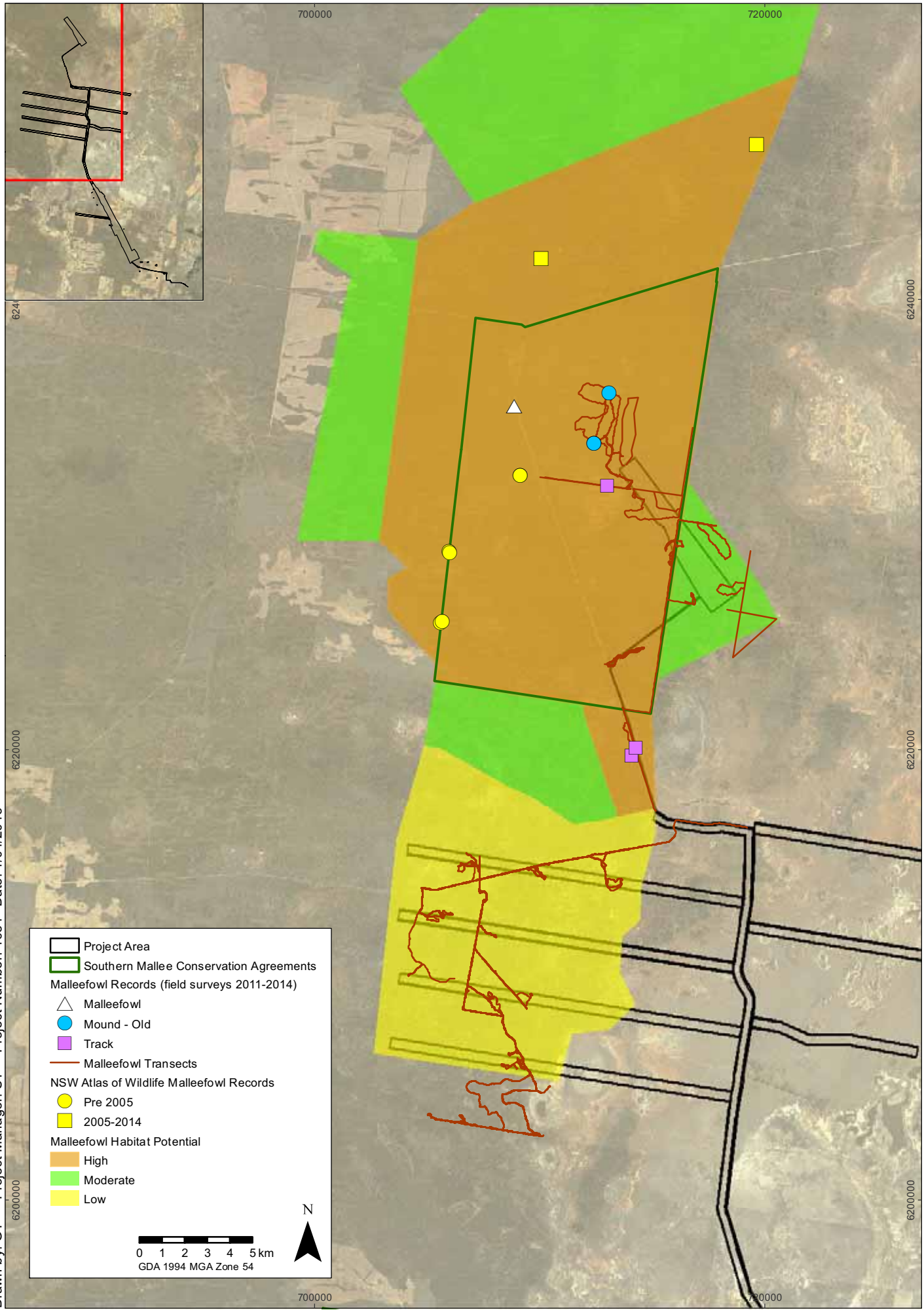
FIGURE 12b

Path: T:\spatial\projects\a2500\a2589_Balranald_Offset_Survey\Maps\report\2589_Figure_12b_MalleeFowl.mxd

Imagery: (c) LPI 2013-03-15



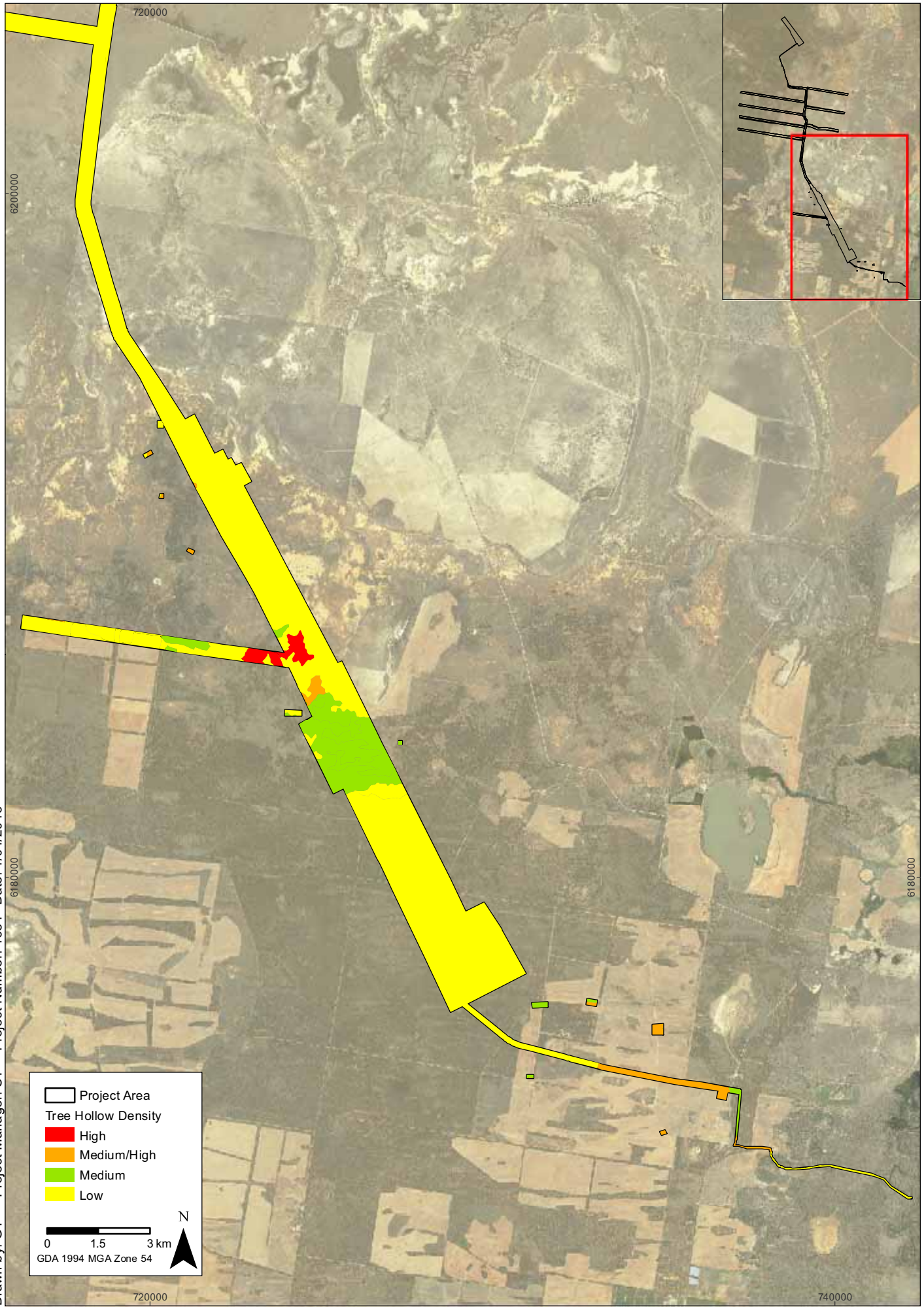
Malleefowl records and potential habitat (Nepean, Haul roads and injection borefields)

Balranald Project - Biodiversity Assessment

FIGURE 12c

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_10b_Malleefowl.mxd

Imagery: (c) Iluka Resources



Tree Hollow Potential within Project Area (West Balranald)

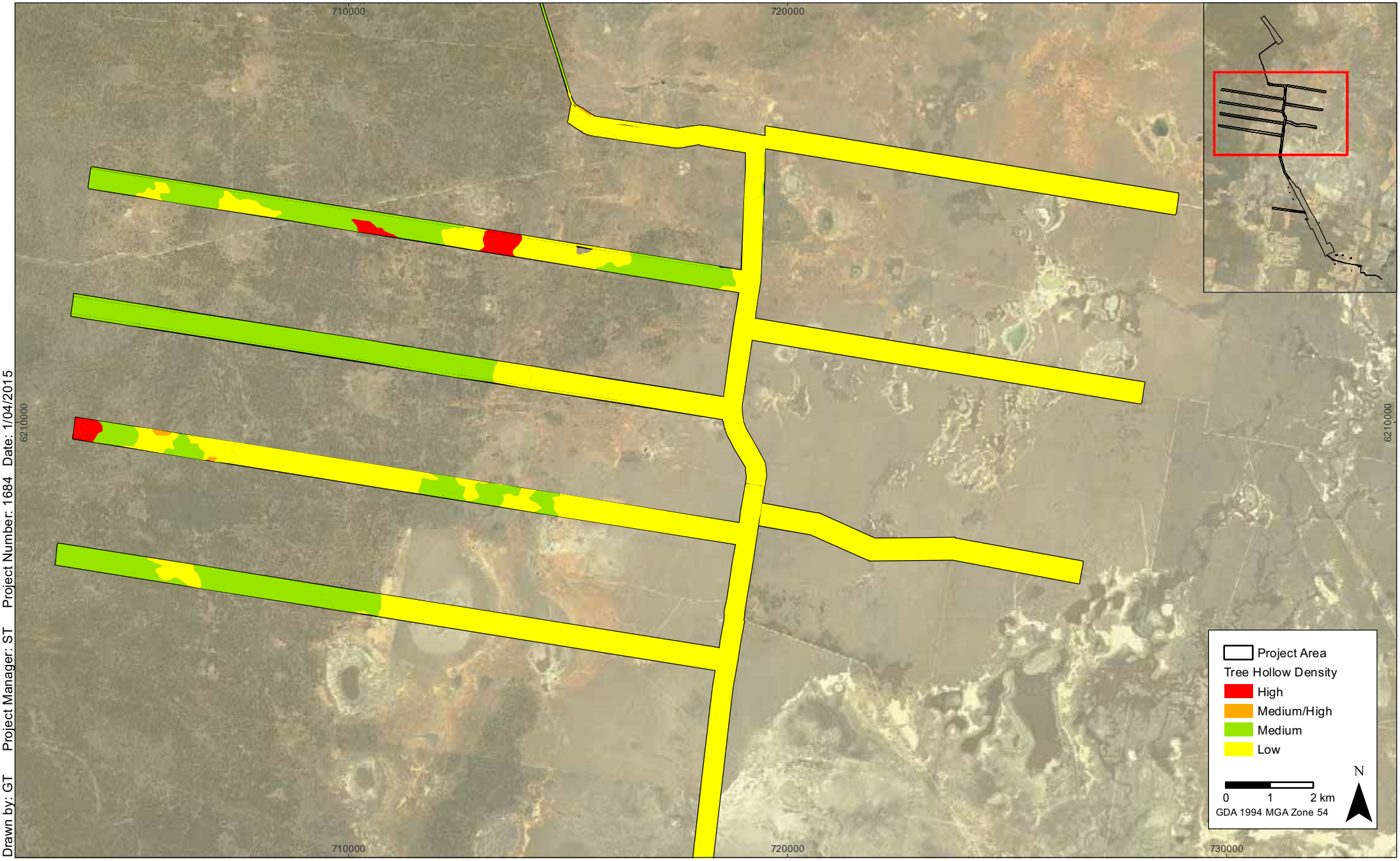
Balranald Project - Biodiversity Assessment

FIGURE 13a

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_11a_HBT.mxd

Imagery: (c) Iluka Resources



Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

Tree Hollow Potential within Project Area (Nepean, Haul roads and injection borefields)

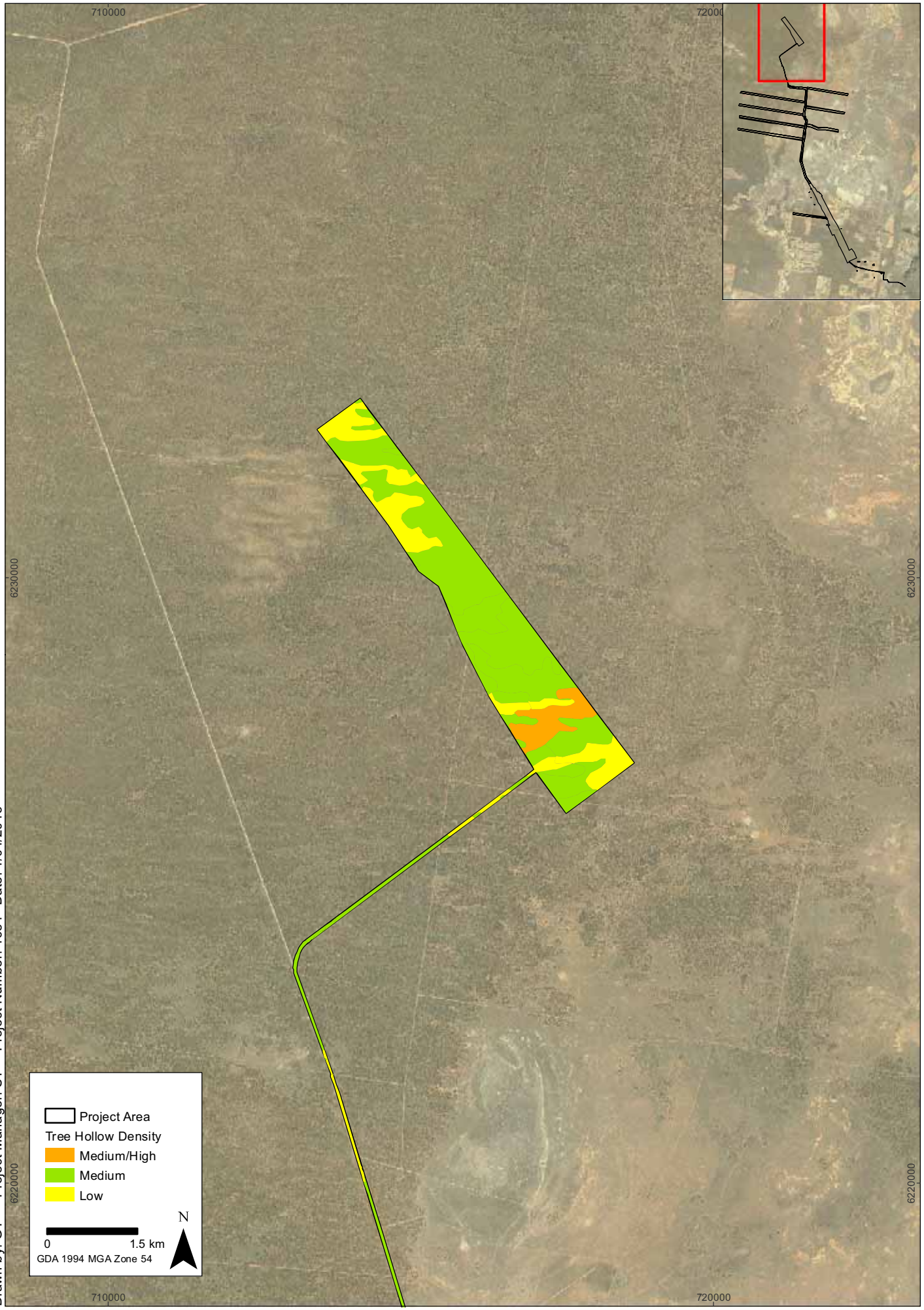
Balranald Project - Biodiversity Assessment

FIGURE 13b

Imagery: (c) Iluka Resources

niche Environment and Heritage

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_11b_HBT.mxd



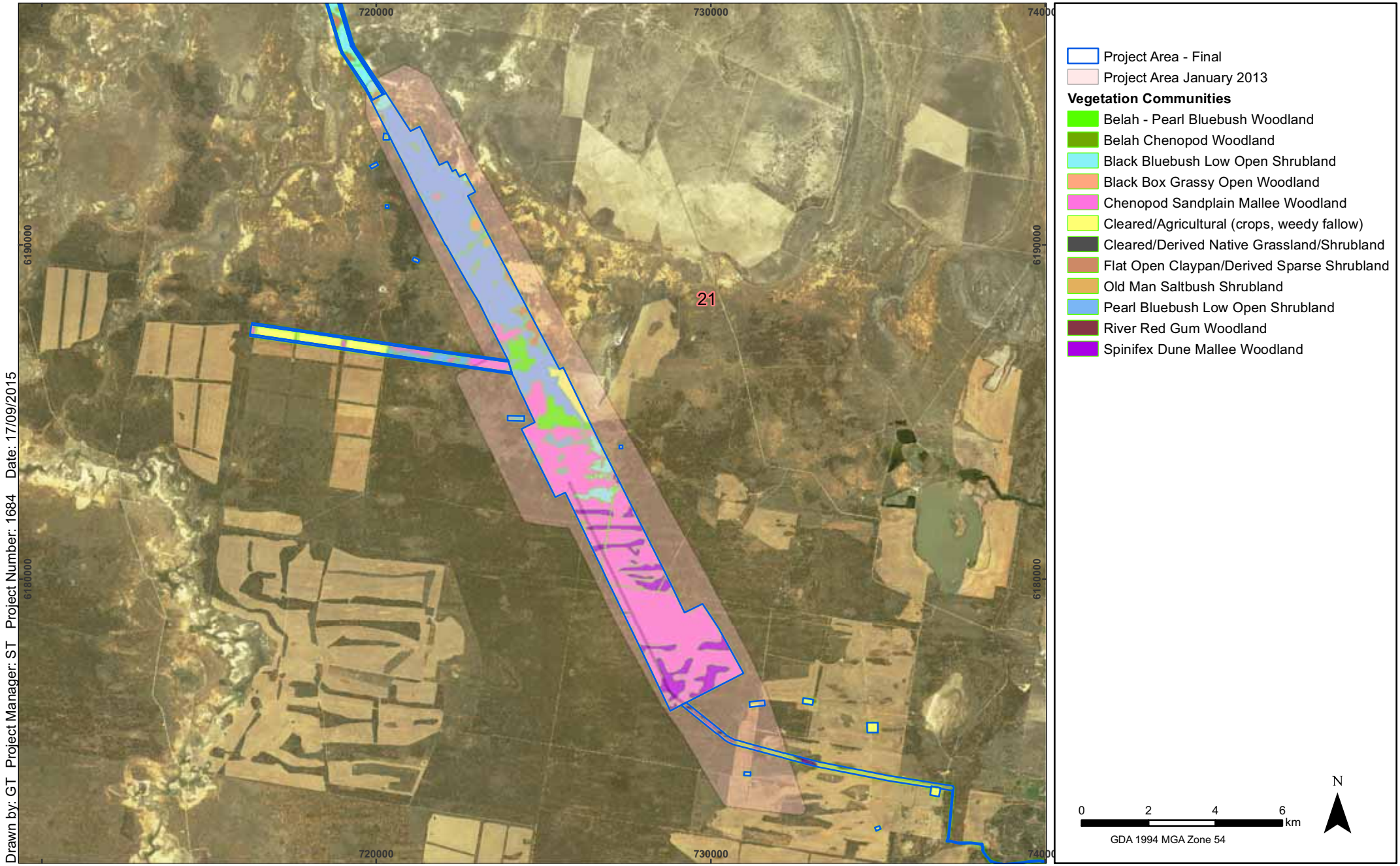
Tree Hollow Potential within Project Area (Nepean)

Balranald Project - Biodiversity Assessment

FIGURE 13c

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_9\1684_Figure_11c_HBT.mxd

Imagery: (c) Iluka Resources



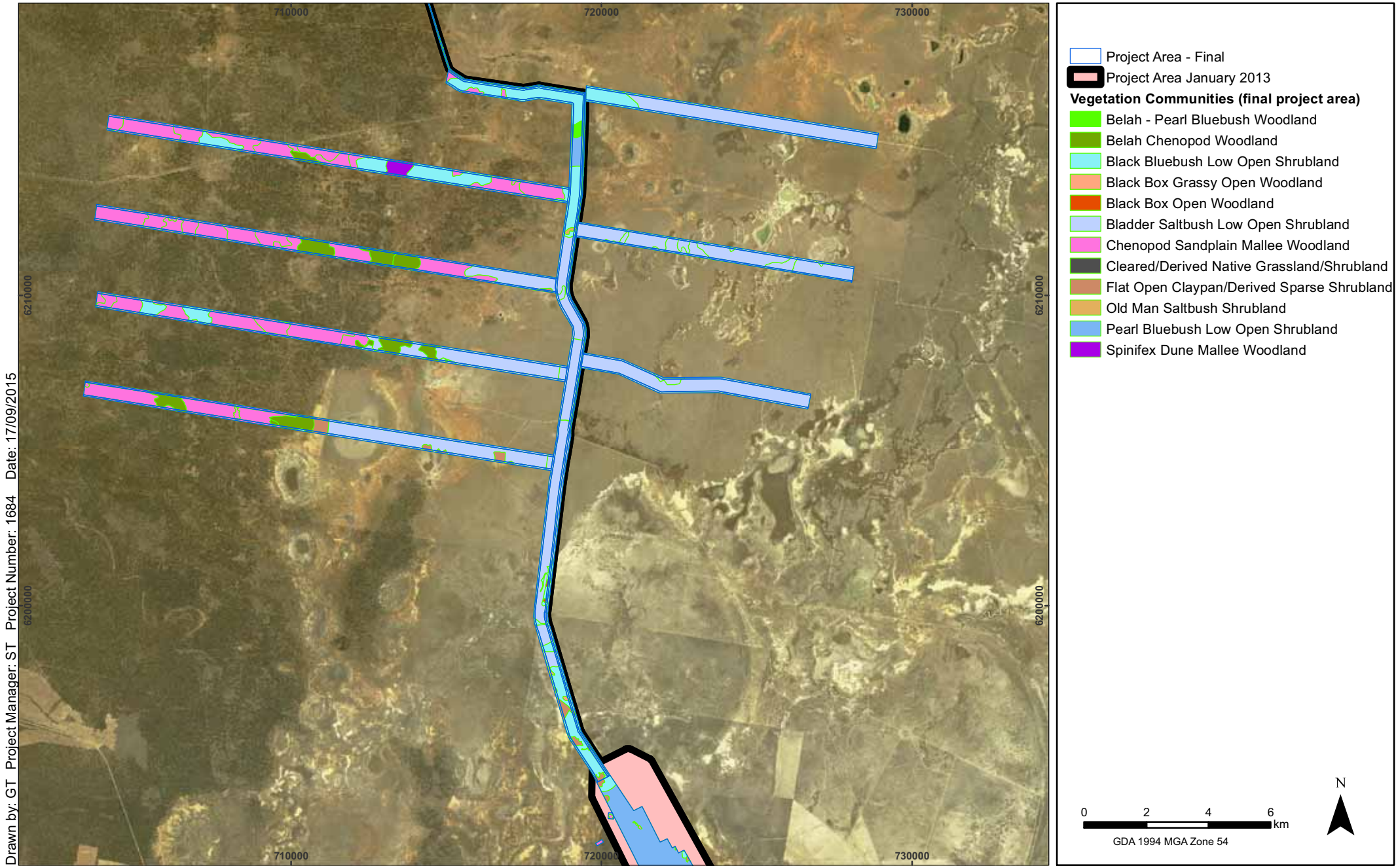
Comparison of Final (preferred alternative) and Original Project Areas (south)

Balranald Mineral Sands Project

FIGURE 14a

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\Old_mine new mine.mxd



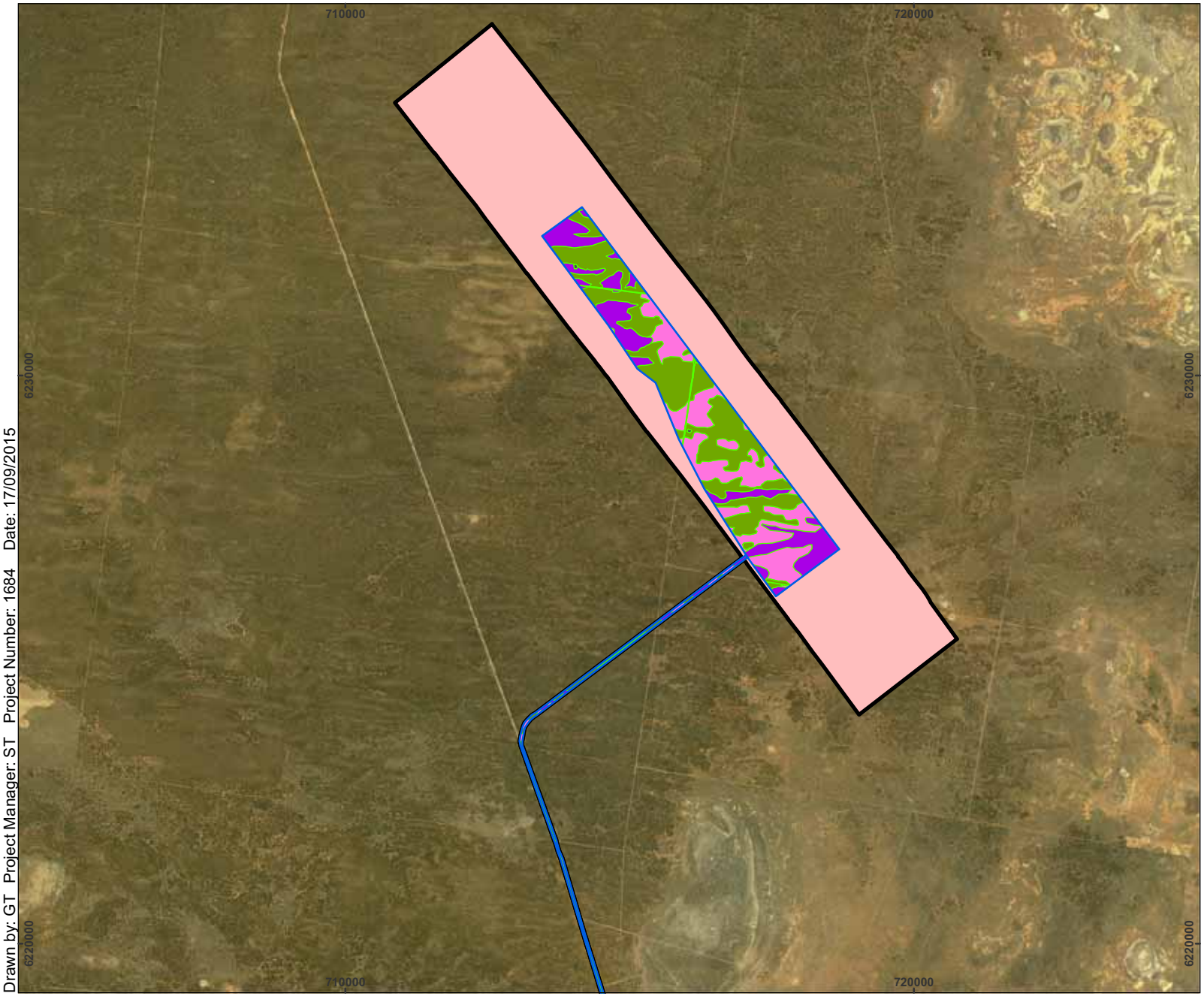
Comparison of Final (preferred alternative) and Original Project Areas (central)

Balranald Mineral Sands Project

FIGURE 14b

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\Old_mine new mine.mxd



Project Area - Final
Project Area January 2013

Vegetation Communities (final project area)

Belah - Pearl Bluebush Woodland
Belah Chenopod Woodland
Chenopod Sandplain Mallee Woodland
Cleared/Derived Native Grassland/Shrubland
Spinifex Dune Mallee Woodland

N

0 2 4 6 km

GDA 1994 MGA Zone 54

Drawn by: GT Project Manager: ST Project Number: 1684 Date: 17/09/2015

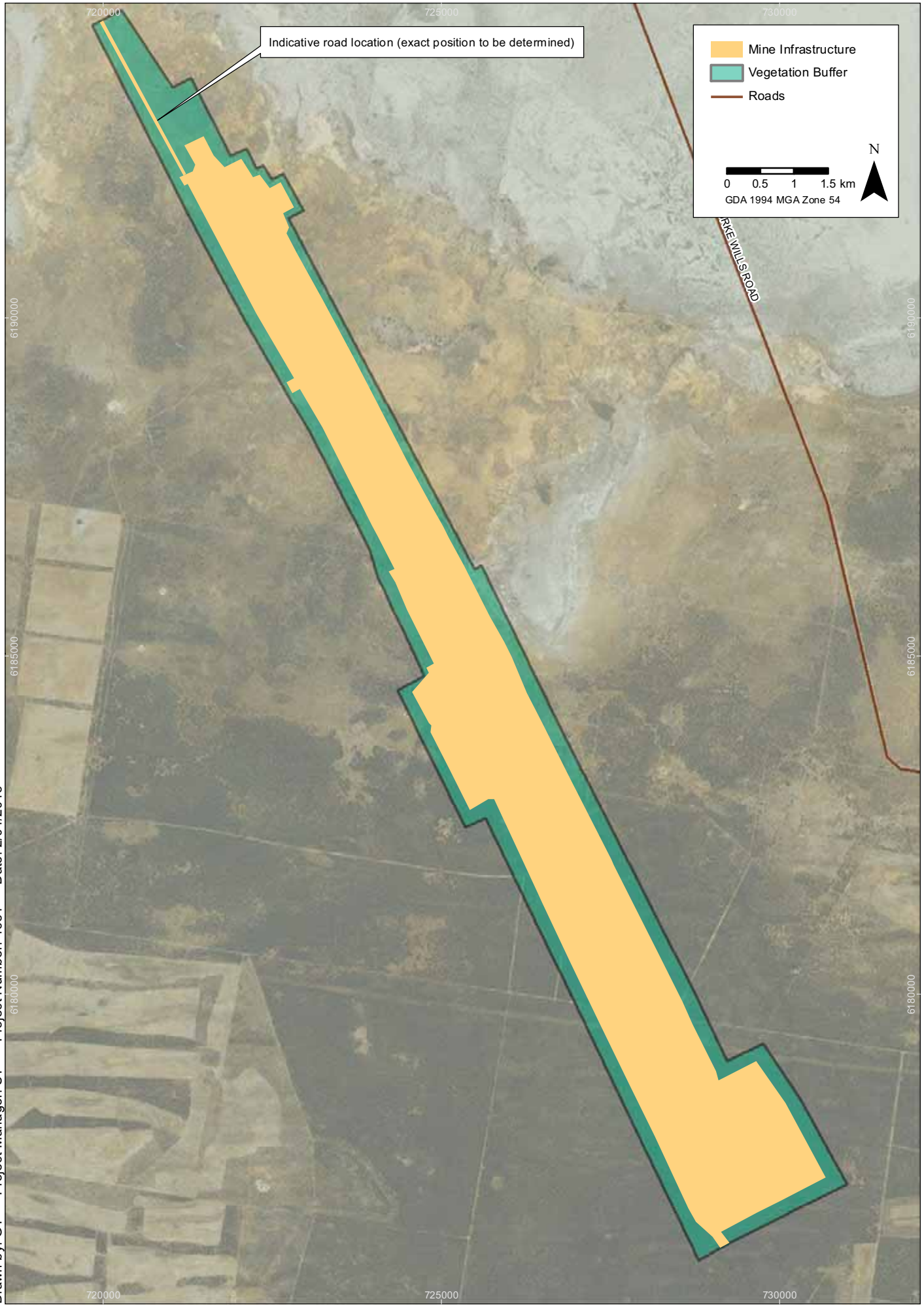
Comparison of Final (preferred alternative) and Original Project Areas (north)

Balranald Mineral Sands Project

FIGURE 14c

niche Environment and Heritage

Path: T:\SpatialWorking\st\2589 Balranald\Maps\Old_mine new mine.mxd



Planned Vegetation Buffers within the West Balranald Mine Area

Balranald Project - Biodiversity Assessment

FIGURE 15a

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_7e_additionalOffsets\1684_Figure_13a_VegBuffers.mxd

Imagery: (c) Iluka Resources

Drawn by: GT Project Manager: ST Project Number: 1684 Date: 1/04/2015

Planned Vegetation Buffers within the Nepean Mine Area

Balranald Project - Biodiversity Assessment

FIGURE 15b

Path: T:\spatial\projects\a1600\a1684_Balranald\Maps\Var_7e_additionalOffsets\1684_Figure_13b_VegBuffers.mxd

Imagery: (c) Iluka Resources

Appendix 1: Threatened Flora Likelihood of Occurrence

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Plants					
Acacia acanthoclada	Harrow Wattle	E	-	Grows in mallee communities on ridges and dunes and very occasionally on rocky outcrops; generally grows in deep, loose, sandy soil. Requires a warm, well-drained position in full sun or a little shade; grows well in well-drained sandy or loamy soils but will tolerate some clay. Associated species include White Mallee (*Eucalyptus dumosa*), Red Mallee (E. *socialis*), Yorrell (*E. gracilis*), Ridge-fruited Mallee (*E. costata subsp. murrayana*), Mallee Pine (*Callitris verrucosa*), Native Poplar (*Codonocarpus cotinifolius*) and Porcupine Grass (*Triodia scariosa subsp. scariosa*). Flowers from August to October. Plants have been recorded in or adjacent to areas regenerating after fire.	Low – nominally suitable habitat is present in the spinifex mallee community, but the project area is some distance east of its known distribution.
Acacia carneorum	Purple-wood Wattle	V	V	Occurs in the far western plains, south from west of Tibooburra to the Menindee area. Also has a limited distribution in SA. Grows in grassland and woodland in red, sandy soil; also found in mulga communities on sand dunes, level sandy sites and alluvial accumulations along watercourses; recorded from inland semi-arid Acacia and Casuarina shrublands and woodlands. Preferred soils are shallow, calcareous and loamy, and include brown earths, crusty alkaline soils and neutral red duplex soils; confined to red-earth dune soils in Kinchega NP as a dominant or occasionally co-dominant, usually on dune crests or slopes.	Low – nominally suitable habitat is present in the belah community, but the project area is a considerable distance east of its known distribution.
Acacia rivalis	Creek Wattle	E	-	Confined to woodland communities near Broken Hill, bordering ephemeral creeks and streams and along watercourses. It grows in a variety of stony soils, often with limestone content.	None – project area outside known range.
Atriplex infrequens	A saltbush	V	V	*Atriplex infrequens* is associated with broad drainage tracts, clay flats and possibly occasionally inundated habitats. Very little ecological information is available for this species so its critical habitat components can only be speculated as relatively undisturbed and ungrazed drainage lines and flats.	Low – suitable habitat may be present in the saltbush and claypan communities, but the nearest known occurrences are distant.
Austrostipa metatoris	A spear grass	V	-	Grows in sandy areas of the Murray Valley; habitats include sandhills, sand ridges, undulating plains and flat open mallee country, with red to red-brown clay-loam to sandy-loam soils. Associated species include *Eucalyptus populnea, E. intertexta, Callitris glaucophylla, Casuarina cristata, Santalum acuminatum* and *Dodonaea viscosa*. Flowers in response to rain. It is not known if fire plays a role in the ecology of this species although most species of Austrostipa provide an abundance of highly flammable ephemeral fuel in periods following above-average rainfall. Recorded in populations as locally frequent or dominant only in scattered patches.	Low – suitable habitat may be present, but most of the characteristic associated species are absent.

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Austrostipa nullanulla	Club spear grass	E	-	Within the Murray mallee it is restricted to gypseous lunettes and copi rises and at Nulla Station it grows on the margins of relict lakes, on the crests and sides of lunettes above old lake floors. In South Australia is thought to occupy gypseous soils on the outskirts of salt lakes across the north of the state. In all cases, gypsum is a major constituent of the soils in the habitat. The vegetation on the lunettes at Nulla Station is an open shrubland of Pearl Bluebush (*Maireana sedifolia*), Bladder Saltbush (*Atriplex vesicaria*), Black Bluebush (*Maireana pyramidata*) and Spiny Saltbush (*Rhagodia spinescens*) with scattered Belah (*Casuarina pauper*), Western Rosewood (*Alectryon oleifolius* and Yorrell (*Eucalyptus gracilis*). Other species include the grass Austrostipa nitida, Cannonball Burr (*Dissocarpus paradoxus*), Turpentine Bush (*Eremophila sturtii*), Shrubby Twinleaf (*Zygophyllum auranticum*) and Boobialla (Myoporum) species.	Low – nominally suitable habitat is present in the chenopod communities, but the project area is a considerable distance east of its known distribution.
Austrostipa wakoolica	A Spear-grass	E	E	Grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils; habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine forest on low sandy range; and a low, rocky rise.	Low – suitable habitat may be present on the Murrumbidgee River floodplain, but most of the characteristic associated species are absent.
Brachyscome papillosa	Mossgiel Daisy	V	V	Recorded primarily in clay soils on bladder saltbush and leafless bluebush plains, but also in grassland and in inland grey box- cypress pine woodland.	**Moderate**– suitable habitat may be present in the bladder saltbush, black bluebush or derived grassland habitats. Recorded recently within 25 km of Nepean mine (AMBS 2012).

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Caladenia tensa	Greencomb Spider-orchid	-	E	Historically, the Greencomb Spider-orchid was widespread on aeolian sand deposits surrounding, and including, the Little Desert in western Victoria and south-east South Australia. The species was found within the areas of the Murray-Darling Depression bioregion and generally associated with 300–400 mm annual rainfall areas (Todd 2000). In the early 1990s, the species was considered to be confined to western Victoria: in the Murray Mallee, Lowan Mallee and Wimmera Natural Regions. The Greencomb Spider-orchid grows on red-brown sandy loams on rises in open woodland dominated by Yellow Gum (*Eucalyptus leucoxylon* sens. lat.) and Rottnest Island Pine (*Callitris preissii*). Its habitat, between the Little Desert and Big Desert, was formerly expansive and extended into SA. This species has also been recorded from Black Box (*Eucalyptus largiflorens*)/Yellow Gum woodland and mallee/heathland (MEL collection records).	Low
Callitriche cyclocarpa	Western Water-starwort	V	V	In NSW only recorded at 'The Gut' near Koraleigh, on the floodway from the Murray to Wakool River, about 26 km NNW of Swan Hill.	Low – suitable habitat may be present on the Murrumbidgee River floodplain, but the proposed impact area in this habitat type was thoroughly traversed and the species was not recorded.
Calotis moorei	Moore's Burr-daisy	E	E	Moore's Burr-daisy occurs on red-brown fine sand in relatively flat areas on upper areas of low sandhills.	Low – nominally suitable habitat may be present but the nearest known occurrence is distant.
Casuarina obesa	Swamp She-oak	E	-	Requires moist, slightly saline soils. Potential habitats include shorelines of permanent, ephemeral or relict lakes. These systems may be freshwater or saline-influenced judging by the present distribution of the species. In NSW, associated species *include Eucalyptus camaldulensis, E. largiflorens* and *Acacia stenophylla* with the understorey dominated by grasses and sedges.	Low – no permanent ephemeral lakes in project area.
Convolvulus tedmoorei	Bindweed	E	-	Grows in self-mulching grey clay soils on the floodplains of the Darling and Murrumbidgee Rivers.	Low – nominally suitable habitat may be present but the nearest known occurrence is distant.

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Cratystylis conocephala	Bluebush Daisy	E	-	Grows in mallee with areas of belah, on calcareous red soil; rare in N.S.W., restricted to a few plants in the Wentworth district.	None – project area not within predicted habitat range.
Dodonaea stenozyga	Desert Hopbush	CE	-	Presumed extinct in NSW (with the only record from the Darling River prior to 1859) until recorded in 1998 from Nanya Station, north west of Wentworth in far south-western NSW. A recent record of two plants from a property to the west of Lake Victoria have yet to be confirmed. Widespread in southern Australia, from southern Western Australia, through South Australia to western Victoria.	None – likely extinct and not within close proximity to project area.
Erodiophyllum elderi	Koonamore Daisy	E	-	Occurs south from the Broken Hill district, at localities including Mazar Station south of Broken Hill and just east of the South Australian border. Also distributed throughout southern SA (including Koonamore Station, approx. 400 km NNE of Adelaide, from where the species gets its common name) and Western Australia.	None – project area not within predicted habitat range.
Eucalyptus leucoxylon subsp. pruinosa	Boland Yellow Gum	V	-	In New South Wales, *Eucalyptus leucoxylon* subsp. *pruinosa* is currently known from several localities along the Murray River valley, including a concentration of six stands to the west of Moulamein, and small scattered occurrences between Barham and Euston. A disjunct occurrence of the species reported from near Boorowa on the central western slopes has been investigated and refuted.	Low – nominally suitable habitat is present, but the project area is some distance east of its known distribution.
Kippistia suaedifolia	Fleshy Minuria	E	-	Grows around saline lakes and depressions, often in association with gypsum. Recorded from several collections near Conoble in the Ivanhoe district. This locality is an open-cast gypsum mine (Marlow Gypsum Mine), located 22 km north of Conoble railway siding. Also reported from the Scotia mapsheet area in far south-western NSW.	None – project area not near any known locations.
Lasiopetalum behrii	Pink Velvet Bush	CE	-	Grows in mallee and red dune and swale country. In Victoria recorded in *Eucalyptus gracilis* mallee woodland with an understorey of Acacia and Triodia, *Halgania andromedifolia* and *Eutaxia microphylla*, on deep sand. In South Australia, associated species include *Eucalyptus diversifolia, E. socialis, Melaleuca uncinata, Casuarina* stricta and *Prostanthera, Eremophila* and Templetonia species. Flowering period is late winter to spring. Recorded as a single plant in NSW, however in interstate populations (Victoria and SA) plants are frequent to very common.	Low – nominally suitable habitat is present, but the project area is some distance east of its known distribution, which is represented by a single plant in NSW.

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Lepidium monoplocoides	Winged Peppercress	E	E	Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by bulloak and-or eucalypts, particularly black box or poplar box. The field layer of the surrounding woodland is dominated by tussock grasses.	**Moderate**– potential habitat may be seasonally present in the chenopod mallee, black box, black bluebush, saltbush, claypan or grassland communities. These habitat areas are likely to be lightly grazed within the project area. Recorded recently within 20km of Nepean mine (AMBS 2012).
Leptorhynchos waitzia	Button Immortelle	E	-	Grows on sandy or loamy soils, often in intermittently flooded areas and salt flats. Found in Kinchega NP on an open Bluebush plain with scattered chenopods. In Victoria, it is found on open grassy plains, grassy woodlands and sandy flats in mallee areas, with isolated occurrences on cracking clays.	Low – suitable habitat could be present in lower lying flood-prone parts of the site, such as river and creek floodplains.
Leucochrysum albicans var. tricolor	Hoary Sunray	-	E	The Hoary Sunray occurs at relatively high elevations in woodland and open forest communities, in an area roughly bounded by Goulburn, Albury and Bega. The species has been recorded in the Yass Valley, Tumut, Upper Lachlan, Snowy River and Galong (ACT Commissioner for the Environment 2004; Umwelt 2009). The species is known from the South Eastern Highlands, Australian Alps and Sydney Basin bioregions. Herbarium records indicate that the taxa once occurred more widely in inland NSW, near Cobar, Dubbo, Lithgow, Moss Vale and Delegate.	Low - nominally suitable habitat is present
Maireana cheelii	Chariot Wheels	V	V	Usually found on heavier, grey clay soils with bladder saltbush. Soils include heavy brown to red-brown clay-loams, hard cracking red clay, other heavy texture-contrast soils. Tends to grow in shallow depressions, often on eroded or scalded surfaces, and does not extend to the higher soils in the habitat. It has been found on the edges of bare, windswept claypans, in shallow depressions of eroded surfaces where rainwater collects and on a shelf in the crabhole complex of heavy grey soils.	**Low to Moderate**– suitable habitat including some of the commonly associated species are present on the bladder saltbush plains.

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Phyllanthus maderaspatensis	Phyllanthus maderaspatensis	E	-	Recorded for the Brewarrina and Collarenebri districts in the north-western plains of NSW. Very widely distributed across the tropics of Qld, the NT, and WA, with additional records from SA.Grows in floodplain areas on heavy soils and may rely on appropriate and intermittent rainfall and flooding events for its survival. The species is described as being a summer-growing annual and is thus dependent on seasonal conditions.Often associated with open grasslands and eucalypt woodlands in or near creek beds, and grassy flats and levees near watercourses.	None – predicted habitat occurs outside of the Balranald project area.
Pimelea serpyllifolia subsp. serpyllifolia	Thyme Rice-Flower	E	-	Grows in scrub and woodland on calcareous soils. Often found in sandy red soils supporting mallee scrub.Associated species include *Eucalyptus oleosa, E. leptophylla, E. dumosa, Melaleuca lanceolata, Myoporum insulare, Rhagodia candolleana, Acacia* and Hakea spp., spinifex and other tall grasses. Flowers most of the year, especially July to November. Plants in a population west of Euston in NSW are noted as being frequent in an area burned about 5 years ago. Recorded as scattered and occasional, to common and frequent in populations.	Low – nominally suitable habitat is present in the spinifex mallee community, but the project area is some distance east of its known distribution.
Pterostylis cobarensis	Greenhood Orchid	V	-	Habitats are eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include *Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna spp.* and *Eremophila* spp.. Potential habitat for the species within the project area includes: Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116).The species is known to be present at a site approximately 20 kms to the north of the Balranald project area (Resource Strategies 2013).	**Low to Moderate**–The species is known to be present at a site approximately 20 kms to the north of the Balranald project area (AMBS 2013).
Santalum murrayanum	Bitter Quandong	E	-	Usually grows in mallee communities. Generally grows in gravelly and sandy loam soils on dunes, in open woodland and tall shrubland. Also recorded in sand in spinifex-shrub steppe. NSW populations are found in mallee habitats on soft linear dune-crests, with deep and well-drained calcareous earths or red and brown sands, loamy sands or clay-loams. Associated species include *Eucalyptus socialis, E. costata, E. leptophylla, E. dumosa, Callitris verrucosa, Triodia scariosa* and *Pimelea microcephala*. Santalum species are root-parasitic shrubs or small trees. This species is sometimes found as an isolated tree, but is also regularly found in small to large groups (up to 28 plants) scattered over a relatively small area. Many plants appear to be senescent, though juvenile plants are also present in some populations.	**Moderate**– suitable habitat (including the commonly associated species) is present in the spinifex mallee community on linear dunes, but nearby records are scant. Nearest recent record is at Arumpo Road near the Nepean site (Ogyris 2007) and along the Sturt Highway 10 km west of Balranald.

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Solanum karsense	Menindee Nightshade	V	V	Grows in occasionally flooded depressions with heavy soil, including level river floodplains of grey clay with black box and old man saltbush, and open treeless plains with solonized brown soils. Habitats are generally lake beds or floodplains of heavy grey clays with a highly self-mulching surface. Also found on sandy floodplains and ridges and in calcareous soils, red sands, red-brown earths and loamy soils. Flowers chiefly in spring. Has been observed in the field to have an extensive root system which will grow when cut and left on the soil surface. This species is ephemeral in nature, appearing following rainfall events. It also tolerates disturbance and will often appear after such activities as grading, ploughing and flooding for irrigation. Menindee nightshade is a clonal species and is recorded as common to locally abundant in most populations. It can form small colonies of several hundred plants. Isolated and few plants have also been recorded at some sites.	Low – potential seasonally suitable habitat may be present, but the nearest records are distant.
Swainsona adenophylla	Violet Swainson-Pea	E	-	Grows on red sandy or stony flats, especially near lake margins. Associated species in South Australia include Eucalyptus microtheca and Acacia species. The records from Victoria were on higher river red gum terraces, well away from the main river channel.	Low – suitable habitat may be present but the sole record within the data search area is historic.
Swainsona colutoides	Bladder Senna	E	-	Occurs in the south-western corner of NSW, with several populations all located within Tarawi Nature Reserve. Also found in inland parts of southern Western and South Australia (where it is widespread), and in the Northern Territory near Alice Springs. Grows on sandy flats or skeletal hillside soils in mallee woodland. Plants are usually found in large numbers in areas of previous controlled burns and wildfires.	None – predicted habitat occurs outside of the project area.
Swainsona flavicarinata	Yellow-keeled Swainsona	E	-	Grows in deep red sand, recorded from a roadside on a treeless plain in NSW. In central Australia, the species grows in mulga communities on red earths and on stony soils supporting Bladder Saltbush. Also found on sandy plains and ridges, in grassland, and in watercourses and floodplains near creeks or rock holes.	None – predicted habitat occurs outside of the Balranald project area.
Swainsona murrayana	Slender Darling Pea	V	V	Slender Darling-pea is found in grassland, herbland, and open Black-box woodland, often in depressions. This species grows in heavy grey or brown clay, loam, or red cracking clays. It is often associated with low chenopod shrubs, wallaby-grass and spear grass. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated.	**Moderate**

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Swainsona pyrophila	Yellow Swainson-pea	V	V	The Yellow Swainson-pea occurs in mallee vegetation communities on a variety of soil types including well-drained sands, sandy loams and heavier clay loams. The only detailed habitat information is from South Australia, where the species was recorded from mallee woodland with Eucalyptus species including *E. brachycalyx, E. calycogona, E. dumosa, E. gracilis, E. incrassata, E. leptophylla, E. oleosa* and *E. socialis*, sometimes with Broombush *Melaleuca uncinata* tall shrubland. There are some records apparently from riverine vegetation. In NSW, Yellow Swainson-pea has only been recorded a few times, mainly at Mt Hope, Euston and Menindee. In 1988, it was also recorded from Nanya Station (approximately 150 km south of Broken Hill) (NSW undated). The Yellow Swainson-pea has also been found at Mallee Cliffs and possibly at Tarrawee.	**Low to Moderate**– potentially suitable habitat is present.
Swainsona sericea	Silky Swainson-pea	V	-	Recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro. Found in Natural Temperate Grassland and Snow Gum Woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. Sometimes found in association with cypress-pines.	Low – Unlikely to be present given no records within 50 kms, previous records are too distance from project area, and potential habitat sparse.
Swainsona viridis	Creeping Darling Pea	E	-	Grows in dry, sandy or stony areas on the banks or in the beds of creeks. Found in the Broken Hill area on sandy soils near watercourses. Also collected along a roadside sandplain in sandy-loam soil.	Low – predicted habitat too far north from project area.

Appendix 2: Threatened Fauna Likelihood of Occurrence

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Amphibians								
Neobatrachus pictus	Painted Burrowing Frog	E	-	-	-	This species is widespread in south eastern South Australia and western Victoria, but has been found at only two locations in NSW: Scotia Sanctuary, adjacent to the South Australian border and in an area to the west of Pooncarie. Animals can occur in open grassland, mallee, woodland, farmland and cleared areas and are usually found in or around flooded areas after periods of heavy rainfall, including grassy marshes, lagoons, flooded claypans, temporary roadside pools, ditches, mallee swales and farm dams.	Very Low – project area well outside of known range. No atlas records within mapsheets examined.	Unlikely – Unlikely to occur and preferred habitat is predominantly avoided.
Litoria raniformis	Southern Bell Frog	E	V	2008 Wildlife Atlas	WB 105	A highly adaptable and wide-ranging large frog found in a very wide range of habitats to the west of the Great Dividing Range in SW NSW. This includes permanent and ephemeral black box-lignum-nitre goosefoot swamps, lignum-typha swamps and river red gum swamps or billabongs along floodplains and river valleys as well as irrigated rice crops and farm dams in agricultural environments. The species prefers areas with emergent aquatic vegetation that they can use for shelter and for basking sites. Individuals can be found sheltering and overwintering under debris or in vegetation immediately adjacent to the breeding sites.	Moderate	**Moderate**– there is a chance of some minor impact– see assessment of significance. A significant impact is not likely.
Birds								
Botaurus poiciloptilus	Australasian Bittern	E	E	1991 Wildlife Atlas	WB 6	The Australasian Bitterns is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes. Potential presence adjacent to Murrumbidgee at eastern extent of water supply pipeline.	Moderate	Unlikely – negligible impacts to marginalhabitat only.

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Ardeotis australis	Australian Bustard	E	-			The Australian Bustard mainly occurs in inland Australia and is now scarce or absent from southern and south-eastern Australia. In NSW, they are mainly found in the north-west corner and less often recorded in the lower western and central west plains regions. Occasional vagrants are still seen as far east as the western slopes and Riverine plain. Breeding now only occurs in the north-west region of NSW. Mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams. Breeds on bare ground on low sandy ridges or stony rises in ecotones between grassland and protective shrubland cover; roosts on ground among shrubs and long grasses or under trees.	Low	Unlikely
Rostratula australis	Australian Painted Snipe	E	E, M	2011 Peter Morton	WB 1	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. May occasionally visit the larger farm dams within the project areas, particularly at West Balranald as recorded at nearby Paika Lake and wetlands (Peter Morton pers. com.). Potential presence adjacent to Murrumbidgee at eastern extent of water supply pipeline.	Low	Unlikely – negligible impacts to marginalhabitat only.
Ninox connivens	Barking Owl	V	-			Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country. Known to occur along parts of the Darling and Murrumbidgee Rivers although only a single record from Atlas search. Available habitat within the mining areas is considered marginal. Could occur along the river where water supply pipeline is proposed.	Low	Unlikely – negligible impacts to foraging habitat only.

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Falco subniger	Black Falcon	V	-			The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kms (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	Low	Unlikely
Hamirostra melanosternon	Black-breasted Buzzard	V	-		1 WB	The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts.	Low	Unlikely
Melithreptus gularis gularis	Black-chinned Honeyeater	V	-			The Black-chinned Honeyeater has two subspecies, with only the nominate (gularis) occurring in NSW. The other subspecies (laetior) was formerly considered a separate species (Golden-backed Honeyeater) and is found in northern Australia between central Queensland west to the Pilbara in Western Australia. The eastern subspecies extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions, though it is very rare in the latter. 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*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*).	Low	Unlikely
Manorina melanotis	Black-eared Miner	CE	E			In NSW, it is restricted to old growth mallee in the Scotia region, particularly within Scotia Sanctuary. Birds are restricted to large tracts (30,000 has or greater) of mature, un-fragmented mallee on the more fertile soils.	None – project area not within Scotia region.	None

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Limosa limosa	Black-tailed Godwit	V	-	1989 Atlas	1 WB	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and-or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Farm dams within the project area may provide marginal habitat however this is considered to be unlikely.	Low - Some potential habitat within areas of dams and watercourses	Unlikely – marginal habitat at eastern end of water supply pipeline would be negligibly impacted.
Oxyura australis	Blue-billed Duck	V	-	2011 Ecotone	WB 17 N3	Widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Known to occur at Paika Lake (Ecotone 2011, Peter Morton pers. com.) but unlikely to occur within the project areas.	Low	Unlikely – marginal habitat at eastern end of water supply pipeline would be negligibly impacted.
Grus rubicunda	Brolga	V	-	-	-	The Brolga was formerly found across Australia, except for the south-east corner, Tasmania and the south-western third of the country. It still abundant in the northern tropics, but very sparse across the southern part of its range. Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged. Little suitable habitat within Balranald project area.	Low	Unlikely – marginal habitat at eastern end of water supply pipeline would be negligibly impacted.
Burhinus grallarius	Bush Stone-curlew	E	-	2013 Ecotone 1995 Wildlife Atlas x 4 records.	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Atlas records occur for the wider region, and the species was detected during surveys outside the project area at a proposed power transmission line corridor near the Murrumbidgee River in January 2013. Previous records are all close to major waterways. Within western NSW it is known from grassy woodland communities (DEC 2006) rather than from comparatively low nutrient mallee communities.	Moderate – potential habitat confined to Murrumbidgee River area.	Unlikely – marginal habitat at eastern end of water supply pipeline would be negligibly impacted.

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Ardea ibis	Cattle Egret	-	M			The Cattle Egret is widespread and common according to migration movements and breeding localities surveys. Two major distributions have been located; from north-east Western Australia to the Top End of the Northern Territory and around south-east Australia. In Western Australia and the Northern Territory, the Cattle Egret is located from Wyndham to Arnhem Land. In south-east Australia it is found from Bundaberg, inland to Roma, Thargominda, and then down through Inverell, Walgett, Nyngan, Cobar, Ivanhoe, Balranald to Swan Hill, and then west to Pinnaroo and Port Augusta. In Australia the principal breeding sites are the central east coast from about Newcastle to Bundaberg. The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures.	High	Unlikely
Cinclosoma castanotus	Chestnut Quail-thrush	V	-	2011, 2012, 2013 Ecotone	WB 50 N 35	Throughout its distribution it occurs in a wide range of arid and semi-arid habitats; mainly in the low shrubs and undergrowth of mallee scrub, but also in Acacia scrubs, dry sclerophyll woodland, heath, and native pine. However, in NSW it seems to occur almost exclusively in mallee habitats, with understorey dominated by spinifex, chenopods or other shrubs including Acacia spp.	Known	**Known**– see assessment of significance. Significant impact not likely.
Stagonopleura guttata	Diamond Firetail	V	-	2013 Ecotone	-	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. A single Atlas record exists for the locality from Red-gum Woodland within State Forest 35 km east. The species was detected at the proposed Murrumbidgee River crossing for the power transmission line on one occasion but not recorded in subsequent surveys.	Moderate – may occur in area of Murrumbidgee.	Unlikely – only a small area of potential habitat would be impacted by the proposed water supply pipeline. There would be negligible impacts from that activity for this species.

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Apus pacificus	Fork-tailed Swift	-	M			In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs. The Fork-tailed Swift is almost exclusively aerial, flying from less than one metre to at least 300 metres above ground and probably much higher.	Moderate – may fly over project area. Unlikely any breeding resources.	Unlikely
Stictonetta naevosa	Freckled Duck	V	-	2006 Wildlife Atlas	WB 33 N 8	The freckled duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits. May occasionally visit the larger farm dams within the project areas. Known to occur at Paika Lake (Peter Morton pers. com.).	Moderate	Unlikely – marginal non-breeding farm dam habitat may be impacted but such impacts would be negligible.
Pachycephala inornata	Gilbert's Whistler	V	-	2008 Wildlife Atlas	WB 19 N 11	Recorded in mallee shrublands, but also occurs in box-ironbark woodlands, cypress pine and belah woodlands and river red gum forests, though at this stage it is only known to use this habitat along the Murray, Edwards and Wakool Rivers. Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including wattles, hakeas, sennas and hop-bushes. Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including wattles, hakeas, sennas and hop-bushes. Given the number of records nearby could occur within project area in low numbers as dispersing individuals or where there is a well-established shrub layer (rare).	Moderate – resident species not detected during surveys.	**Moderate** chance of impacts– see assessment of significance. A significant impact is not likely.
Tyto capensis	Grass Owl	V	-			Found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	Low	Unlikely
Ardea alba	Great Egret	-	M			Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.	Known	Unlikely

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Falco hypoleucos	Grey Falcon	E	-	-	-	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. No local recent records.	Low	Unlikely – if occurred would likely be on a transient basis and unlikely to be a local population reliant on habitat within project area
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	2011 Ecotone	WB 14 N 1	The eastern subspecies (temporalis occurs from Cape York south through Queensland, NSW and Victoria and formerly to the south east of South Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Conspicuous large communal nests/roosts are constructed out of twigs. A group of >3 birds were recorded at the Nepean project area during the 2011 surveys.	Known	**Known**– will be impacted– see assessment of significance. **Possible significant impact.**
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	2011, 2012, 2013 Ecotone Niche 2014	WB 5 N 2	This widespread species prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. It requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. A pair of birds was recorded at Sites 1 & 2 at West Balranald Ecological project area and near Site 3 at Nepean Ecological project area during the 2011 surveys, at the proposed haul road corridor in 2012 and at the Nepean Ecological project area in 2013.	Known	**Known** – will be impacted– see assessment of significance. A significant impact is not likely.
Antechinomys laniger	Kultarr	E	-			Widespread across arid and semi-arid NSW but present in very low numbers. Records typically derive from captures by domestic cats or are collected after falling into steep-sided holes. Recent records have come primarily from the Cobar and Brewarrina region. A terrestrial insectivore that inhabits open country, especially claypans among Acacia woodlands.	Low	Unlikely

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Gallinago hardwickii	Latham's Snipe	-	M			Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.	Low	Unlikely
Charadrius mongolus	Lesser Sand-plover	V	-			Inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. Non-breeding in Australia.	None – outside predicted range and no breeding habitat present.	None
Hieraaetus morphnoides	Little Eagle	V	-	2011, 2013 Ecotone, Niche 2013, 2014	WB 14 N 2	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees. Recorded during field surveys at both the West Balranald and Nepean Ecological project areas in 2011 and along the proposed power transmission line corridor in 2013.	Known	**Likely** to be impacted– see assessment of significance. A significant impact is not likely.
Anseranas semipalmata	Magpie Goose	V	-			The Magpie Goose is still relatively common in the Australian northern tropics, but had disappeared from south-east Australia by 1920 due to drainage and overgrazing of reed swamps used for breeding. Since the 1980s there have been an increasing number of records in central and northern NSW. Vagrants can follow food sources to south-eastern NSW. Mainly found in shallow wetlands less than 1 m deep, with a dense growth of rushes or sedges.	Moderate	Unlikely
Cacatua leadbeateri	Major Mitchell's Cockatoo	V	-	2011, 2012, 2013 Ecotone Niche 2013, 2014	WB 64 N 35	Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kms. Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Small groups were occasionally observed during the field survey within both the West Balranald and Nepean Ecological project areas.	Known	**Likely** to be impacted– see assessment of significance. A significant impact is not likely.

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Leipoa ocellata	Malleefowl	E	V, M	Field surveys	WB 58 N 33	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Utilises mallee with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other eucalypt woodlands, such as inland grey box, ironbark or bimble box woodlands with thick understorey, or in other woodlands such dominated by mulga or native cypress pine species. Several records from within or near both the West Balranald and Nepean Ecological project areas and also detected along the haul road and power transmission line corridors.	Known	**Known**– will be impacted– see assessment of significance. **A significant impact is likely.**
Grantiella picta	Painted Honeyeater	V	-	1997 Wildlife Atlas	WB1	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests. Limited habitat within the project areas and given the low number of records this species may not occur.	Low	Unlikely - limited area of marginal habitat with negligible impacts from Balranald Project.
Certhionyx variegatus	Pied Honeyeater	V	-	2011(unconfirmed) Ecotone	WB 2 N 1	Widespread throughout Acacia, mallee and spinifex scrubs of arid and semi-arid Australia. Occasionally occurs further east, on the slopes and plains and the Hunter Valley, typically during periods of drought. Inhabits mulga shrub, mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes; also from mistletoes and various other shrubs; also eats saltbush fruit, berries, seed, flowers and insects. A single unconfirmed sighting of this species was made at Site 4, West Balranald during the field surveys.	Moderate – potential habitat present.	**Moderate** chance of impacts– see assessment of significance. A significant impact is not likely.
Pedionomus torquatus	Plains-wanderer	E	V	1973 Wildlife Atlas 2011?	WB 1?	They occur in semi-arid, lowland native grasslands that typically occur on hard red-brown soils. These grasslands support a high diversity of plant species, including a number of state and nationally threatened species. Although no database records occur within 50km of the project area, Tin Tin landowner, Ron Hoare, indicated that they were present and a possible call was recorded in the northern part of West Balranald Ecological project area.	Moderate	**Moderate** chance of impact– see assessment of significance. A significant impact is not likely.

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V	-			The Purple-crowned Lorikeet occurs across the southern parts of the continent from Victoria to south-west Western Australia. It is uncommon in NSW, with records scattered across the box-ironbark woodlands of the Riverina and south west slopes, the River Red Gum forests and mallee of the Murray Valley as far west as the South Australian border, and, more rarely, the forests of the South Coast. The species is nomadic and most, if not all, records from NSW are associated with flowering events. Found in open forests and woodlands, particularly where there are large flowering eucalypts. Also recorded from mallee habitats. It is a nomadic species following peak tree flowering events, therefore it could seasonally forage within the project areas. It is known to breed and roost several km from its foraging areas. Three Atlas records two of which area approximately 40 km north of Nepean mine within Belah and Mallee communities.	Low – unlikely to be present given distance from previous records. Furthermore, only likely to use project area during flowering events.	Unlikely given wide ranging species.
Lichenostomus cratitius	Purple-gaped Honeyeater	V	-	2008 Wildlife Atlas	WB 1 N 2	Inhabits mallee heathlands and less commonly in associated mallee with a more open understorey (such as Spinifex associations). Is also occasionally recorded in river red gum forest bordering waterways. Most records are from south of the Murray River with few records in NSW. 5 records from Atlas search across various habitats including Mallee areas.	Low – not detected despite extensive survey.	Unlikely
Merops ornatus	Rainbow Bee-eater	-	M	Field surveys	N/A	Found throughout mainland Australia most often in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.	Known	High – EPBC Act. Significant impact not likely.
Pachycephala rufogularis	Red-lored Whistler	CE	V			Found in mallee woodland with a shrub layer, usually of broombush and native pine such as mallee pine, with occasional patches of spinifex and emergent mallee, forming a relatively dispersed canopy.	Low	Unlikely
Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo	-	E			The Red-tailed Black-Cockatoo (south-eastern) is restricted to a small area of South Australia and Victoria, delimited by Keith to Lucindale to Mt Gambier in South Australia and Portland to Casterton, Toolondo, Natimuk, Dimboola, Nhill, and Kaniva in Victoria (Hill & Burnard 2001). It is widespread but rare within this range, and breeds throughout in loose colonies with several nests within 1 km² and a minimum of 40 m between active nests (Hill, undated).	Low – project area outside of predicted range.	Unlikely

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Pyrrholaemus brunneus	Redthroat	V	-	Field surveys	WB 25 N19	In NSW the species has been recorded mainly in chenopod shrublands including old man saltbush, black bluebush and dillon bush shrublands. Most likely to occur in the northern part of the West Balranald and southern part of Nepean project areas. This species was detected within the West Balranald Ecological project area and within the proposed haul road corridor during the 2013 survey period.	Known	**Known**– will be impacted– see assessment of significance. A significant impact is not likely.
Polytelis anthopeplus monarchoides	Regent Parrot	E	V	Field surveys	WB 111	The eastern subspecies is restricted to areas around the Murray River in South Australia, Victoria and NSW. In NSW it occurs along the Murray River downstream of Tooleybuc (though there are few records between Mildura and the South Australian border), the Wakool River downstream of Kyalite, and the Murrumbidgee River immediately upstream from the junction with the Murray River and adjoining areas of mallee. There are scattered records along the Darling River as far north as Menindee, but at this stage the species has not been confirmed to breed along this river. The nominate subspecies occurs in south western Western Australia. The species nests within River Red Gum forests along the Murray, Wakool and lower Murrumbidgee Rivers, and possibly the Darling River downstream of Pooncarie. Typical nest trees are large, mature healthy trees with many spouts (though dead trees are used) and are usually located close to a watercourse. It is possible that the mallee in the southern part of the West Balranald project area would be within foraging range, but is outside of the typical foraging range.	Moderate	**Moderate** – maybe impacted– see assessment of significance. A significant impact is not likely.
Calamanthus campestris	Rufous Fieldwren	V	-	-	WB 1	Eight subspecies are distributed through arid and in the west coastal southern Australia. In NSW most records are of the subspecies isabellinus and are centred in the Broken Hill-Mutawintji-Fowlers Gap area. Inhabits low shrublands, particularly saltbush and bluebush communities, and also areas around inland saline lakes. A single bird thought to be this species was heard calling at Site 8, West Balranald Ecological project area during these surveys in 2011 however it may have been confused with the redthroat.	Low	Unlikely
Calidris alba	Sanderling	V	-	-		Found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands.	None – project area not within predicted range.	None

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Myiagra cyanoleuca	Satin Flycatcher	-	M			Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. In NSW, they are widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains.	Low	Unlikely
Neophema splendida	Sclarlet-chested Parrot	V	-			Thinly distributed across the arid interior of southern Australia from far western NSW to the vicinity of Kalgoorlie (WA), extending as far north as southern Northern Territory. Sometimes locally common and subject to local irruptions. Rarely recorded in NSW, with historical records from Menindee Lakes (1849), the 'Darling River' (1863), Bourke (1892) and near Broken Hill (1952). More recently, this species has been recorded occasionally in Danggali Conservation Park (SA) and in the adjoining Scotia Mallee (Tarawi NR, Scotia Sanctuary) in NSW.	Low	Unlikely
Hylacola cauta	Shy Heathwren	V	-		WB 1	Inhabits mallee woodlands with a relatively dense understorey of shrubs and heath plants. The central NSW population (for example in Cocoparra NP) also occurs at low densities in rocky hilltop vegetation with a thick shrub layer such as broombush or tea-tree. In 2011, a pair of birds thought to be this species, were sighted in bluebush near a mallee remnant in the northern part of the West Balranald Ecological project area. However they may have been confused with the redthroat which was confirmed to occur in January 2013. Numerous records from region - Mallee Cliffs National Park area as well as private land to its south.	Low	Unlikely
Drymodes brunneopygia	Southern Scrub-robin	V	-	-	-	This species is restricted to mallees and shrublands across southern Australia and in NSW is confined to two main areas: central NSW, centred on Round Hill and Nombinnie Nature Reserves; far south west of NSW, mainly within the Scotia mallee centred on Tarawi NR and Scotia Sanctuary. Inhabits mallee and Acacia scrub, particularly with dense sub-shrubs in the understorey, including Broombush and other dry shrubs.	Low - resident species not detected during surveys and records > 50 km west.	Unlikely

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Chthonicola sagittata	Speckled Warbler	V	-	1994 Wildlife Atlas	WB 1	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive. The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. The habitat appears unsuitable for this species. Current four Atlas records are from near Euston and Mildura in Black-box and Red-gum Woodland.	Low – marginal potential habitat. No areas of rocky ridges of gullies.	Unlikely. If present a limited area of marginal habitat would be affected and therefore negligible impacts expected from Balranald Project.
Circus assimilis	Spotted Harrier	V	-	2011, 2012 Ecotone	WB 5 N 3	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. . Nests are constructed in larger trees within the landscape. Observed foraging in the open plains of the project areas during the 2011 surveys and over the proposed haul road corridor in 2012.	Known	**Moderate** chance of impact– see assessment of significance. A significant impact is not likely.
Lophoictinia isura	Square-tailed Kite	V	-	1989 Wildlife Atlas	WB 1 N 1	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata or E. smithii. Individuals appear to occupy large hunting ranges of more than 100km2. They require large living trees for breeding, particularly near water with surrounding woodland - forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	Moderate	Unlikely - single record and preferred habitat along Murrumbidgee would largely not be impacted.

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Amytornis striatus	Striated Grasswren	V	-			This species is widely distributed through the arid and semi-arid regions of mainland Australia, with three subspecies currently recognised. In NSW, the race striatus was formerly distributed from the Namoi Valley area through the southern half of the Murray-Darling Basin. It is now currently known from only two disjunct localities. In central NSW, populations remain extant in Yathong Nature Reserve and surrounding areas of leasehold land. A second population occurs in south-western NSW in the Scotia Mallee west of the Darling River, including Tarawi NR, Scotia Sanctuary and adjoining properties. This population is contiguous with populations in adjoining mallee country in South Australia. Confined to areas with mature spinifex, usually in association with mallee eucalypts and sandy soils.	Low – project area just to south of predicted range, however some potential habitat occurs. Not recorded despite extensive survey.	Unlikely
Lathamus discolor	Swift Parrot	E	E	-	-	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	Low	Unlikely
Amytornis textilis modestus	Thick-billed Grasswren	CE	V			The eastern subspecies of the Thick-billed Grasswren occurs in chenopod shrublands (which occur in the arid and semi-arid zones), especially shrublands dominated by saltbush Atriplex spp. and bluebush Maireana spp., sometimes with widely scattered trees. The eastern subspecies of the Thick-billed Grasswren has contracted from much of the eastern part of its range. It is now probably extinct in NSW (Higgins et al. 2001). There are confirmed historical records from the following locations in western NSW: (1) two collected on Pimpara Lake Station, near Milparinka, in the Upper Western Region, October 1912; (2) one collected at Yandembah, around 40 km east-southeast of Mossgiel, in the Lower Western Region, possibly collected in November 1886; and (3) a specimen collected from the lower Namoi River valley, inland northern NSW, in December 1839 or January 1840, but the precise locality is not known (Higgins et al. 2001; McAllen 1987; Parker 1972). The last confirmed records from NSW were of the specimens collected on Pimpara Lake Station in October 1912,	None – Species likely extinct in NSW. Project area outside of predicted range.	Unlikely

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Daphoenositta chrysoptera	Varied Sittella	V	-	Field surveys	WB 7 N4	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows. Recorded at Nepean Ecological project area during both the 2011 and the 2013 survey periods as well as injection borefields.	Known	**Known**– will be impacted– see assessment of significance. A significant impact is not likely.
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M			Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	Known	Unlikely – movements mostly confined to around Murrumbidgee.
Epthianura albifrons	White-fronted Chat	V	-	2011 Ecotone	WB 17 N 11	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground.	Known	**Known**– will be impacted– see assessment of significance. A significant impact is not likely.
Mammals								
Pseudomys bolami	Bolam's Mouse	E	-	2000 Wildlife Atlas;	WB 1 N 4	Records in NSW are centred on the Scotia Mallee including Tarawi Nature Reserve, Nanya Station, Scotia Sanctuary and surrounding properties. A smaller number of records also to the south east of Mungo National Park, from Mutawintji National Park and more recently east of Broken Hill. Recorded in a wide variety of habitats, with a preference for chenopod shrubland plains or low mallee woodland where there is a developed understorey of Acacia, Dodonaea or Eremophila spp. Four records from Wampo station adjacent to project area.	Moderate	**Moderate** - see assessment of significance. A significant impact is not likely.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-			Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Moderate	Unlikely

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Niche 2013, 2014	WB 22 N 26	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Inhabits a variety of vegetation types, including mallee, bulloak and box 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. Roosts in tree hollows, crevices, and under loose bark. Captures twice during these surveys, suitable habitat occurs in both the West Balranald and Nepean Ecological project areas and elsewhere where mature vegetation is present.	Known	**Known** - see assessment of significance. A significant impact is unlikely.
Vespadelus baverstocki	Inland forest Bat	V	-	2011 Ecotone	WB 22 N 28	Roosts in tree hollows and abandoned buildings. Known to roost in very small hollows in stunted trees only a few metres high. The habitat requirements of this species are poorly known but it has been recorded from a variety of woodland formations, including mallee, mulga and river red gum. Most records are from drier woodland habitats with riparian areas inhabited by the Little forest Bat. However, other habitats may be used for foraging and-or drinking. Suitable known habitat occurs in both of the project areas. A low tree roost, possibly belonging to this species was observed within Nepean Ecological project area in 2013.	Known	**Known** - see assessment of significance. A significant impact is unlikely.
Phascolarctos cinereus	Koala	V	V	-	-	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall. In Western NSW only possible within River Red Gum forest along major watercourses so small area where Water supply pipeline near Murrumbidgee River is the only habitat within the project area. Three existing atlas records are from Murray River.	Low	Unlikely - If present a limited area of marginal habitat would be minimally affected and therefore negligible impacts are expected from the Balranald Project
Chalinolobus picatus	Little Pied Bat	V	-	2011 Ecotone	WB 1 N 5	The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria. Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Recorded at Nepean and a dead specimen was found outside of the West Balranald project area in Tin Tin shearer's quarters during this survey.	Known	**Known** - see assessment of significance. **A significant impact is possible.**

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Lasiorhinus latifrons	Southern Hairy-nosed Wombat	E	-			Distribution has become fragmented and contracted in the last 200 years. Once regarded as common in south-western NSW but the current size of this population is unknown. Habitat is semi-arid grasslands and open woodlands.	None – outside of known distribution and not recorded during survey.	None
Ningaui yvonneae	Southern Ningaui	V	-	2009 Wildlife Atlas, 2011 Ecotone	WB 9 N 30	In NSW most records are from the far south west, including the Scotia mallee (Tarawi Nature Reserve, Scotia Sanctuary and surrounding properties) and east of the Darling River (Mungo and Mallee Cliffs National Parks and many surrounding properties). Shelters in spinifex clumps, beneath logs, and in dense vegetation, but may also dig its own burrows. Recorded in the Nepean mine area during the surveys and is expected to occur in the southern part of West Balranald in area where suitable mallee/spinifex habitat occurs.	Known	**Known** - see assessment of significance. A significant impact is unlikely.
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	2004 Atlas	WB 2	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Most likely to occur in habitats closely associated with the major river systems, therefore there is a remote chance that it could occur around the water supply pipeline near the river.	Low – around Murrumbidgee only	Unlikely – Negligible impacts in potential habitat area.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Field surveys	WB 1? N 1?	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. A possible ultrasonic call was recorded at Site 2 West Balranald Ecological project area and at an opportunistic site within Nepean Ecological project area during these surveys.	Known	**Known** - see assessment of significance. A significant impact is unlikely.
Cercartetus concinnus	Western Pygmy Possum	E	-	2001 Wildlife Atlas	WB 55 N 65	In NSW, has been found in mallee shrubland either dominated by spinifex or with an understorey of tea-tree and also in belah in a mixed woodland with a well-developed understorey of saltbush. Several captures were made in the Wampo Conservation Area to the north in 2000-2001 however subsequent surveys have failed to record the species (James Val, OEH pers. com.)	Moderate – While not recorded during survey, numbers are likely to fluctuate and may be difficult to detect over large areas.	**Moderate** - see assessment of significance. A significant impact is unlikely.
Reptiles								

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Echiopsis curta	Bardick	E	-	1983 Wildlife Atlas	WB 1 N 1	There are three known records from NSW, one from the Balranald district in 1974, one north west of Balranald in 1983 and one north east of Mildura. Inhabits hummock grasslands and mallee areas on sandy or loamy soils and is usually associated with run-off slopes and drainage from local rises. The species is particularly common in areas of spinifex. Suitable habitat occurs within the Balranald mine area.	Moderate – While not recorded during survey, may be difficult to detect.	**Moderate** - see assessment of significance. A significant impact is unlikely.
Diplodactylus stenodactylus	Crowned Gecko	V	-			In NSW, known from four separate locations in the state's far west: Sturt National Park, Mutawintji National Park, Loch Lilly, 125km south of Broken Hill, and Thurloo Downs, 145km east of Tibooburra. In NSW, the species has been reported from red sand habitats and elsewhere from savannah woodland and stony areas with shrubs.	Low – Outside of known distribution and not detected during survey.	Unlikely
Diplodactylus elderi	Jewelled Gecko	V	-	2000 Wildlife Atlas, 2013 Ecotone	N 2	In NSW records of the species are largely confined to the south-west of the state in two broad areas: between Mildura and Menindee and between Menindee and Robinvale. The Jewelled Gecko is restricted to spinifex, Triodia species, habitat on red soils, usually in association with mallee woodlands. The species is entirely dependent on spinifex clumps for shelter and foraging sites and is found within relatively large, mature clumps in areas that are not frequently burnt.	Known	**Known -** see assessment of significance. **A significant impact is possible.**
Delma australis	Marble-faced Delma	E	-	-	-	In NSW, appears to be restricted to temperate mallee woodlands or spinifex grasslands but elsewhere is also found in chenopod shrublands, heathlands and bulloak associated with mallee habitats or eucalypt lined watercourses. Single record only from south of Mallee Cliffs National Park.	Low	Unlikely
Aprasia inaurita	Mallee Worm-lizard	E	-	2000 Wildlife Atlas 2007/8 Val et al.	WB 1 N 3	Inhabits semi-arid, mallee woodlands on red sands. Often shelters in sand, beneath mallee stumps, in leaf litter or in the nests of ants and other insects; thought to be dependent on spinifex. Suitable habitat occurs in the Balranald project area and it was recorded for the Weimby 1: 100,000 map sheet near West Balranald (Val et al. 2012). Single Atlas record within West Balranald mine and several records north of Nepean mine.	Moderate – while not detected, species is cryptic so could occur given nearby records.	**Moderate** - see assessment of significance. **A significant impact is possible.**

Scientific name	Common name	TSC Act	EPBC Act	Most Recent Record	Atlas Records within 50 km	Habitat	Likelihood of occurrence	Potential for Impact
Cyclodomorphus melanops elongatus	Mallee Slender Blue-tongue Lizard	E	-			The species is widely distributed in inland areas of all mainland states (except Victoria) and the Northern Territory, with the subspecies elongatus occurring from southern Western Australia to central Queensland. In NSW it is restricted to the far south west with records scattered from mallee areas either side of the Darling River (including the Scotia mallee and Mungo and Mallee Cliffs National Parks). Recent surveys have detected this species in spinifex occurring on rocky hillsides to the north west of Broken Hill, a range extension over 100 kms in NSW. In NSW, animals inhabit mallee/spinifex communities on a sandy or mixed sand/gravel substrate (plains, ridges or hillslopes). It is assumed that the species seeks refuge in vegetation clumps such as spinifex and in fallen timber and leaf litter. Two records from south of Mallee Cliffs National Park.	Low – not recorded despite extensive survey in and adjacent to project area.	Unlikely
Pseudonaja modesta	Ringed Brown Snake	E	-			Recorded from Tarawi Nature Reserve, 140km south of Broken Hill, Silverton, Tibooburra, Wanaaring and from Kilberoo, 140km north-west of Bourke. A terrestrial species that inhabits drier areas including rocky outcrops and dry watercourses. Occurs in a variety of vegetation types including woodlands, shrublands, mallee and grasslands.	None - outside of known distribution.	None
Tiliqua occipitalis	Western Blue-tongued Lizard	V	-	1994 Wildlife Atlas, 2013 Ecotone	WB 2	Scattered records across central western and western NSW. Inhabits plains, swales, ranges and sometimes dunes of loamy or clayey-sandy soils vegetated by woodlands, especially mallee, shrublands (including chenopods), heaths or hummock grasslands. Preferred vegetation type appears to be mixed mallee-spinifex communities. Suitable habitat occurs in both the West Balranald and Nepean Ecological project areas and this species was detected at the Nepean Ecological project area during the 2013 survey period.	**Known**	**Moderate** - see assessment of significance. **A significant impact is possible.**
Lerista xanthura	Yellow-tailed Plain Slider	V	-	-	-	In NSW, the species is known from two disjunct populations. One population occurs between Tarawi Nature Reserve, Ivanhoe and Broken Hill, and the other in the north-west corner of the state. Occurs in a variety of semi-arid and arid habitats. Occurs on grassed alluvial sands and sand dunes, including dry open woodlands and spinifex-dominated red sand plains. Not predicted to occur within CMA subregion. Six Atlas records all south of Mallee Cliffs National Park.	Low	Unlikely

Appendix 3: Threatened Aquatic Fauna Likelihood of Occurrence

Scientific name	Common name	FM Act	EPBC Act	Records	Habitat	Likelihood of Occurrence	Potential for Impact
Fish							
Ambassis agassizii	Olive Perchlet	EP	-	1881 Murrumbidgee down stream of Balranald (ALA)	Olive Perchlets are a small native fish that occur in both eastern (coastal) and western (Murray-Darling) drainages, but these populations may be genetically distinct. The western population of the Olive Perchlet was once widespread throughout the Murray-Darling system of South Australia, Victoria, western New South Wales and southern Queensland. This population has suffered a serious decline and is now found only at a few sites in the Darling River drainage	Low	Unlikely
Bidyanus bidyanus	Silver Perch	V	CE	Records upstream of Balranald (2009)(ALA)	Silver Perch were once widespread and abundant throughout most of the Murray-Darling river system. They have now declined to low numbers or disappeared from most of their former range. Only one remaining secure and self-sustaining population occurs in NSW in the central Murray River downstream of Yarrawonga weir, as well as several anabranches and tributaries. Silver Perch seem to prefer fast-flowing, open waters, especially where there are rapids and races.	Known	Unlikely
Craterocephalus fluviatilis	Murray Hardyhead	CE	E	1995 Naranderra - Bundigeree Creek (DPI)	Murray Hardyhead is a species of small freshwater fish, native to inland parts of south-eastern Australia. They were once widespread and abundant in the Murray and Murrumbidgee river systems in southern NSW and northern Victoria; however, they have suffered a serious population decline, and now seem to be limited to a few sites, mainly in northern Victoria. There are very few recent records of Murray Hardyhead in NSW. Murray hardyhead live along the edges of slow-flowing lowland rivers, as well as in lakes, billabongs and backwaters. They are often found amongst aquatic weeds, in both fresh and quite saline waters	Moderate	Unlikely
Galaxias rostratu	Flathead Galaxias	CE	-	1995 at Hay on the Murrumbidgee River (DPI)	Flathead Galaxias are found in still or slow moving water bodies such as wetlands and lowland streams. The species has been recorded forming shoals. They have been associated with a range of habitats including rock and sandy bottoms and aquatic vegetation. Flathead Galaxias, also known as Murray jollytail are a small native fish that are known from the southern part of the Murray Darling Basin. They have been recorded in the Macquarie, Lachlan, Murrumbidgee and Murray Rivers in NSW. Despite extensive scientific sampling over the past 15 years there have been very few recorded sightings of Flathead Galaxias. They have not been recorded	Low	Unlikely

Scientific name	Common name	FM Act	EPBC Act	Records	Habitat	Likelihood of Occurrence	Potential for Impact
					and are considered locally extinct in the lower Murray, Murrumbidgee, Macquarie and Lachlan Rivers. The species is now only known from the upper Murray River near Tintaldra and wetland areas near Howlong		
Macquaria australasica	Macquarie Perch	E	E	No records close to survey area	Macquarie perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven. Macquarie perch are found in both river and lake habitats; especially the upper reaches of rivers and their tributaries. Macquaria australasica was regularly recorded in the Murrumbidgee River around and below Wagga Wagga in the early and mid 1900's however Macquaria australasica may be extirpated in the lower Murray and Murrumbidgee rivers.	Low	Unlikely
Maccullochella macquariensis	Trout Cod	E	E	2006 Murrumbidgee at Leeton (DPI)	The Trout Cod is endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central NSW. The species was once widespread and abundant in these areas but has undergone dramatic declines in its distribution and abundance over the past century. The last known reproducing population of Trout Cod is confined to the Murray River below Yarrawonga downstream to Tocumwal. Trout Cod are often found in faster flowing water with rocky and gravel bottoms as well as slower flowing, turbid lowland rivers. They tend to occupy areas which have lots of large woody debris or 'snags.	Moderate	Unlikely
Maccullochella peelii	Murray Cod	-	V	2007 Murrumbidgee River near Balranald (DPI)	The Murray Cod is found extensively throughout the Murray-Darling Basin (the Basin) in south-eastern Australia. Its range throughout the Basin includes Queensland, New South Wales (NSW), the Australian Capital Territory (ACT), Victoria and South Australia. Historically, the species occurred throughout the entire Basin with the exception of the upper reaches of some tributaries. It still occurs throughout most of the Basin with the exception of some localised extinctions. The Murray-Darling Basin contains approximately 13 245 km of waterways that may encompass areas of suitable habitat for the Murray Cod. The Murray Cod utilizes a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW, to slow-flowing, turbid rivers and billabongs	Known	Unlikely
Mogurnda adspersa	Purple spotted gudgeon	E	-	1910 Murrumbidgee	Purple Spotted Gudgeons occur in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland. The	Low	Unlikely

Scientific name	Common name	FM Act	EPBC Act	Records	Habitat	Likelihood of Occurrence	Potential for Impact
				River at Bringagee (ALA)	western population of the Purple Spotted Gudgeon was previously widespread in the Murray, Murrumbidgee and Lachlan River systems and tributaries of the Darling, but has experienced a significant decline in recent times. Purple Spotted Gudgeons are now extremely rare in inland NSW, having been recorded from this area only once since 1983.		
Nannoperca australis	Southern Pygmy Perch	E	-	1918 at Murrumbidgee at Bringagee (ALA)	Southern Pygmy Perch were once widely distributed throughout the Murrumbidgee and Murray River systems, as well as coastal streams in South Australia and Victoria, north-eastern Tasmania and King and Flinders Islands in Bass Strait. There have been large-scale reductions in their range since European settlement, particularly in inland regions. Populations of Southern Pygmy Perch have recently been discovered in tributaries of the upper Lachlan and upper Murray River catchments.	Low	Unlikely
Tandaunus Tandanus	Eel tailed Catfish	EP	-	1963 Murrumbidgee at Naranderra (ALA)	The western population of Tandanus tandanus was originally widely distributed throughout the Murray-Darling River System in NSW, Queensland, Victoria and South Australia, with the exception of the cooler parts of the southern tributaries. It was relatively uncommon upstream of Wagga Wagga on the Murrumbidgee River and Lake Mulwala on the Murray River. .Tandanus tandanus is non migratory and lives in a wide range of habitats including rivers, creeks, lakes, billabongs and lagoons, and although it inhabits flowing streams, prefers sluggish or still waters. It can be found in clear to turbid waters, and over substrates ranging from mud to gravel and rock	Moderate	Unlikely
Mulluscs							
Notopala sublineata	River snail	E	-	2011 Murray at Mildura (ALA)	Notopala sublineata is a freshwater snail that was once common and widespread in the Murray-Darling river system. The river snail once occurred in flowing rivers throughout the Murray-Darling system, where it was found along the banks attached to logs and rocks or crawling in the mud. Although now virtually extinct throughout its natural range, remaining populations appear to be restricted to artificial habitats (irrigation pipelines) in the Murray and Darling systems.	Low	Unlikely
Crustaceos							
Euastacus armatus	Murray River Cray Fish	V	-	No specific recent database records are available	The Murray Crayfish is a freshwater crayfish that is endemic to the southern tributaries of the Murray-Darling Basin. They can be found in a variety of habitats, ranging from pasture-lands to sclerophyll forest, in a range of	Low	Unlikely

Scientific name	Common name	FM Act	EPBC Act	Records	Habitat	Likelihood of Occurrence	Potential for Impact
				however are now considered rare in the lower Murrumbidgee (DPI).	stream sizes and throughout a broad altitudinal range		

Habitat information was source from DPI Fisheries http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current and Department of Environment http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66633 Accessed February 2015

Appendix 4: Flora recorded during survey

Table 38: Flora records from Biobanking floristic plots collected within the West Balranald mine area (Ecotone)

Scientific Name	West Balranald Plot Name/number																				
	1	2	3	4	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
*Amaranthus albus**																		X			
*Ambrosia tenuifolia**				X																	
Angianthus tomentosus																		X			
Atriplex leptocarpa												X									X
Austrostipa elegantissima							X														X
Austrostipa nitida			X			X	X		X		X										
Austrostipa nodosa	X												X		X						
Austrostipa scabra	X	X			X		X	X	X	X		X				X	X	X	X	X	X
Brachyscome lineariloba										X	X	X									X
Chenopodim desertorum	X																				
Chenopodium					X	X	X	X													
Daucus glochidiatus											X										
Dichopogon fimbriatus			X																		
Dissocarpus paradoxus												X									
Dodonaea viscosa subsp.					X																
Einadia nutans	X		X			X											X	X	X		
Enchylaena tomentosa				X		X	X	X					X				X	X	X		
Eragrostis dielsii											X										X
Eucalyptus dumosa	X	X	X	X	X	X	X	X	X			X	X		X		X	X			
Eucalyptus leptophylla					X	X	X	X	X				X	X	X	X	X				
Eucalyptus oleosa subsp.	X	X			X	X		X								X	X				
Eucalyptus socialis	X	X	X	X	X	X	X	X							X			X	X	X	
Goodenia fascicularis				X						X	X										X
Halgania cyanea																			X		
*Hordeum leporinum**	X									X								X			X

Scientific Name	West Balranald Plot Name/number																				
	1	2	3	4	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Juncus aridicola											X										
Lawrencia squamata					X							X									
Lepidium sp.						X					X										X
Lomandra effusa	X		X						X				X	X		X		X			
Lomandra glauca			X											X							
Lomandra leucocephala			X																X		
Maireana erioclada												X									
Maireana georgei			X		X				X												
Maireana pentatropis					X	X	X	X	X	X						X	X		X	X	
Maireana pyramidata						X	X	X													
Maireana sedifolia										X	X										X
Marsdenia australis			X																		
*Medicago minima**										X	X										X
Minuria cunninghamii																					X
Myoporum montanum					X																
Nitraria billardierei						X	X			X	X	X									X
Olearia muelleri		X						X					X		X	X	X				
Olearia pimeleoides																	X		X	X	
Oxalis perennans				X							X										
Plantago cunninghamii										X	X										X
Prostanthera aspalathoides			X																X		
Ptilotus exaltatus var.												X									
Ptilotus seminudus	X					X			X							X					
Rhodanthe corymbiflora																					X
Rytidosperma sp.										X	X										
Schenkia spicata										X	X										
Schoenus subaphyllus			X																		

Scientific Name	West Balranald Plot Name/number																				
	1	2	3	4	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Sclerolaena brachyptera		X			X	X						X				X					
Sclerolaena diacantha	X								X	X	X				X	X	X	X	X	X	X
Sclerolaena divaricata						X	X														
Sclerolaena parviflora		X																X			
Senna artemisioides subsp.				X									X			X					
Sida intricata										X											
*Silene apetala**	X		X	X																	X
*Silene gallica var. gallica**											X										
*Sisymbrium erysimoides**	X		X	X	X	X	X			X								X			X
*Sonchus asper**										X	X										
*Sonchus oleraceus**	X		X	X																	
Teucrium racemosum			X							X											X
Thysanotus baueri																					
Triodia scariosa subsp.	X	X	X											X			X	X	X	X	
Triraphis mollis										X	X										
Unid. dried composite																					X
Unid. dried herb*												X									
Unid. exotic grass*	X																				
Unid. native grass												X									
Unid. native herb																X					
Vittadinia cervicularis var.																		X			
Vittadinia cuneata var.	X		X								X										
Wahlenbergia luteola				X																	
Xerochrysum bracteatum			X																		
Zygophyllum ammophilum		X																			
Zygophyllum apiculatum		X		X	X	X	X	X	X			X	X								
Zygophyllum aurantiacum									X							X					

Notes: * = exotic species; ? = insufficient material to identify species with total certainty

Table 39: Flora records from Biobanking floristic plots collected within the West Balranald mine area (Ecotone cont.)

	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47	B48	B49	B50	B51
Actinobole uliginosum			X									X	X		
Atriplex eardleyae	X	X													
Atriplex nummularia													X	X	X
Atriplex semibaccata			X			X		X				X			
Atriplex stipitata							X								
Atriplex vesicaria			X					X				X			
Austrodanthonia caespitosa				X											
Austrostipa nodosa				X											
Austrostipa scabra	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bossiaea walkeri							X								
Brachyscome dentata			X												
Bulbine semibarbata														X	X
Calandrinia eremaea			X												
Callitris verrucosa	X	X													
Calotis cuneifolia					X										
Chenopodium curvispicatum											X				
*Conyza sumatrensis**		X	X			X						X			
Crassula colorata			X									X			
Dichopogon fimbriatus															
Dissocarpus paradoxus			X	X		X		X				X	X	X	
Dodonaea bursariifolia		X													

	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47	B48	B49	B50	B51
Dodonaea viscosa subsp.						X									
Einadia nutans	X	X	X									X			
Enchylaena tomentosa			X					X				X	X		
Enneapogon avenaceus															
Eragrostis australasica															X
Eragrostis dielsii			X					X				X	X		X
Eucalyptus dumosa	X	X		X	X				X	X		X			
Eucalyptus gracilis			X	X		X				X		X			
Eucalyptus leptophylla											X				
Eucalyptus oleosa subsp.					X		X	X	X						
Eucalyptus socialis			X			X	X	X			X				
Eucalyptus spp.															
Euchiton sphaericus			X												
Geijera parviflora							X								
Grevillea huegelii	X	X			X				X	X					
Halgania cyanea					X										
*Hordeum leporinum**			X									X			
Juncus aridicola															X
Lachnagrostis filiformis							X				X				X
Lepidium leptopetalum								X							
Lomandra collina	X	X			X					X					
Lomandra effusa	X	X		X	X	X	X		X	X	X				
*Lycium ferocissimum**							X								
Maireana astrotricha				X											

	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47	B48	B49	B50	B51
Maireana erioclada				X		X									
Maireana pentatropis		X	X	X		X	X	X			X	X			
Maireana pyramidata				X			X	X				X	X	X	X
Maireana sedifolia													X		
Maireana sp.	X	X		X											
Marsilea drummondii															X
*Medicago minima**			X									X			X
*Mentha pulegium**												X			
Myoporum platycarpum					X										
Nitraria billardierei												X			X
Olearia muelleri		X													
*Oxalis pes-caprae**			X									X			
*Petrorhagia nanteuilii**													X	X	X
Plantago coronopus subsp.															X
*Psilocaulon tenue**												X			
Ptilotus seminudus			X				X				X				
Rhagodia spinescens													X	X	X
Rytidosperma setaceum													X	X	X
Santalum acuminatum									X						
Sarcozona praecox			X												
Schoenus subaphyllus	X				X										
Sclerolaena brachyptera															
Sclerolaena diacantha			X	X		X	X	X	X		X	X	X	X	X
Sclerolaena muricata													X		

	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47	B48	B49	B50	B51
Sclerolaena parviflora	X	X			X	X	X		X		X				
Senna artemisioides				X							X				
*Silene apetala**													X		
*Silene gallica var. gallica**			X					X							
*Sisymbrium erysimoides**			X					X				X	X	X	
*Sonchus oleraceus**			X									X			
Stemodia florulenta															X
Thysanotus baueri										X	X				
Triodia scariosa subsp.	X	X			X	X			X	X					
Unid. herb*														X	
Unidentified species 1														X	X
Unidentified species 2	X	X				X									X
Unidentified species 3													X	X	
Unidentified species 4	X		X		X								X		
Unidentified species 6						X									
Vittadinia dissecta var. hirta	X					X			X		X				
Vittadinia pterochaeta	X		X					X							
Wahlenbergia fluminalis			X			X									
Westringia rigida						X			X	X					
Xerochrysum bracteatum			X			X									
Zygophyllum apiculatum			X	X			X	X			X	X			
Zygophyllum aurantiacum				X											

Notes: * = exotic species; ? = insufficient material to identify species with total certainty

Table 40: Flora records from Biobanking floristric plots collected within the Nepean mine area (Ecotone)

	Nepean Plot Name/number																			
Scientific Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Acacia burkittii?															X						
Atriplex acutibracteata subsp. acutibracteata?		X																			
Atriplex leptocarpa?		X																			
Atriplex nummularia	X	X	X	X			X	X	X	X			X		X		X			X	
Atriplex semibaccata		X							X												
Atriplex stipitata					X	X		X													
Atriplex vesicaria															X						
Austrodanthonia setacea				X					X	X											
Austrostipa drummondii				X													X	X			
Austrostipa nodosa								X		X		X									
Austrostipa scabra subsp. scabra	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Brachyscome basaltica var. gracilis															X	X					
Brachyscome lineariloba						X															
Bulbine semibarbata		X				X															
Cassytha melantha			X																		
Casuarina pauper				X				X							X			X			
Chenopodium curvispicatum														X	X	X		X	X	X	
Chenopodium desertorum					X				X	X			X								

	Nepean Plot Name/number																				
Scientific Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Dichopogon fimbriatus												X									
Dissocarpus paradoxus	X	X	X	X				X										X			
Dodonaea viscosa subsp. angustissima			X	X																	
Duboisia hopwoodii									X	X								X			
Einadia nutans				X		X							X					X			
Enchylaena tomentosa	X		X			X	X		X	X	X	X		X			X	X			
Eragrostis dielsii		X				X	X			X							X			X	
Eremophila glabra			X		X																
Eremophila longifolia																					
Eremophila sturtii			X															X			
Eucalyptus costata subsp. murrayana					X		X				X						X		X		
Eucalyptus dumosa	X	X	X			X	X			X		X		X		X				X	
Eucalyptus leptophylla																X				X	
Eucalyptus oleosa subsp. oleosa	X	X			X	X			X				X								
Eucalyptus socialis			X			X				X	X	X	X	X			X		X		
Exocarpos aphyllus				X						X					X			X			
Geijera parviflora			X															X			
Lachnagrostis filiformis																	X				
Lepidium leptopetalum																X					
Lomandra effusa														X							
Lomandra leucocephala																X					

	Nepean Plot Name/number																			
Scientific Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
subsp. robusta																					
Lotus cruentus										X											
Maireana appressa	X																				
Maireana brevifolia						X		X			X	X				X	X				
Maireana erioclada												X	X		X						
Maireana pentatropis	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X
Maireana pyramidata		X		X	X	X	X	X	X	X			X	X	X		X	X	X	X	X
Maireana sedifolia			X																		X
Marsdenia australis			X											X			X				
Myoporum platycarpum					X			X		X					X	X					
Olearia muelleri			X													X					
Olearia pimeleoides			X	X		X	X										X	X			
Ptilotus exaltatus var. exaltatus			X																		
Ptilotus nobilis										X	X										
Ptilotus seminudus													X	X							
Rhagodia spinescens													X	X							
Rhodanthe uniflora?						X															
Schenkia spicata										X											
Schoenus subaphyllus											X								X		
Sclerolaena brachyptera					X			X											X	X	X
Sclerolaena diacantha	X	X		X		X	X		X			X	X		X		X	X		X	X
Sclerolaena parviflora					X		X				X					X			X		

	Nepean Plot Name/number																			
Scientific Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Senna form taxon 'coriacea'			X												X						
Senna artemisioides				X													X				
Sida intricata			X																		
Solanum esuriale							X														
Thysanotus baueri														X							
Triodia scariosa subsp. scariosa					X	X	X				X	X	X	X		X	X		X		
Vittadinia cervicularis var. cervicularis			X																		
Vittadinia pterochaeta		X	X		X		X	X	X	X		X	X		X	X		X	X		X
Wahlenbergia fluminalis		X								X											
Zygophyllum apiculatum			X										X		X			X		X	
Zygophyllum eremaeum				X																	X
Unidentified native species 1		X																			
Unidentified native species 2					X																
Unidentified native species 3						X			X								X				
Unidentified native species 4				X																	
Unidentified native species 5					X																
Unidentified native species 6																			X		
Unidentified native species																	X				X

	Nepean Plot Name/number																			
Scientific Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
7																					
*Herniaria cinerea**										X											
*Hordeum leporinum**						X															
*Marrubium vulgare**						X	X			X							X	X			
*Medicago minima**		X								X								X			X
*Mentha pulegium**		X																			
*Oxalis pes-caprae**						X											X				
*Spergularia diandra**		X																			
Unidentified exotic species 1*														X	X						
Unidentified exotic species 2*						X												X			

Notes: * = exotic species; ? = insufficient material to identify species with total certainty

Table 41: Flora records from Biobanking floristric plots collected within injection borefiled areas (Niche)

	Injection Borefields Plot Name/number																		
Scientific Name	**1684 ns014**	**BB 3**	**BID 1**	**BID 10**	**BID 11**	**BID 12**	**BID 13**	**BID 2**	**BID 5**	**BID 6**	**BID 7**	**BID 8**	**BID 9**	**BID BB4**	**NS_ 011**	**NS_ 012**	**NS_ 013**	**NS_ 015**	**NS_ 016**	**NS_ 017**	**NS_ 019**
Alectryon oleifolius	X																X				
Aristida spp.																					
Asphodelus fistulosus							X							X							
Atriplex nummularia				X	X				X												
Atriplex spp.																			X		X
Atriplex vesicaria				X					X					X							
Austrodanthonia caespitosa									X												
Austrodanthonia spp.		X							X	X	X			X							
Austrostipa nodosa																					
Austrostipa scabra			X	X	X	X	X		X	X	X	X	X	X							
Austrostipa spp.														X							
Calotis spp.								X													
Casuarina cristata																	X				
Casuarina pauper									X	X											
Dissocarpus paradoxus		X		X		X			X	X	X		X	X	X					X	
Enchylaena tomentosa		X	X	X	X	X		X	X	X	X	X	X	X	X				X	X	X
Eucalyptus dumosa	X														X	X		X	X	X	X

	Injection Borefields Plot Name/number																			
Scientific Name	**1684 ns014**	**BB 3**	**BID 1**	**BID 10**	**BID 11**	**BID 12**	**BID 13**	**BID 2**	**BID 5**	**BID 6**	**BID 7**	**BID 8**	**BID 9**	**BID BB4**	**NS_ 011**	**NS_ 012**	**NS_ 013**	**NS_ 015**	**NS_ 016**	**NS_ 017**	**NS_ 019**
Eucalyptus gracilis	X	X				X					X					X		X	X	X	X
Eucalyptus largiflorens																					
Eucalyptus socialis			X	X	X	X		X				X									
Grevillea huegelii			X																		
Hordeum spp.							X							X							
Imperata spp.			X																		
Lactuca serriola														X							
Lawrencia squamata											X										
Lomandra effusa			X																		
Maireana appressa				X																	
Maireana erioclada				X	X	X															
Maireana georgei							X														
Maireana pentagona								X									X				
Maireana pentatropis		X	X	X	X	X	X		X	X	X	X	X		X	X			X	X	X
Maireana pyramidata	X	X	X	X			X		X	X	X	X	X	X	X			X	X	X	
Maireana sedifolia	X						X							X		X	X				
Maireana spp.												X						X			
Medicago minima							X							X							
Medicago polymorpha													X								

	Injection Borefields Plot Name/number																			
Scientific Name	**1684 ns014**	**BB 3**	**BID 1**	**BID 10**	**BID 11**	**BID 12**	**BID 13**	**BID 2**	**BID 5**	**BID 6**	**BID 7**	**BID 8**	**BID 9**	**BID BB4**	**NS_ 011**	**NS_ 012**	**NS_ 013**	**NS_ 015**	**NS_ 016**	**NS_ 017**	**NS_ 019**
Nitraria billardierei			X	X	X		X			X				X							X
Rhagodia gaudichaudiana	X														X	X		X			X
Rhagodia spinescens	X	X		X		X	X	X	X	X					X	X	X	X			
Sclerolaena diacantha							X														
Sclerolaena obliquicuspis		X		X		X					X		X					X	X	X	X
Sida corrugata														X							
Triodia scariosa								X													
Vittadinia cuneata								X						X							
Wahlenbergia luteola											X										
Zygophyllum ammophilum		X	X	X	X			X	X			X	X		X						
Zygophyllum angustifolium																		X			
Zygophyllum apiculatum		X	X	X	X	X	X	X		X	X		X			X	X		X	X	

Notes: * = exotic species; ? = insufficient material to identify species with total certainty

Table 42: Flora records from Biobanking floristic plots collected along the water supply pipeline (Niche)

Scientific Name	Water Supply Pipeline Plot Name/number		
	LB 1490	LB 1495	LB 1508
Austrodanthonia spp.			X
Austrostipa scabra			X
Axonopus fissifolius	X		
Baumea spp.	X		
Carex appressa	X		
Enchylaena tomentosa			X
Eragrostis spp.	X		
Eucalyptus camaldulensis	X	X	X
Eucalyptus largiflorens			X
Gamochaeta calviceps	X		
Hordeum vulgare		X	X
Isolepis nodosa	X		
Juncus continuus		X	
Lactuca saligna		X	
Lolium perenne	X	X	X
Onopordum acanthium	X		X
Oxalis perennans	X		
Phalaris aquatica		X	
Ranunculus undosus	X		
Richardia stellaris		X	X
Rumex brownii	X		
Sclerolaena obliquicuspis			X
Sclerolaena spp.	X	X	
Setaria gracilis		X	
Sonchus oleraceus	X		
Wahlenbergia stricta	X	X	

Notes: * = exotic species; ? = insufficient material to identify species with total certainty

Appendix 5: Fauna recorded during survey

Notes:

* indicates introduced species (not native to the area)

Bold indicates a threatened species

V - Vulnerable, E – Endangered, Mi – Migratory

PTL = transmission line easement

(mainly at Murrumbidgee River crossing point)

1 = October/November 2011 Surveys (Ecotone)

2 = September 2012 Surveys (opportunistic records only)

3 = January 2013 Surveys

4 = Val *et al* 2012 (Turlee Map Sheet closest to Nepean and Weimby Map Sheet closest to West Balranald)

5 = October 2013 – March 2014 Surveys (Niche)

6 = Septermber – December 2014 Surveys (Niche)

Common Name	Scientific Name	Conservation Status		Project Area						
		TSC Act	EPBC Act	West Balranald Mine area	Nepean Mine area	Nepean Access Road	Injection Borefields (northern)	Water Supply Pipeline	West Balranald (out of project area)	PTL South of Sturt Highway (out of project area)
Eastern Sign-bearing Froglet	*Crinia parinsignifera*							6		
Eastern Banjo Frog	*Limnodynastes dumerilii*			1						
Fletcher's Frog	*Limnodynastes fletcheri*				1			6		
Spotted Grass Frog	*Limnodynastes tasmaniensis*			1,3	1	3		6		
Emerald-spotted Tree Frog	*Litoria peronii*							6		
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*			1,3	1,3,4	2,3	6		5	5
Inland Thornbill	*Acanthiza apicalis*			1	1		6		5	5
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*			1	3	2,3, 5	6		5	5
Yellow Thornbill	*Acanthiza nana*						6		5	5
Brown Thornbill	*Acanthiza pusilla*			1						
Buff-rumped Thornbill	*Acanthiza reguloides*									5
Chestnut-rumped Thornbill	*Acanthiza uropygialis*			1,3	1,3,4	2,3, 5	6		5	5

Common Name	Scientific Name	Conservation Status		Project Area						
		TSC Act	EPBC Act	West Balranald Mine area	Nepean Mine area	Nepean Access Road	Injection Borefields (northern)	Water Supply Pipeline	West Balranald (out of project area)	PTL South of Sturt Highway (out of project area)
Collared Sparrowhawk	*Accipiter cirrhocaphalus*			1	3					
Brown Goshawk	*Accipiter fasciatus*			1	1,3				5	5
Australian Owlet-nightjar	*Aegotheles cristatus*			1,3	1,3		6		5	
Grey Teal	*Anas gracilis*			1,3						5
Pacific Black Duck	*Anas superciliosa*			3						5
Australasian Darter	*Anhinga novaehollandiae*							6		
Red Wattlebird	*Anthochaera carunculata*			1	4	2	6		5	5
Australasian Pipit	*Anthus novaeseelandiae*			1,3	1	5, 3	6		5	
Southern Whiteface	*Aphelocephala leucopsis*			1	3	3, 5	6		5	5
Wedge-tailed Eagle	*Aquila audax*			1,3	1	3, 5	6		5	5
Great Egret	*Ardea alba*		Mi	1						
Eastern Great Egret	*Ardea modesta*							6		
Pacific Heron	*Ardea pacifica*			1				6		
Black-faced Woodswallow	*Artamus cinereus*			1,3		3, 5	6		5	
Dusky Woodswallow	*Artamus cyanopterus*									5
Masked Woodswallow	*Artamus personatus*			3	1,3,4	3, 5	6		5	5
White-browed Woodswallow	*Artamus superciliosus*			3	1,3,4	3, 5	6		5	
Hardhead	*Aythya australis*			1,3	1					
Australian Ringneck	*Barnardius zonarius*			1,3,4	1,3,4	3, 5	6		5	5
Australian Coral Snake	*Brachyurophis australis*				1,4					
Sulphur-crested Cockatoo	*Cacatua galerita*									5
Major Mitchell'S Cockatoo	***Cacatua leadbeateri***	**V**		**1,3**	**1**	**5**	**6**		**5**	
Little Corella	*Cacatua sanguinea*				3					

Common Name	Scientific Name	Conservation Status		Project Area						
		TSC Act	EPBC Act	West Balranald Mine area	Nepean Mine area	Nepean Access Road	Injection Borefields (northern)	Water Supply Pipeline	West Balranald (out of project area)	PTL South of Sturt Highway (out of project area)
Long-billed Corella	*Cacatua tenuirostris*							6		
Pied Honeyeater	***Certhionyx variegatus***	**V**		**1Pos**						
Horsefield'S Bronze-cuckoo	*Chalcites basalis*			3		5				
Black-eared Cuckoo	*Chalcites osculans*				1					
Inland Dotterel	*Charadrius australis*					3				
Australian Wood Duck	*Chenonetta jubata*			1					5	5
Brown Songlark	*Cincloramphus cruralis*			1,3		3				
Rufous Songlark	*Cincloramphus mathewsi*			1	1				5	5
Chestnut Quail-thrush	***Cinclosoma castanotus***	**V**		**1,3,4**	**1,3,4**		**6**		**5**	
Spotted Harrier	***Circus assimilis***	**V**		**1**	**1**	**5**			**5**	
Brown Treecreeper	*Climacteris picumnus picumnus*			1	1,3	2	6			5
White-browed Treecreeper	*Climacteris sffinus*				1,3	3				
Grey Shrike-thrush	*Colluricincla harmonica*			1,3,4	1,3,4		6		5	5
Black-Faced Cuckoo-shrike	*Coracina novaehollandiae*			1,3	1,3,4	3	6		5	5
White-bellied Cuckoo-shrike	*Coracina papuensis*						6			
White-winged Chough	*Corcorax melanorhamphos*			1,4	1,3		6		5	5
Stubble Quail	*Corturnix pectoralis*			1	1					
Little Crow	*Corvus bennetti*			1,3	3,4	3, 5			5	
Australian Raven	*Corvus coronoides*			1,3	1,3	3, 5	6		5	5
Little Raven	*Corvus mellori*			1,4	1,4		6			
Brown Quail	*Coturnix ypsilophora*			1						
Pied Butcherbird	*Cracticus nigrogularis*			1,3,4	1	2,3, 5	6		5	5
Grey Butcherbird	*Cracticus torquatus*			1,3,4	1,3,4	2,3	6		5	5

Common Name	Scientific Name	Conservation Status		Project Area						
		TSC Act	EPBC Act	West Balranald Mine area	Nepean Mine area	Nepean Access Road	Injection Borefields (northern)	Water Supply Pipeline	West Balranald (out of project area)	PTL South of Sturt Highway (out of project area)
Black Swan	*Cygnus atratus*			1						
Laughing Kookaburra	*Dacelo novaeguineae*								5	5
Varied Sittella	***Daphoenositta chrysoptera chrysoptera***	**V**			**1,3**	**2**	**6**		**5**	**5**
Plumed Whistling-duck	*Dendrocygna eytoni*			1						
Mistletoebird	*Dicaeum hirundinaceum*								5	5
Emu	*Dromaius novaehollandiae*			1,3	1,3	2,3, 5	6		5	5
White-faced Heron	*Egretta novaehollandiae*			1						5
Black-shouldered Kite	*Elanus axillaris*			1,3	1					
Black-fronted Dotterel	*Elseyornis melanops*			1					5	5
Galah	*Eolophus roseicapillus*			1,3,4	1,3,4	3, 5	6	6	5	5
White-fronted Chat	***Epthianura albifrons***	**V**		**1**		**5**	6		5	
Orange Chat	*Epthianura aurifrons*			1,3		3				
Crimson Chat	*Epthianura tricolor*								5	
Spotted Nightjar	*Eurostopodus argus*			1	1,3				5	
Brown Falcon	*Falco berigora*			1	1,3	3, 5	6		5	
Nankeen Kestrel	*Falco cenchroides*			1,3	1,3	3, 5	6		5	5
Australian Hobby	*Falco longipennis*			1,3		5			5	
Peregrine Falcon	*Falco peregrinus*						6			
Black Falcon	*Falco subniger*			1						
Eurasian Coot	*Fulica atra*			3						
Black-tailed Native-hen	*Gallinula ventralis*			1						
Peaceful Dove	*Geopelia striata*						6			5
White-throated Gerygone	*Gerygone albogularis*						6			

Common Name	Scientific Name	Conservation Status		Project Area						
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Western Gerygone	*Gerygone fusca*			1	1				5	5
Magpie-lark	*Grallina cyanoleuca*			1,3					5	5
Australian Magpie	*Gymnorhina tibicen*			1,3,4	1,3,4	2,3	6		5	5
Whistling Kite	*Haliastur sphenurus*			1,3						5
Little Eagle	***Hieraeetus morphnoides***	**V**		**1,3**	**1,3**	**5**			**5**	
Welcome Swallow	*Hirundo neoxena*			1		5				
Tree Martin	*Hirundo nigricans*			1			6		5	5
White-winged Triller	*Lalage sueurii*			1,3	1,4	5			5	5
Malleefowl	***Leipoa ocellata***	**E**	**V Mi**	**1,3**	**1,3**	**1,3**				
White-eared Honeyeater	*Lichenostomus leucotis*			1,3,4	3,4	3			5	5
Yellow-plumed Honeyeater	*Lichenostomus ornatus*			3,4	1,3,4		6		5	5
White-plumed Honeyeater	*Lichenostomus penicillatus*			1	1				5	5
Singing Honeyeater	*Lichenostomus virescens*			1	1,3,4	2,3, 5	6		5	
Square-tailed Kite	***Lophoictinia isura***	**V**								**5**
Superb Fairy-wren	*Malurus cyaneus*									5
Variegated Fairy-wren	*Malurus lamberti*			1			6		5	5
White-winged Fairy-wren	*Malurus leucopterus*			1,3	1	2,3, 5	6		5	5
Splendid Fairy-wren	*Malurus splendens*			1,3,4	1,3	2,3	6		5	
Yellow-throated Miner	*Manorina flavigula*			1	3	3, 5	6		5	5
Noisy Miner	*Manorina melanocephala*					5			5	5
Little Grassbird	*Megalurus gramineus*			1						
Hooded Robin	***Melanodryas cucullata***	**V**		**1**	**1,3**	**2**	**6**			
Brown-headed Honeyeater	*Melithreptus brevirostris*			1,3,4	1,3,4	3	6		5	5

Common Name	Scientific Name	Conservation Status		Project Area						
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Budgerigar	*Melopsittacus undulatus*			1	1					
Rainbow Bee-eater	*Merops ornatus*		Mi	1,3	1,3,4	3, 5	6		5	5
Jacky Winter	*Microeca fascinans*			1,4	1,3,4	5	6		5	5
Black Kite	*Milvus migrans*			1,3		5	6		5	5
Satin Flycatcher	*Myiagra cyanoleuca*						6			
Restless Flycatcher	*Myiagra inquieta*			1	1					5
Southern Boobook	*Ninox boobook*			1	1,3					
Southern Boobook	*Ninox novaeseelandiae*						6			
Blue Bonnet	*Northiella haematogaster*			1,3	1,3	3			5	5
Nankeen Night Heron	*Nycticorax caledonicus*			1						
Cockatiel	*Nymphicus hollandicus*				1				5	
Crested Pigeon	*Ocyphaps lophotes*			1,3	1,3	3, 5	6		5	5
Crested Bellbird	*Oreoica gutturalis*			1,3,4	1,3,4	3	6		5	5
Rufous Whistler	*Pachycephala rufiventris*			1,3	1,3,4	2,3	6		5	5
Spotted Pardalote	*Pardalotus punctatus xanthopyge*			3,4	3,4				5	5
Striated Pardalote	*Pardalotus striatus*			1,3	1,3,4	2,3, 5	6		5	5
House Sparrow	*Passer domesticus* *			3						
Plains Wanderer	***Pedionomus torquatus***	**E**	**V**	**1Pos**						
Australian Pelican	*Pelecanus conspicillatus*									5
Red-capped Robin	*Petroica goodenovii*			1,3	1,3,4	2,3, 5	6		5	5
Great Cormorant	*Phalacrocorax carbo*									5
Little Black Cormorant	*Phalacrocorax sulcirostris*							6		
Common Bronzewing	*Phaps chalcoptera*			1,3	1,3				5	5

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Little Friarbird	*Philemon citreogularis*									5
Noisy Friarbird	*Philemon corniculatus*									5
Yellow-billed Spoonbill	*Platalea flavipes*							6		
Crimson Rosella	*Platycercus elegans*							6	5	5
Striped Honeyeater	*Plectorhyncha lanceolata*			1,3	1,3	2	6		5	5
Tawny Frogmouth	*Podargus strigoides*				1,3	3, 5				
Hoary-headed Grebe	*Poliocephalus poliocephalus*			1,3						
Regent Parrot	***Polytelis anthopeplus***	**E**	**V**						**5**	**6**
Superb Parrot	*Polytelis swainsonii*									5
Chestnut-crowned Babbler	*Pomatostomus ruficeps*			1		3, 5	6			5
White-browed Babbler	*Pomatostomus supercilliosus*				1,3				5	
Grey-crowned Babbler	***Pomatostomus temporalis temporalis***	**V**			**1**			**6**	**5**	
Spotless Crake	*Porzana tabuensis*			1						
Red-rumped Parrot	*Psephotus haematonotus*			1			6	6	5	5
Mulga Parrot	*Psephotus varius*			1,3	1,3	3, 5	6		5	5
Chirruping Wedgebill	*Psophodes cristatus*			1						
White-fronted Honeyeater	*Purnella albifrons*			3	1,3,4				5	
Redthroat	***Pyrrholaemus brunneus***	**V**		**3**		**3**				
Grey Fantail	*Rhipidura fuliginosa*					2				5
Willie Wagtail	*Rhipidura leucophrys*			1,3	1,3,4	5	6		5	5
Weebill	*Smicrornis brevirostris*			1,3,4	1,3,4	2,3	6		5	5
Grey Currawong	*Strepera versicolor*			1,4	1,3,4	3	6		5	5
Apostlebird	*Struthidea cinerea*				1,3	2			5	5

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Common Starling	*Sturnus vulgaris*									5
Black Honeyeater	*Sugomel niger*			1	1					
Australasian Grebe	*Tachybaptus novaehollandiae*			1,3	1					5
Zebra Finch	*Taeniopygia guttata*					3				
Red-Backed Kingfisher	*Todiramphus pyrrhopygia*				1	3				
Sacred Kingfisher	*Todiramphus sanctus*			1			6			5
Painted Button-quail	*Turnix varia*			1						
Barn Owl	*Tyto alba*			1	1					
Masked Lapwing	*Vanellus miles*								5	
Banded Lapwing	*Vanellus tricolor*			6						
Silvereye	*Zosterops lateralis*								5	
Goat	*Capra hircus* *			1,3	1,3	2,3	6		5	
Gould'S Wattled Bat	*Chalinolobus gouldii*			1,4	1,4	5	5		5	5
Chocolate Wattled Bat	*Chalinolobus morio*			1,4	1	5	5		5	5
Little Pied Bat	***Chalinolobus picatus***	**V**		**1**	**1,4**	**5**	**6**		**5Pr**	
Cat	*Felis catus* *			1,3	1,3	3	6			
Brown Hare	*Lepus capensis*								5	
Brown Hare	*Lepus capensis* *			1		3				
Western Grey Kangaroo	*Macropus fuliginosus*			1,3	1,3	3	6		5	
Eastern Grey Kangaroo	*Macropus giganteus*						6			
Red Kangaroo	*Macropus rufus*			1	1	3	6		5	
Inland Freetail Bat	*Mormopterus petersi*			1	1,4	5	6, 5		5	5
South-eastern Freetail Bat	*Mormopterus planiceps*			1,4	1,4	5	6, 5		5	5

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Eastern Freetail Bat	*Mormopterus ridei*				1					
House Mouse	*Mus musculus* *			1	1		6		5	
Large-footed Myotis	***Myotis macropus***	**V**								**5** - Pos
Southern Ningaui	***Ningaui yvonneae***	**V**			**1,4**					
Corben's Long-eared Bat	***Nyctophilus corbeni***	**V**	**V**			**5**			**5**	
Lesser Long-eared Bat	*Nyctophilus geoffroyi*			1	1	5	6		5	
Rabbit	*Oryctolagus cuniculus* *			1,3	1,3	2,3	6		5	
Domestic Sheep	*Ovis aries**			1,3	1	2	6		5	5
Yellow-bellied Sheathtail Bat	***Saccolaimus flaviventris***	**V**		**1?,4**	**1?**	**5**	**5**		**5**	
Inland Broad-nosed Bat	*Scotorepens balstoni*			1,4	1,4	5Pr	6, 5Pr		5	5Pr
Little Broad-nosed Bat	*Scotorepens greyii*				1	5	5		5	5
Fat-tailed Dunnart	*Sminthopsis crassicaudata*			1			6			
Common Dunnart	*Sminthopsis murina*			1	1,3		6			
Pig	*Sus scrofa*								5	
Short-beaked Echidna	*Tachyglossus aculeatus*			1,3	1,3	2,3		6	5	
White-striped Freetail Bat	*Tadarida australis*			1,3,4	1,3,4	3, 5	5		5	5
Inland Forest Bat	***Vespadelus baverstocki***	**V**		**1**	**1**	**5**	**5**		**5**	**5**
Large Forest Bat	*Vespadelus darlingtoni*			1	1					
Southern Forest Bat	*Vespadelus regulus*			1	1	5	5		5	5
Little Forest Bat	*Vespadelus vulturnus*			1	1,4	5	5		5	5
Fox	*Vulpes vulpes*			1,3	1,3	3	6		5	
Jacky Dragon	*Amphibolurus muricatus*						6			
Nobbi Dragon	*Amphibolurus nobbi*			1,3,4	1,3,4	3				

Common Name	Scientific Name	Conservation Status		Project Area						
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Mallee Worm-lizard	***Aprasia inaurita***	**E**		**4**						
Spiny-palmed Shinning Skink	*Cryptoblepharus carnabyi*			1	1,3	2	6			
Mallee Military Dragon	*Ctenophorus fordi*			1,3,4	1,3,4	2,3			5	
Painted Dragon	*Ctenophorus pictus*				1,3		6			
Southern Mallee Ctenotus	*Ctenotus atlas*			1,4	1,3,4		6		5, 4	
Short-clawed Ctenotus	*Ctenotus brachyonyx*			1,4	1,3,4	3				
Ctenotus	*Ctenotus olympicus / orientalis*			1						
Pale-rumped Ctenotus	*Ctenotus regius*			1	1,3,4	3	6		5	
Barred Wedgesnout Ctenotus	*Ctenotus schomburgkii*			1,3,4	1,3,4					
Spinifex Snake-lizard	*Delma butleri*			3	4					
Yellow-faced Whip Snake	*Demansia psammophis*			1						
Beaded Gecko	*Diplodactylus damaeus*			1,4	1,3,4		6		5	
Box-patterned Gecko	*Diplodactylus steindachneri*			1						
Tesselated Gecko	*Diplodactylus tessellatus*			1						
Wood Gecko	*Diplodactylus vittatus*			1	1, 4		6		5	
Nobbi Dragon	*Diporiphora nobbi*						6		5	
Tree Skink	*Egernia striolata*			1,3	1,3	5	6		5	
Tree Dtella	*Gehyra variegata*			1	1,3	3	6		5	
Bynoe's Gecko	*Heteronotia binoei*			1	1,3	2,3	6			
Wood Mulch-slider	*Lerista muelleri*			1,3,4	1,3,4	3				
Spotted Lerista	*Lerista punctatovittata*			1,4	1,4		5		5	
Burtons Legless Lizard	*Lialis burtonis*			3	3	3			5	
Desert Skink	*Liopholis inornata*			1,3	1,3,4					

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Common Dwarf Skink	*Menetia greyii*			1,3,4	1,3,4	2,3				
Saltbush Morethia Skink	*Morethia adelaidensis*			1						
South-Eastern Morethia Skink	*Morethia boulengeri*			1	1	2,3	6			
Shrubland Morethia Skink	*Morethia obscura*			1,3,4	3	3	6			
Short-tailed Snake	*Parasuta nigriceps*			4	1,4				5	
Bearded Dragon	*Pogona barbata*			1			6			
Central Bearded Dragon	*Pogona vitticeps*			1	1,3,4	2,3	6			
Mulga Snake	*Pseudechis australis*			1						5
Western Brown Snake	*Pseudonaja nuchalis*						6			
Common Scaly-foot	*Pygopus lepidopodus*				1					
Eastern Hooded Scaly-foot	*Pygopus schraderi*			1						
Southern Blind Snake	*Ramphotyphlops australis*				1					
Blackish Blind Snake	*Ramphotyphlops nigrescens*						6			
Beaked Gecko	*Rhynchoedura ornata*				1,4	5				
Jewelled Gecko	***Strophurus elderi***	**V**			**3**					
Eastern Spiny-tailed Gecko	*Strophurus intermedius*			1,4	1,4				5	
Western Blue-tongue	***Tiliqua occipitalis***	**V**			**3**					
Shingleback	*Tiliqua rugosa*			1	1,3	3	6		5	
Thick-tailed Gecko	*Underwoodisaurus milii*			1,3	1,3	3	6		5	
Sand Goanna	*Varanus gouldii*			1,3	1,3,4	2,3	6		5	
Lace Monitor	*Varanus varius*			1	1				5	

Appendix 6: Weather observations

Weather observations (Bureau of Meteorology Australia 2015 – Balranald Rsl station)

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2011	10	10	17.9	4.4	0.2
2011	10	11	19.6	6.6	0
2011	10	12	21.2	5.5	0
2011	10	13	24	8	0
2011	10	14	30	10.7	0
2011	10	15	24	12.5	0
2011	10	16	20.8	9.8	0
2011	10	17	23.6	7.1	0
2011	10	18	28.2	9.7	0
2011	10	19	31.8	15.7	0
2011	10	20	32.7	17.2	0
2011	10	21	24.2	15	0
2011	10	22	28.8	16.2	0
2011	10	23	34.4	14.4	0
2011	10	24	30.6	20.8	0
2011	10	25	22.5	8.7	8.6
2011	10	26	25.7	11	0
2011	10	27	28	14.3	0
2011	10	28	34.4	17.8	0
2011	10	29	23.9	15.8	4.4
2011	10	30	21.5	8.2	0
2011	10	31	22.5	5	0
2011	11	1	25.8	7.6	0
2011	11	2	23.8	9.4	0
2011	11	3	-	11.9	0
2011	11	4	29.4	-	0
2011	11	5	34	11	0
2011	11	6	31.8	19.4	0
2011	11	7	33.9	15.2	1.2
2011	11	8	30	19.3	0.6
2011	11	9	34	18.5	4.2
2011	11	10	24.2	13.7	42
2011	11	11	27	9.6	0
2011	11	12	30.5	10.8	0
2011	11	13	32.1	17	0
2011	11	14	-	17.1	0
2011	11	15	33	-	0
2011	11	16	22.6	10.9	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2011	11	17	31.6	14	0
2011	11	18	35.8	20.2	0
2011	11	19	31.4	22.1	0
2011	11	20	24.7	15	1
2011	11	21	24.4	10.1	0
2011	11	22	22.9	13.1	0
2011	11	23	25.1	11.6	0
2011	11	24	24.2	11.6	0
2011	11	25	27.4	14.8	8.2
2011	11	26	23.3	13.7	19
2011	11	27	28.2	13.9	1.4
2011	11	28	34.2	14	0
2011	11	29	37	21.4	0
2011	11	30	23	16.2	0
2011	12	1	23	7.1	0
2011	12	2	26	9.4	0
2011	12	3	29.1	13.2	0
2011	12	4	24	11	0
2011	12	5	26.5	9.5	0
2011	12	6	28.4	13.5	0
2011	12	7	30.6	14.3	0
2011	12	8	32.6	15.2	0
2011	12	9	30.1	22	0
2011	12	10	32	19.2	0
2011	12	11	28	17.3	0
2011	12	12	25.6	11.1	0
2011	12	13	25	10.7	0
2011	12	14	-	10.5	0
2011	12	15	31.6		0
2011	12	16	35.3	13.9	0
2011	12	17	33	22.2	0
2011	12	18	28.8	20.3	5.4
2011	12	19	27.2	17.4	60.2
2011	12	20	28.2	13.9	0
2011	12	21	29	13.8	0
2011	12	22	33	14.9	0
2011	12	23	35	17.5	0
2011	12	24	-	20.5	0
2011	12	25	-	-	-
2011	12	26	-	-	-
2011	12	27	37.1	-	-
2011	12	28	30.2	12.4	3.4

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2011	12	29	31.3	13.4	0
2011	12	30	-	15.8	0
2011	12	31	-	-	0
2012	1	1	38	-	0
2012	1	2	39.4	21.3	0
2012	1	3	40.7	22.5	0
2012	1	4	31.2	21.4	0
2012	1	5	29.8	14.2	0
2012	1	6	30.2	13.2	0
2012	1	7	37.7	15.6	0
2012	1	8	28.2	21.2	5.6
2012	1	9	24.4	13.1	1.6
2012	1	10	25	14.6	0
2012	1	11	-	14.2	0
2012	1	12	-	-	0
2012	1	13	-	-	0
2012	1	14	28.4	-	0
2012	1	15	31	10.5	0
2012	1	16	-	-	0
2012	1	17	-	-	0
2012	1	18	-	-	0
2012	1	19	-	-	0
2012	1	20	-	-	0
2012	1	21	-	-	0
2012	1	22	35.1	-	0
2012	1	23	34.4	20.3	0
2012	1	24	35	20	0
2012	1	25	37.1	18.3	0
2012	1	26	36.1	19.8	0
2012	1	27	36.2	19.2	0
2012	1	28	31.4	23.8	0
2012	1	29	27.8	22.6	0.2
2012	1	30	29	21.2	23
2012	1	31	24.8	13.2	5.6
2012	2	1	28.2	10.6	0
2012	2	2	28	14.4	11
2012	2	3	30.2	15.6	0
2012	2	4	33.5	15.2	0
2012	2	5	34.6	24.4	0
2012	2	6	25	11	0
2012	2	7	25.9	12.1	0
2012	2	8	26	10	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2012	2	9	27.6	10.1	0
2012	2	10	28.2	11.8	0
2012	2	11	28.5	12.4	0
2012	2	12	28.3	12.5	0
2012	2	13	30.1	13.9	0
2012	2	14	33.7	15.8	0
2012	2	15	36	18.3	0
2012	2	16	35	22.6	0
2012	2	17	35	16.8	0
2012	2	18	36.2	17.4	0
2012	2	19	35.3	19.6	0
2012	2	20	30	21.5	1
2012	2	21	30.4	17.4	7.6
2012	2	22	32	15.7	0
2012	2	23	-	13.4	0
2012	2	24	-		0
2012	2	25	37	-	0
2012	2	26	36.5	23.2	0
2012	2	27	34.3	23.6	0
2012	2	28	27	22.4	7.8
2012	2	29	22.3	17.7	3.6
2012	9	1	17.6	-	0
2012	9	2	22.4	1.2	0
2012	9	3	25.8	4.6	0
2012	9	4	26.9	7.3	0
2012	9	5	26.2	14.2	0
2012	9	6	21.2	10.6	0
2012	9	7	16.8	8.8	0
2012	9	8	17	7.4	0
2012	9	9	19.8	10.5	0
2012	9	10	23.6	2	0
2012	9	11	24.5	4.1	0
2012	9	12	28.2	5.2	0
2012	9	13	16.3	7.1	1.4
2012	9	14	18.6	2	0
2012	9	15	20.8	7.4	0
2012	9	16	21	7.3	0
2012	9	17	21.3	7.6	0
2012	9	18	18	10.5	11
2012	9	19	19.2	4	0.6
2012	9	20	30.5	12.2	0
2012	9	21	21.7	11.7	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2012	9	22	23.7	7.2	0
2012	9	23	20.3	11.8	0
2012	9	24	16.8	6	0
2012	9	25	21	2.9	0
2012	9	26	26.1	7	0
2012	9	27	35.3	14.2	0
2012	9	28	21	20.6	0
2012	9	29	16.6	8.5	0.2
2012	9	30	-	3	0
2013	1	1	-	-	0
2013	1	2	33	-	0
2013	1	3	38.9	19.2	0
2013	1	4	44.3	22.1	0
2013	1	5	45	22.3	0
2013	1	6	40	20.2	0
2013	1	7	44.1	20.9	0
2013	1	8	37	24.1	0
2013	1	9	25.8	12.9	0
2013	1	10	32.8	13.2	0
2013	1	11	41.8	16.2	0
2013	1	12	30	20.6	0
2013	1	13	24	19.5	0
2013	1	14	-	10	1.4
2013	1	15	-	-	0
2013	1	16	-	-	0
2013	1	17	-	-	0
2013	1	18	-	-	0
2013	1	19	-	-	0
2013	1	20	34.4	-	0
2013	1	21	37	15.2	0
2013	1	22	32.5	16	0
2013	1	23	32	15.5	0
2013	1	24	38.6	16.2	0
2013	1	25		23.7	0
2013	1	26	32.5	-	0
2013	1	27	30.6	12	0
2013	1	28	31.2	13.9	0
2013	1	29	26.5	13.9	0
2013	1	30	29.8	10	0
2013	1	31	32.4	12.8	0
2013	10	1	18.8	12.6	4.6
2013	10	2	22	4.7	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2013	10	3	18.2	7.9	3
2013	10	4	24.5	2.7	0
2013	10	5	30.1	8.8	0
2013	10	6	22.1	10.5	0
2013	10	7	22.9	5.6	0
2013	10	8	25	8.5	0
2013	10	9	33.6	7.8	0
2013	10	10	32	18.5	0
2013	10	11	22.7	7.5	0.8
2013	10	12	29.6	5.5	0
2013	10	13	19.2	9	0
2013	10	14	19	5.8	0
2013	10	15	23.8	2.8	0
2013	10	16	29.9	8.2	0
2013	10	17	20	14	0
2013	10	18	24.8	1.9	0
2013	10	19	30.2	6	0
2013	10	20	36.8	10	0
2013	10	21	29	21.5	0
2013	10	22	28.7	20.1	0
2013	10	23	20	13.2	3
2013	10	24	18.7	7.5	0
2013	10	25	20.2	3.2	0
2013	10	26	23	6.1	0
2013	10	27	26.5	10.3	0
2013	10	28	29.7	14	0.4
2013	10	29	22.6	12.5	0
2013	10	30	24.2	4.9	0
2013	10	31	25.4	6.1	0
2013	11	1	30.5	7.2	0
2013	11	2	35	9.9	0
2013	11	3	23.2	13.9	0
2013	11	4	22.6	7.1	0
2013	11	5	29	9.1	0
2013	11	6	33.7	11.1	0
2013	11	7	38	15.9	0
2013	11	8	27.5	17.8	0
2013	11	9	21.3	6.9	0.2
2013	11	10	22	5.6	0
2013	11	11	16.2	9	0
2013	11	12	22	7.5	0.8
2013	11	13	22.3	10.2	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2013	11	14	24.1	8	0
2013	11	15	24.8	10.1	0
2013	11	16	26.2	8.4	0
2013	11	17	29.4	10.7	0
2013	11	18	32	12.1	0
2013	11	19	35.4	14.6	0
2013	11	20	30.9	14.3	0
2013	11	21	26	11.1	0.6
2013	11	22	24.7	8.6	0
2013	11	23	24	10.2	0
2013	11	24	24.8	9.6	0.6
2013	11	25	29.8	9.1	0
2013	11	26	32.5	14.8	0
2013	11	27	36.3	13	0
2013	11	28	-	-	0
2013	11	29	-	10.3	0.6
2013	11	30	29	7.4	0
2013	12	1	34.5	15.1	0
2013	12	2	38.8	16.2	0
2013	12	3	39.3	25.7	0.6
2013	12	4	21	19.2	14.2
2013	12	5	19.6	10.6	35.4
2013	12	6	23.8	7.4	0
2013	12	7	29	12.8	0
2013	12	8	36.5	16.6	0
2013	12	9	28.7	22.3	0
2013	12	10	24.1	12.6	0
2013	12	11	25.5	12.2	0
2013	12	12	27.4	11.9	0
2013	12	13	-	13.1	0
2013	12	14	-	-	0
2013	12	15	-	-	0
2013	12	16	-	-	0
2013	12	17	35.2	-	0
2013	12	18	39	18.2	0
2013	12	19	42.2	24.2	0
2013	12	20	42	23.9	0
2013	12	21	40.4	18.5	0
2013	12	22	30.1	23	0
2013	12	23	24	15	18
2013	12	24	26.3	12.5	0
2013	12	25	29.7	14.9	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2013	12	26	34	16.8	0
2013	12	27	31.6	15.1	0
2013	12	28	40.8	15.6	0
2013	12	29	28.2	11.4	0
2013	12	30	30.8	12.3	0
2013	12	31	33	14.1	0
2014	3	1	30	10.1	0
2014	3	2	30.7	16.9	0
2014	3	3	33	16.6	0
2014	3	4	32.6	20.1	0
2014	3	5	30.8	18.9	17.4
2014	3	6	-	13	0
2014	3	7	-	-	0
2014	3	8	30.8	-	0
2014	3	9	-	14.1	0
2014	3	10	-	-	0
2014	3	11	35	-	0
2014	3	12	26.2	15.6	1.4
2014	3	13	-	11	0
2014	3	14	-	-	0
2014	3	15	31.3	-	0
2014	3	16	23	13.2	6.4
2014	3	17	28.5	13.2	0
2014	3	18	28.6	13.5	0
2014	3	19	28.8	12.4	0
2014	3	20	33	12.7	0
2014	3	21	33.2	18.7	0
2014	3	22	24	9	0
2014	3	23	20.6	10	0
2014	3	24	23	10.5	0
2014	3	25	25.9	13	0.4
2014	3	26	30.2	15.1	0
2014	3	27	27.8	18.4	0
2014	3	28	29.8	14.5	0
2014	3	29	30.5	14.9	0
2014	3	30	32.6	14.1	0
2014	3	31	34.8	14.6	0
2014	9	1	17.4	13.1	0
2014	9	2	-	-	4
2014	9	3	15.6	-	8.4
2014	9	4	17.7	4.9	0
2014	9	5	20.6	3.3	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2014	9	6	22	6.4	0
2014	9	7	22.6	6.7	0
2014	9	8	24.2	10	0
2014	9	9	27.6	17	0.4
2014	9	10	20.9	10.3	0
2014	9	11	19.5	6	0
2014	9	12	18.5	2.7	0
2014	9	13	22	2.3	0
2014	9	14	26.5	4.3	0
2014	9	15	27	11.6	0
2014	9	16	21	11.9	0
2014	9	17	19	8.3	0
2014	9	18	17	3.7	0
2014	9	19	-	2.7	0
2014	9	20	-	-	0
2014	9	21	23.2	-	0
2014	9	22	26.4	7.6	0
2014	9	23	27.4	8.1	0
2014	9	24	21.3	14.4	0
2014	9	25	21.6	13.8	5.2
2014	9	26	20.5	7	0
2014	9	27	27	6.6	0
2014	9	28	31.3	13.3	0
2014	9	29	25	8.7	0
2014	9	30	28	-	0
2014	10	1	19.4	-	0
2014	10	2	21.4	4.6	0
2014	10	3	25	5.9	0
2014	10	4	31	6.6	0
2014	10	5	31	13.8	0
2014	10	6	33	14.6	0
2014	10	7	20.2	11.1	0.6
2014	10	8	23	5.8	0
2014	10	9	28	5.8	0
2014	10	10	31.6	7.5	0
2014	10	11	34	10.5	0
2014	10	12	36	11.2	0
2014	10	13	18.6	10.4	0
2014	10	14	20	5.6	0
2014	10	15	20.7	3.3	0
2014	10	16	21.8	5.5	0
2014	10	17	24.2	8.2	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2014	10	18	29.4	8.6	0
2014	10	19	34.6	11.3	0
2014	10	20	31	13.5	0
2014	10	21	35	12.4	0
2014	10	22	37.6	19	0
2014	10	23	36.2	18.8	0
2014	10	24	33	17.8	0
2014	10	25	38	16.4	0
2014	10	26	28.8	12.5	0
2014	10	27	23.2	16.3	1.2
2014	10	28	24.3	7	0
2014	10	29	28	8.2	0
2014	10	30	32	12.3	0
2014	10	31	36.3	13.1	0
2014	11	1	21.7	15.1	1
2014	11	2	22.5	5.2	0
2014	11	3	27	8.8	0
2014	11	4	32.9	9.4	0
2014	11	5	24.8	11	0
2014	11	6	27.9	9.2	0
2014	11	7	34.2	10.6	0
2014	11	8	39	14.7	0
2014	11	9	28	11.6	0
2014	11	10	28	10.6	0
2014	11	11	29.2	9.8	0
2014	11	12	34	13.5	0
2014	11	13	38.5	15.5	0
2014	11	14	38	25.3	0
2014	11	15	25	16.6	0
2014	11	16	22.5	12.7	6
2014	11	17	24.8	10.2	0
2014	11	18	26.5	10.8	0
2014	11	19	33	11.1	0
2014	11	20	36.7	18.8	0
2014	11	21	29.8	16.2	0
2014	11	22	34.3	13.4	0
2014	11	23	35	17.8	0
2014	11	24	34.4	21	1
2014	11	25	25	8.8	1.6
2014	11	26	26.6	9.4	0
2014	11	27	29.2	13	0
2014	11	28	33.2	12.3	0

Year	Month	Day	Temp		
			Max	Min	Rain (mm)
2014	11	29	37	16.3	0
2014	11	30	39.6	19.4	0
2014	12	1	34	21.2	0
2014	12	2	35	14	0
2014	12	3	36.4	17.9	4.4
2014	12	4	33.6	18.4	3
2014	12	5	30.5	17.8	0
2014	12	6	27.2	15.5	0
2014	12	7	27	14.2	0
2014	12	8	31	14.4	0
2014	12	9	35.8	16.2	0
2014	12	10	34	20	0
2014	12	11	29.5	14.8	0.8
2014	12	12	31.2	15.5	0
2014	12	13	31	18.8	0
2014	12	14	36		0
2014	12	15	39.1	15.2	0
2014	12	16	36	19.5	0
2014	12	17	27.5	9.9	0
2014	12	18	28.7	10.6	0
2014	12	19	26.5	9.6	0
2014	12	20	31.5	14.4	0
2014	12	21	37	15.3	0
2014	12	22	39.4	25.5	0
2014	12	23	35	19.9	0.4
2014	12	24	31.7	13.8	0
2014	12	25	29.2	14.2	0
2014	12	26	26	11.1	0
2014	12	27	29.2	13.2	0
2014	12	28	34	11	0
2014	12	29	32	14.4	0
2014	12	30	28	13	0
2014	12	31	29	11	0

Appendix 7: Assessments of Significance for impacts on Threatened Flora and Fauna Species under EP&A Act (Seven Part Tests)

Threatened Flora

Brachyscome papillosa (Mossgiel Daisy)

Brachyscome papillosa (Mossgiel Daisy) is a multi-stemmed perennial herb which grows to 40cm high. Between June and December, solitary flowers occur on a peduncle up to 25cm long. Flowers are mauve in colour with a yellow centre. Leaves are sessile and up to 7cm long (DoE 2008).

B. papillosa is endemic to NSW, and primarily found within the Riverina Bioregion. The species is distributed between Mossgiel in the north, Yanga National Park to the south west and Urana to the south east.

B. papillosa is vulnerable listed species under the TSC Act.

Assessment of Significance

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.

B. papillosa is known to occur mainly from Mossgiel to Urana, in south-western NSW with sites around Jerilderie, Hay Plain, Willandra Lakes, and north to Ivanhoe. A north-western outlier is at Byrnedale Station, north of Menindee. The only known site on the South Western Slopes is at Ganmain Reserve (DECC, 2005). The species is found primarily recorded in clay soils on Bladder Saltbush (*Atriplex vesicaria*) and Leafless Bluebush (*Maireana aphylla*) plains, but also in grassland and in Inland Grey Box (*Eucalyptus microcarpa*) - Cypress Pine (*Callitris* spp.) woodland.

Despite targeted surveys, *B. papillosa* was not recorded within the project area. A large population comprising several thousand plants was recorded at a single location on both sides of a 1.5 km stretch of road in chenopod shrubland habitat, approximately 25 kms east-north-east of the northern end of the proposed Nepean mine (Bemax 2012, AMBS 2012).

The two habitat types within the project area Bladder Saltbush Low Open Shrubland (LM110) and Pearl Bluebush Low Open Shrubland (LM138) provide habitat for this species.

No viable local population is known to occur within the project area. Suitable habitat does occur within the project area and will be impacted by the Balranald Project.

The Balranald Project is unlikely to have an adverse impact on *B. papillosa* such that a viable population is likely to be placed at risk of extinction due to the following:

- the Balranald Project will not impact upon any known individuals of *B. papillosa*
- the Balranald Project is unlikely to result in the loss of any known pollinators of the species
- the Balranald Project is unlikely to change the fire regime associated with the species
- the population 25 kms to the east-north-east will not be impacted by the project.

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

(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

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

(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.

Extent of habitat

Despite comprehensive targeted surveys, *B. papillosa* was not recorded within the project area despite several years of survey. A large population comprising several thousand plants was recorded at a single location on both sides of a 1.5 km stretch of road in chenopod shrubland habitat, approximately 25 kms east-north-east of the northern end of the proposed Nepean mine (Bemax 2012).Given the extensive population (1000 individuals) of *B. papillosa* within 25km of the project area, it seems reasonable to assume that the extensive targeted survey undertaken for this project would have been sufficient to detect the species within the project area, should it have occurred. On this basis, it is not likely that the project area contains a population of this species.

This species is known from the two vegetation types that occur within the project area including Bladder Saltbush Low Open Shrubland (LM110) and Pearl Bluebush Low Open Shrubland (LM138). Approximately 1630 has of potential habitat will be impacted by the Balranald Project.

Fragmentation

Fragmentation of habitat may occur within the footprint of disturbance area, however connectivity will be retained within contiguous habitat around the periphery of the project area.

Importance of habitat

Significant areas of habitat outside of the project area are contiguous with potential habitat within the project area. Approximately 141,741.5ha of vegetation considered to be habitat for this species has been mapped within the locality. Given the extent of habitat outside the project area, the habitat within the

project area is not considered to be of high importance to the long-term survival of the species within the locality.

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

Critical Habitat, as defined by the TSC Act, has not been declared for *B. papillosa*. There is no critical habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

There is no adopted recovery plan for this 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 relevant listed key threatening processes to these species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of approximately 5,139 ha of vegetation, of which approximately 1,630 ha is considered potential habitat for this species.

Conclusion

The Balranald Project is unlikely to have a significant impact on *Brachyscome papillosa* due to the following:

- no known habitat for *Brachyscome papillosa* would be removed as a result of the Balranald Project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- the Balranald Project will reduce potential habitat within the locality by less than one per cent
- fragmentation of known populations will not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

Lepidium monoplocoides (winged peppercress)

Assessment of Significance

Lepidium monoplocoides (Winged Peppercress) is an erect annual herb 15–20 cm high which can be smooth or have small tubercles (wart-like outgrowths) and angular stems. Small flowers with minute/absent petals form in elongated clusters. Fruit are more conspicuous than flowers, and comprise a flattened circular pod, 5mm long and 4mm wide. It is considered rare though widespread in semi-arid regions of NSW and also occurs in Victoria and South Australia (OEHa).*L. monoplocoides* is listed as endangered under both the TSC Act and EPBC Act.

L. monoplocoides is endemic to south-eastern Australia and due to disturbance, its distribution is significantly reduced. At the time of publication of the recovery plan, the species existed as 6000 plants in 13 populations (DSE 2010). Whilst little is known of the ecology of this species, the number of adult plants varies annually based on environmental conditions, including rainfall. It is therefore likely that seed remains viable in the soil for many years, and that the size of the soil stored seed at known location is substantial.

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.

L. monoplocoides is found on fertile soils, subject to seasonal waterlogging. The species is often found in association with open woodland dominated by *Allocasuarina luehmannii* (Bulloak) and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *Eucalyptus populnea* (Poplar Box).

This species was not recorded within the Balranald project area during the field surveys. However, the species was recorded at six locations at or near to the Atlas Campaspe Project (AMBS 2013), with the closest of those populations occurring within 20 kms to the north of the northern end of the proposed Nepean mine. Numbers at each location ranged from one to 188 plants, but only two of the locations containing a single plant each occurred within the proposed disturbance area with a total of 301 plants recorded. Despite not being detected during targeted surveys, *L. monoplocoides* has potential habitat could potentially occur in a range of habitats within the project area, mainly wetter areas including Black Box Woodland, wet or waterlogged grassland/shrubland such as that in the River Red Gum Woodland (LM143) and Black Bluebush Shrubland. The species is highly dependent on seasonal conditions, occurring in periodically flooded and waterlogged habitats. It does not tolerate grazing disturbance. Such habitats occur throughout the project area, but few areas are completely free from grazing, except for some road reserves (which may nevertheless be grazed by rabbits or feral goats).

The Balranald Project is unlikely to have an adverse impact such that a viable population is likely to be placed at risk of extinction due to the following:

- the Balranald Project will not impact upon any known individuals of *L. monoplocoides*
- the Balranald Project is unlikely to result in the loss of any known pollinators of the species
- the Balranald Project is unlikely to change the fire regime associated with the species
- the population 20kms to the north will not be impacted by the Balranald Project.

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

(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

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

(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.

Extent of habitat

L. monoplocoides was not recorded within the project area during the surveys and no records exist for this species within the locality, thus the site contains potential habitat only. Habitat for this species could include a broad range of vegetation communities within the project area including: Black Box Grassy Chenopod Open Woodland, River Red Gum Woodland and Black Bluebush Low Open Shrubland.

Approximately 295.6ha of potential habitat will be directly or indirectly modified as a result of the project.

Fragmentation

Minor fragmentation of habitat may occur within the disturbance area, however connectivity will be retained within contiguous habitat around the periphery of the project area.

Importance of habitat

Significant areas of potential habitat for this species outside of the project area are contiguous with the habitat within the project area. Approximately 79,237.0ha of similar vegetation is found within the locality. However it should be noted that the species is likely to occur within the wetter areas within these vegetation communities. Given the abundance of habitat outside the project area and that it is potential habitat only, the habitat within the project area is not considered to be of high importance to the long-term survival of the species within the locality.

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

Critical Habitat, as defined by the TSC Act, has not been declared for *L. monoplocoides*. There is no critical habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

There is no adopted recovery plan for this 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 relevant listed key threatening processes to these species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of approximately 5,160.4has of vegetation, of which approximately 295.6 ha is considered potential habitat for this species.

Conclusion

The Balranald Project is unlikely to have a significant impact on the *L. monoplocoides* due to the following:

- no known habitat for *L. monoplocoides* would be removed as a result of the Balranald Project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- the Balranald Project will reduce potential habitat within the locality by 1 per cent
- fragmentation of populations or individuals is not likely to occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area
- no known pollinators are likely to be impacted by the Balranald Project.

Maireana cheelii (Chariot Wheels)

Assessment of Significance

Maireana cheelii (Chariot wheels) is a small tufted perennial which grow to 20cm tall. Woolly erect branches, with fleshy linear alternate leaves 5-9cm long, grow from a swollen tap root. This species produces flowers and fruit in spring time. Flowers are green and 1mm wide, growing in the leaf axial. The fruit is 6mm in diameter and has 5 distinct wings, giving rise to the common name of Chariot Wheels (OEH 2014d).

M. cheelii occurs in western Victoria and south-west NSW. In Victoria, Chariot Wheels occurs in an area bounded by Mitiamo in the east, Swan Hill in the north and Minyip in the south. In NSW, the species mostly occurs between Hay and Deniliquin but extending as far west as Moulamein. *M. cheelii* has been recorded from about 30 sites in Victoria and NSW since 1950, almost all on roadsides or on private land, with few records in reserves. Since 2000, plants have been recorded in about 15 populations, with most plants occurring in just six populations; five in Victoria and one in New South Wales, with four on private property and two along roadsides. No substantial populations exist in reserves. In suitable habitat, the species can be numerically abundant, with perhaps 700,000 plants in the six largest populations.

M. cheelii is listed as vulnerable under the TSC Act and EPBC 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.

M. cheelii is usually found in chenopod shrubland and grassland communities on heavy clay soils, dominated by various native shrubs, grasses and herbs, notably *Maireana pentagona, Maireana excavata, Nitraria billardierei, Austrostipa nodosa, A. scabra, Erodium crinitum, Rhodanthe corymbiflorum, Hyalosperma semisterile* and *H. glutinosa*.

In NSW the species appears to favour heavier grey clay soils that support *Atriplex vesicaria* communities. *M. cheelii* typically occupies sparsely vegetated sites, with a high proportion of bare ground, often as a result of over-grazing and subsequent wind erosion. It often occurs in low-lying sites that become waterlogged during the winter months, and may be slightly saline. It is likely that a loss of habitat and the lack of competition from other species due to the occupation of a relatively hostile environmental niche are factors influencing the current distribution of the species.

This species was not recorded within the project area during the field surveys. The species has been recorded from about 30 sites in Victoria and NSW since 1950, almost all on roadsides or on private land, with few records in reserves. Since 2000, plants have been recorded in about 15 populations, with most plants occurring in just six populations, five in Victoria and one in New South Wales, with four on private property and two along roadsides. No substantial populations exist in reserves. In suitable habitat, the species can be numerically abundant, with perhaps 700,000 plants in the six largest populations. It is likely that more populations exist, particularly on roadsides and private properties.

The Balranald Project is unlikely to have an adverse impact on such that a viable population is likely to be placed at risk of extinction due to the following:

- the Balranald Project will not impact upon any known individuals of *M. cheelii*
- the Balranald Project is unlikely to change the fire regime associated with the species

- no know populations will be impacted.

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

(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

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

(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.

Extent of habitat

M. cheelii was not recorded within the project area during the surveys and no records exist for this species within the locality, thus the site contains potential habitat only. The following vegetation communities constitute potential habitat: Bladder Saltbush Low Open Shrubland (LM110), Pearl Bluebush Low Open Shrubland (LM138), Black Bluebush Low Open Shrubland (LM102) and Old Man Saltbush Shrubland (LM137).

Approximately 1,934has of potential habitat will be directly or indirectly modified as a result of the project.

Fragmentation

Minor fragmentation of habitat may occur within the disturbance footprint, however connectivity will be retained with contiguous habitat around the periphery of the project area.

Extent of habitat

Potential habitat for this species within the project area is contiguous with extensive areas of potential habitat outside of the project area. Based on existing mapping, approximately 181,565.3ha of suitable habitat is found within the locality. Given the extent of habitat outside the project area, the potential habitat within the project area is not considered to be high importance to the long-term survival of the species within the locality.

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

Critical Habitat, as defined by the TSC Act, has not been declared for *M. cheelii*. There is no critical habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

There is no state adopted recovery plan for this species. There is however a Commonwealth adopted Recovery Plan for this species, prepared and adopted under the EPBC Act. Recovery objectives listed within the recovery plan, include:

- determine distribution, abundance and population structure
- determine habitat requirement
- ensure that important populations and their habitat are protected and managed.
- manage threats to populations
- identify key biological functions
- determine growth rates and viability of populations
- build community support for conservation.

A core focus of these objectives is the protection of important populations, research into the ecology of the species and building community capacity and support. No known population occurs within the project area.

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 relevant listed key threatening processes to these species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of approximately 5,160.4has of vegetation, of which 1,934 ha of vegetation is considered potential habitat for this species.

Conclusion

The Balranald Project is unlikely to have a significant impact on *M. cheelii* due to the following:

- no known habitat for *M. cheelii* would be removed as a result of the Balranald Project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- the Balranald Project will reduce potential habitat within the locality by less than one per cent
- fragmentation of populations or individuals will not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

Pterostylis cobarensis

A terrestrial orchid with seven to eleven narrow elliptic leaves forming a basal rosette. Stems are up to 40cm, producing between three and eight flowers per stem. Flowers are transparent with brown and green colouration. The species is deciduous with die back occurring after seed-set. Plants persist as the large, underground tubers. New rosettes form following rain in autumn and winter. The species is one of the most drought tolerant orchids in Australia, with a range of strategies. This includes large tuberoids which store moisture, rosettes with overlapping leaves which trap moisture and direct it to the root zone, and the tendency to grow in sites of litter accumulation and near rocks where run-off is concentrated.

This species occurs from central-eastern South Australia, north-east to the Darling Downs of Queensland and south to the central-west tablelands of New South Wales. Records are chiefly from the Nyngan-Cobar-Bourke area of New South Wales.

Associated species include *Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna* spp. and *Eremophila* spp.

The species is usually only found after fire or disturbance, and would therefore most likely occur in recently cleared or burnt mallee communities.

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

This species was not recorded within the project area during the field surveys. However, the species is known to be present at a site approximately 20 kms to the north of the Nepean mine (AMBS 2013).Habitat for the species includes eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include *Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna spp.* and *Eremophila spp*.

The species flowers from September to November. Vegetative reproduction is not common in this group of Greenhoods, but some species may form more than one dropper annually. Plants are deciduous and die back to the large, underground tubers after seed release. New rosettes are produced following soaking autumn and winter rains.

The orchid is dependent on specific soil mycorrhizal fungus to provide germinating seed with nutrition until the young orchid grows leaves and roots large enough to support the orchid. Without this fungus, there is no possibility of the seed developing.

The species is pollinated by the males of small gnats which are attracted to the flower by a pseudo sexual perfume. The type of gnat and its ability to move over distances is not known.

Potential habitat for the species within the project area includes: Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116).

The Balranald Project is unlikely to have an adverse impact such that a viable population is likely to be placed at risk of extinction due to the following:

- no known habitat *Pterostylis cobarensis* would be removed as a result of the project

- no known individuals or populations will be directly or indirectly impacted by the project
- the Balranald Project will reduce potential habitat within the locality by 1.75 per cent
- fragmentation of known populations or individuals will not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

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

(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

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

(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.

Extent of habitat

The species would most likely occur in sandy or loamy soil in spinifex mallee communities, particularly with *Eucalyptus dumosa*, but could also occur in chenopod mallee. The species is usually only found after fire or disturbance, and would therefore most likely occur in recently cleared or burnt mallee communities. Approximately 2,587.9 ha of potential habitat will be directly or indirectly modified as a result of the project.

Fragmentation

The Balranald Project will result in fragmentation of potential habitat. Fragmentation as a result of the Balranald Project is discussed in section 5. However, it should be noted that the Balranald Project will only fragment potential habitat, and not known habitat for this species. No individuals or populations would be impacted.

Importance of habitat

Habitat for this species within the project area is contiguous with habitat outside of the project area. There is approximately 199,590.7ha of vegetation comprising similar habitat for this species within the locality. Given the abundance of habitat outside the project area, the habitat within the project area is not considered to be of high importance to the long-term survival of the species within the locality.

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

Critical Habitat, as defined by the TSC Act, has not been declared for *Pterostylis cobarensis*. There is no critical habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

There is no adopted recovery plan for this 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 relevant listed key threatening processes to these species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of 5,139 ha of vegetation, of which 2,587.9 is considered potential habitat for this species.

Conclusion

The Balranald Project is unlikely to have a significant impact on the *P. cobarensis* due to the following:

- no known habitat for *P. cobarensis* would be removed as a result of the Balranald Project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- the Balranald Project will reduce potential habitat within the locality by less than 1per cent
- fragmentation of populations or individuals will not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

Santalum murrayanum (Bitter Quandong)

Santalum murrayanum (Bitter Quandong) is a tall, conspicuous shrub or tree which grows to about 4m tall. Leaves are opposite or alternate, between 1.5 and 3.5cm long. Fruit is spherical, 2-3cm in diameter and green to red-brown in colour. Flowers are small, cream coloured and clustered in the leaf axis. Flowering occurs between August and January, with fruit set occurring September and October.

S. murrayanum is found from south–western Western Australia, through South Australia and into western Victoria and NSW. Within NSW, most records are along the Sturt Highway from Dareton to Balranald. Additional records are located south of Menindee, and west of Lake Victoria. Few records occur within formal conservation reserves.

Habitat for *S. murrayanum* includes mallee communities in gravelly sandy loam soils, in open woodland or spinifex communities on dune crests. *S. murrayanum* is often found in association with *Eucalyptus socialis*, *E. dumosa*, *E. costata* and *E. leptophylla* (OEH 2014e).

Assessment of Significance

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 was not recorded within the project area during the field surveys. However, a record of the species exists on the Arumpo Road near the Nepean mine site and the species is known to occur along the Sturt Highway to the west of Balranald and was observed growing there during the current project. A closely-related non-listed species, *Santalum acuminatum*, was recorded in spinifex mallee habitat near the southern end of the West Balranald mine site. It was confirmed as the non-listed species by the Royal Botanic Gardens. This species is not cryptic, and given the level of survey effort, it is considered that it would have been detected had it been present within the project area.

Given the species was not recorded during the survey, there is no known viable local population within the project area which will be impacted by the Balranald Project. Notwithstanding this suitable habitat does occur within the project area and will be impacted by the Balranald Project. Spinifex Dune Mallee Woodland (LM130), Chenopod Sandplain/Swale Mallee Woodland (LM116), Belah – Pearl Bluebush Woodland (LM107), Belah – Chenopod Woodland (LM108) within the project area is considered to be suitable habitat for this species.

The Balranald Project is unlikely to have an adverse impact on the species such that a viable population is likely to be placed at risk of extinction due to the following:

- no known habitat for *S. murrayanum* would be removed as a result of the Balranald Project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- the Balranald Project will reduce potential habitat within the locality by less than one per cent
- fragmentation of populations or individuals will not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

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

(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

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

(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.

Extent of habitat

S. murrayanum was not recorded within the project area during the current assessment. The site contains potential habitat only. Spinifex Dune Mallee Woodland (LM130), Chenopod Sandplain/Swale Mallee Woodland (LM116), Belah – Pearl Bluebush Woodland (LM107), Belah – Chenopod Woodland (LM108) within the project area is assumed to constitute potential habitat for this species – thus approximately 3141.4ha of potential habitat will be directly or indirectly modified as a result of the project.

Fragmentation

Fragmentation of habitat may occur within the disturbance footprint, however connectivity will be retained within contiguous habitat around the periphery of the project area.

Importance of habitat

Habitat for this species within the project area is contiguous with habitat outside of the project area. There is approximately 254,104.2ha of vegetation comprising of similar habitat for this species within the locality. Given the extent of habitat outside the project area, the habitat within the project area is not considered to be of high importance to the long-term survival of the species within the locality.

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

Critical Habitat, as defined by the TSC Act, has not been declared for *S. murrayana*. There is no critical habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

There is no adopted recovery plan for this 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 relevant listed key threatening processes to these species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of 5,160.4 ha of vegetation, of which 3141.4ha is considered potential habitat for this species.

Conclusion

The Balranald Project is unlikely to have a significant impact on the *Santalum murrayanum* due to the following:

- no known habitat for *Santalum murrayanum* would be removed as a result of the Balranald Project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- the Balranald Project will reduce potential habitat within the locality by less than 1per cent
- fragmentation of populations or individuals will not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

Swainsona murrayana (Slender Darling Pea)

Swainsona murrayana (Slender Darling Pea) is prostrate, ascending to erect perennial to 25 cm high, with pubescent stems. Leaves are 5-10cm long, comprising between 3 and 11 leaflets. Flowers are pink or purple, distinguished by a strongly twisted hypanthium and a keel with a retracted tip. Plants flower in spring and summer and dieback following flowering. They reshoot readily and can be found en masse after winter rain (OEH 2014g).

Assessment of Significance

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.

S. murrayana is found in South Australia Victoria, Central NSW and southern Queensland. In NSW this species is found at Jerilderie, Deniliquin, on the Hay Plain and as far north as Broken Hill and Willandra National Park.

This species was not recorded within the project area during the field surveys. However, the species is known to be present at scattered sites in mallee lands 30 to 50kms to the west and south-west of the Nepean mine site.

The species is not cryptic, and the survey effort employed is likely to have been sufficient to detect the species should it be present within the project area. The species would be most likely to occur in sandy or loamy soil in spinifex mallee communities, particularly with *Eucalyptus dumosa*, but could also occur in chenopod mallee. The species is usually found after fire or disturbance, and would therefore be most likely to occur in recently cleared or burnt mallee communities.

The Balranald Project is unlikely to have an adverse impact on such that a viable population is likely to be placed at risk of extinction due to the following:

- no known habitat for S. *murrayana* would be removed as a result of the project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- fragmentation of populations or individuals will not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

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

(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

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

(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.

Extent of habitat

The species would most likely occur in sandy or loamy soil in spinifex mallee communities, particularly with *Eucalyptus dumosa*, but could also occur in chenopod mallee. The species is usually on found after fire or disturbance, and would therefore be most readily recorded within recently cleared or burnt mallee communities. Approximately 2498.9ha of potential habitat will be directly or indirectly modified as a result of the project.

Fragmentation

Fragmentation of potential habitat may occur within the disturbance area, however connectivity will be retained within contiguous habitat at the periphery of the project area.

Importance of habitat

Habitat for this species within the project area is contiguous with habitat outside of the project area. There is approximately 266,225.8ha of vegetation comprising of similar habitat for this species within the locality. Given the abundance of habitat outside the project area, the habitat within the project area is not considered to be of high importance to the long-term survival of the species within the locality.

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

Critical Habitat, as defined by the TSC Act, has not been declared for *S. murrayana*. There is no critical habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

There is no adopted recovery plan for this species. Under the Office of Environment and Heritage, Saving our Species program *S. murrayana* is listed as a 'keep-watch' species (OEH 2014). These are species where no immediate action is required, because they may be naturally rare in the landscape, have no significant threats or be more abundant than originally presumed.

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 relevant listed key threatening processes to these species include:

- clearing of native vegetation. The Balranald Project would result in the removal of 5,160.4ha of vegetation, of which 2498.9ha is considered potential habitat for this species.

Conclusion

The Balranald Project is unlikely to have a significant impact on the *Santalum murrayanum* due to the following:

- no known habitat for *S. murrayanum* would be removed as a result of the Balranald Project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- the Balranald Project will reduce potential habitat within the locality by less than one per cent
- fragmentation of populations or individuals is not likely not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

Swainsona pyrophila (Yellow Swainson-pea)

Swainsona pyrophila is an erect, sub-shrub, soft-wooded perennial, which grows to 1m high. Leaves are 5-1cm long and composed of 15-19 leaflets. Flowers are yellow, 10mm long, and emerge between September and December. Pods are 2-3.6cm long OEH 2014h).

S. pyrophila is distributed on the south-western plains of NSW and into Victoria and South Australia. In Victoria and South Australia, *S. pyrophila* is distributed along the Murray River.

The species grows in association mallee woodland and scrub on sandy and loamy soil and is often only found after fire or disturbance. Previously recorded sites include cleared and burnt mallee scrub on red loam to sand, previously burnt *Eucalyptus dumosa* mallee and disturbed woodland.

Assessment of Significance

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 species would be most likely to occur in sandy or loamy soil in spinifex mallee communities, particularly with *Eucalyptus dumosa*, but could also occur in chenopod mallee. The species is usually on found after fire or disturbance, and would therefore be most likely to occur in recently cleared or burnt mallee communities.

The Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116) communities are considered habitat for this species.

The Balranald Project is unlikely to have an adverse impact on such that a viable population is likely to be placed at risk of extinction due to the following:

- No known habitat for *S. pyrophila* would be removed as a result of the Balranald Project
- No known individuals or populations will be directly or indirectly impacted by the Balranald Project
- The Balranald Project will reduce potential habitat within the locality by 1 per cent
- Fragmentation of populations or individuals will not occur
- An 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

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

(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

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

(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.

Extent of habitat

The Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116) communities are considered habitat for this species. The species is usually on found after fire or disturbance, and would therefore be most likely to occur in recently cleared or burnt mallee communities. Approximately 2,587.9ha of potential habitat will be directly or indirectly modified as a result of the project.

Fragmentation

Minor fragmentation of habitat may occur within the footprint of mine operations, however connectivity will be retained within contiguous habitat around the periphery of the project area.

Importance of habitat

Significant areas of habitat contiguous with the habitat within the project area occurs outside the project area. There is approximately 199,590.7ha of vegetation comprising of similar habitat for this species within the locality. Given the abundance of habitat outside the project area, the habitat within the project area is not considered to be of high importance to the long-term survival of the species within the locality.

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

Critical Habitat, as defined by the TSC Act, has not been declared for *S. pyrophila*. There is no critical habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

There is no adopted recovery plan for this species. Under the Office of Environment and Heritage, Saving out Species program *S. pyrophila* is listed as a 'data-deficient' species (OEH 2014i). These are species where actions are to address data gaps, in order to inform management actions in the future.

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 relevant listed key threatening processes to these species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of 5,139ha of vegetation, of which 2,587.9ha is considered potential habitat for this species.

Conclusion

The result of the impact assessment conclude that the Project is unlikely to have a significant impact on the *Swainsona pyrophila* due to the following:

- no known habitat for *Swainsona pyrophila* would be removed as a result of the Balranald Project
- no known individuals or populations will be directly or indirectly impacted by the Balranald Project
- the Balranald Project will reduce potential habitat within the locality by 1 per cent
- fragmentation of known populations or individuals will not occur
- an 'important population' that is necessary for a species' long-term survival and recovery was not recorded in the project area.

Threatened Fauna

Southern Bell Frog *(Litoria raniformis)*

In NSW the Southern Bell Frog's distribution was centred on the Murray and Murrumbidgee River valleys and their tributaries. The species is currently widespread throughout the Murray River valley (Mahony 1999) and has been recorded from six Catchment Management Areas in NSW: Lower Murray Darling, Murrumbidgee, Murray, Lachlan, Central West and South East (NSW DEC 2005).

The Sothern Bell Frog is usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. Within the locality it is only expected to occur within wetlands and other predominantly permanent water features in close proximity (e.g. 10 km) to the Murrumbidgee River and tributaries.

NSW Wildlife Atlas records from the local area are concentrated around Yanga National Park approximately 20 km NE of the proposed water supply pipeline, however at least one individual has been found within the Balranald township.

Potential habitat within the project area consists of small areas of semi-permanent and ephemeral ponds and ephemeral drainage swales that are part of a larger shallow wetland complex and are also connected to an oxbow lake near the Murrumbidgee River. The potential habitat occurs along the eastern extreme of the proposed water supply pipeline for an approximate stretch of 2.5 km. Such habitat could potentially be used for movement, shelter or foraging. It is not preferred breeding habitat. No Southern Bell Frogs were recorded during a single night of survey after recent rainfall and localised flooding in December 2014, however the species may not have been calling at this time making it difficult to detect individuals within low density populations.

The overall area of potential habitat which would be temporarily disturbed by the Balranald Project is approximately 2 has. This habitat predominantly consists of shallow ephemeral drainage habitat as well as occasional small ephemeral and semi-permanent pools. The habitat to be temporarily disturbed would experience covering by soil while the proposed water supply pipeline is being introduced. There may be excavation of such habitat in some limited areas and clearing of shrubs and small trees fringing the ephemeral wetland habitat. There is also the potential for indirect impacts through sediments escaping to the nearby oxbow lake habitat which in some areas comprises potential breeding habitat for the Southern Bell Frog. The potential risk for these impacts will be lessened through appropriate and standard site management safeguards such as limiting soil disturbance around areas directly connected to permanent wetland areas, stockpile management and sediment and erosion control.

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.

Small semi-permanent and ephemeral ponds and drainage features occurring intermittently along a 2.5 km stretch of the water supply pipeline area will be temporarily disturbed by the Balranald Project. The habitat is not likely to be used for breeding and would be intermittently used predominantly by foraging adults or more likely dispersing young adult or sub-adult frogs if they are present in the vicinity of this area. The habitat affected would not sustain a regular population of the Southern Bell Frog. The Balranald Project would not have an adverse effect on the lifecycle such that a viable local population of this species is likely to be placed at risk of extinction as impacts will be limited to marginal, non-breeding habitat for the

species. Activities such as foraging and dispersal may be minimally impeded in the short-term for a very small area of habitat whilst the pipeline is being installed. This impediment to foraging and dispersal will be short lived and will be removed once the pipeline has been installed and the disturbance footprint of the water supply pipeline is rehabilitated.

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

(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

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

(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.

Approximately 2 ha of potential foraging, sheltering and movement habitat for the Southern Bell Frog will be temporarily disturbed as part of the Balranald Project. The majority (approximately 90%) of this area would experience temporary covering of soil after excavation of an adjacent trench (approximately 60 cm deep and 60 cm wide) for approximately a 48 hour period, before the soil is reinstated. Some clearing around the margins of the affected water features would also occur but this would be confined to small shrubs which would be allowed to regenerate over time. There is the potential for surrounding permanent wetland habitat that may act as breeding habitat to be indirectly impacted by the Balranald Project through increased sedimentation. Such impacts would be confined to approximately 2 – 3 has of permanent wetland habitat and would be short-lived. Standard site management activities such as erosion and sediment control will reduce the risk and severity of any indirect impacts to a minimal level.

The Balranald Project would not result in permanent fragmentation or isolation of Southern Bell Frog habitat as no permanent barrier to movement would be introduced and the area of habitat to be temporarily disturbed is very small in the overall context of the available habitat.

The small amount habitat to be temporarily modified for the Southern Bell Frog is not likely to be important or limiting habitat for the species.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

The Southern Bell Frog Draft Recovery Plan. DEC 2005

The Balranald Project proposed is not specifically consistent with the objectives of the recovery plan due as a small area of wetland habitat that may be temporarily disturbed by the Balranald Project.

The Southern Bell Frog has been assigned to the 'site managed' species management stream under the Office of Environment and Heritage 'Saving our Species program'. The Balranald Project does not directly relate to any of the identified management actions.

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 relevant listed key threatening processes to the Southern Bell Frog include:

- Clearing of native vegetation. The Balranald Project would result in the clearing of some small shrubs around semi-permanent and ephemeral wetland features. Vegetation removal will be avoided where possible and regrowth will be possible.

This key threatening processes has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

Conclusion

The Balranald Project would result in the temporary disturbance of a small amount of potential habitat for the Southern Bell Frog at the site of the water supply pipeline. Loss or modification of the habitat is not expected to occur to the extent that it will significantly impact the local population of this species.

Mobile Birds: White-fronted Chat (*Epthianura albifrons*), Hooded Robin (*Melanodryas cucullata*), Grey Crowned Babbler (*Pomatostomus temporalis temporalis*), Gilbert's Whistler (*Pachycephala inornata*), Varied Sittella (*Daphoenositta chrysoptera*)

Introduction

The **White-fronted Chat** prefers low dense cover (samphire and saltbush) in open plains, wetlands, salt lakes, moist grassland and low heath. Recorded in the northern section of the West Balranald mine during the 2011 survey, opportunistically off site in Jan 2013 and on nine occasions during bird surveys in November 2013 - predominantly at West Balranald (northern end) but also along the Nepean access road and once at the southern extent of the West Balranald mine site. The recent records and Atlas records from the locality are almost exclusively from higher fertility areas of Chenopod Shrubland (predominantly Pearl Bluebush Shrubland), consistent with the described preferred habitat.

The **Hooded Robin** (south-eastern form) prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. It requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. In total six observations were made of Hooded Robins. A pair of birds was recorded at West Balranald mine, at the Nepean mine during the 2011 surveys, at the proposed Nepean access road in 2012, at the Nepean mine in 2013, and around the injection borefield areas in 2014. Collectively the observations indicate that this species is present in low densities throughout woodland habitats within the project area, which is consistent with its regional distribution throughout large and well-connected tracts of woodland.

The **Grey-crowned Babbler** occupies open eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. The species may also be observed along streams in cleared areas and grassy road verges. The species has large conspicuous communal nests/roosts which are constructed out of twigs. Of the six observations of the Grey-crowned Babbler made during surveys five occurred outside of the project area (at least 10 km away) in relatively close proximity (15 km) to the Murrumbidgee River where the majority of Atlas of NSW Wildlife records for this species occur (or within a similar distance from the Murray River). A single sighting of 3 birds was made approximately 500 m south of the Nepean mine area in 2011. It is assumed that foraging and breeding habitat for these individuals would extend into the Nepean project area. There are no other records of the Grey-crowned Babbler within the locality of the Nepean mine.

Gilbert's Whistler is widely recorded in mallee shrublands, but also occurs in box-ironbark woodlands, cypress pine, belah woodlands and river red gum forests (Murray, Edwards and Wakool Rivers). Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including wattles, hakeas, sennas and hop-bushes. Within the project area well developed understorey and midstorey layers were rare and this may explain the absence of the species during field surveys. Nonetheless, parts of the project area are considered potential habitat given the relatively high number of records from approximately 30 km west of the West Balranald mine and scattered records approximately the same distance to the north for the Nepean mine area.

The **Varied Sittella** Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Recorded at Nepean mine area during both the 2011 and the 2013 survey periods.

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.

White-fronted Chat; Hooded Robin; Varied Sittella: These species were recorded throughout woodland areas within the project area and records are well distributed throughout the locality. The Balranald Project will remove habitat for these species, which will have an impact on their ability to forage, breed and nest within the locality. However, extensive areas of suitable vegetation exist adjacent to the disturbance footprint and throughout the locality and these species are likely to continue to utilise that habitat. It is therefore considered unlikely that the life cycle of these species would be adversely affected such that any viable local population of these species would be placed at risk of extinction.

Grey-crowned Babbler: It is expected that individual birds recorded within 500 m of the Nepean mine and any additional local population in this area would be impacted from the Balranald Project, with all aspects of their lifecycle affected. The local population in this area is considered to be small, given there are no other records of Grey-crowned babbler within 20 km of the Nepean mine area and the bird is conspicuous. As clearing within the Nepean mine area would encompass a large area of the known used habitat in the local area, it is considered possible that the local population may be at placed at risk of extinction from the action.

Gilbert's whistler: Habitat for this species within the project area is marginal given the absence of the species despite extensive field survey and the general lack of understorey and midstorey shrub layers. Given the general absence of the species from the project area, it is unlikely that the life cycle of the species would be adversely affected such that any viable local population of the species would be placed at risk of extinction. The species is most likely to use the project area whilst dispersing to other more suitable areas.

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

(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

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

(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.

(i) White-fronted Chat: Approximately 2,018 ha of potential habitat (chenopod shrublands including cleared grassland and claypan areas) will be removed as part of the Balranald Project.

Hooded Robin: Approximately 3,143 ha of potential habitat (woodland areas) will be removed as part of the Balranald Project.

Varied Sittella: Approximately 3,143 ha of potential habitat (mallee, river red gum, black box and belah) will be removed as part of the Balranald Project.

Grey-crowned Babbler: Approximately 2,890 ha of potential habitat (Belah, Black-box, Chenopod Mallee and River Red Gum communities) will be removed as part of the Balranald Project.

Gilbert's Whistler: Approximately 3,143 ha of potential habitat (mallee, river red gum and belah) will be removed as part of the Balranald Project.

(ii) White-fronted Chat; Hooded Robin; Varied Sittella: The disturbance footprint for the mine and associated infrastructure will likely cause some degree of fragmentation between areas of habitat for these species ranging from 700 to 1,700 m in width, however as these species are relatively mobile, fragmentation and isolation of the local population is not likely to be significant. Further, the disturbance footprint will be surrounded by contiguous vegetation, confining the issues of fragmentation to the mine disturbance footprint.

Grey-crowned Babbler – Given the currently known distribution of this species within the project area and its mobility, the Balranald Project is not considered likely to cause fragmentation or isolation of a local population of the species.

Gilbert's Whistler: given the lack of records of this species from the project area during field surveys and the fact that the species is highly mobile, the Balranald Project is not considered likely to cause fragmentation or isolation of a local population of the species.

(iii) White-fronted Chat: Records from the field surveys are from habitat with no protection mechanism regarding conservation and as such are currently subject to pressures such as extensive grazing by introduced herbivores. Such habitat is relatively common throughout the locality and NSW Wildlife Atlas records indicate that the species is broadly distributed throughout the region. The species was recorded as frequently outside the project area as it was within it. Therefore, the habitat to be lost from the Balranald Project is considered to be similar in value and importance to similar areas of habitat within the locality which are common. The habitat to be lost is not expected to be particularly important to the long-term survival of the local population of the species. Rehabilitated habitat and offset areas may also provide suitable habitat for use for this species in the medium to long-term.

Hooded Robin; Varied Sittella; Grey-crowned Babbler: Habitat to be removed includes 1,177 ha of vegetation within the project area. A significant proportion of records from the field surveys and wider NSW Wildlife Atlas records exist from habitat with no protection mechanisms. NSW Wildlife Atlas records for these species indicate that they are broadly distributed throughout the region.

Therefore, the habitat to be removed as a result of the Balranald Project is assumed to be of high importance but not such that the species are dependent upon it for their long-term survival in the region.

Gilbert's Whistler - given the absence of this species from the Project Area during field surveys and the availability of similar habitat within the locality the habitat to be impacted is not considered 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).

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

These species have been assigned to the Landscape species management stream under the Office of Environment and Heritage 'Saving our Species program'. The Balranald Project does not directly relate to any of the recovery actions.

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 relevant listed key threatening processes to these woodland bird species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of vegetation. Such areas would be subject to future mine rehabilitation.

This key threatening processes has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

Conclusion

White-fronted Chat; Hooded Robin and Varied Sittella: The Balranald Project will remove a large area of actual or potential habitat for each of the above bird species. Within the context of the locality, extensive areas of similar habitat occur that will be unaffected by the Balranald Project including large tracts of vegetation that are contiguous with the disturbance footprint. These species are known to inhabit such habitat and are likely to remain in such areas. As a result, the Balranald Project is unlikely to significantly impact local populations of any of these bird species such that local populations are placed at risk of extinction.

Grey-crowned Babbler: Given the currently limited known extent of the population of this species within and around the Nepean mine, the removal of an area of potential breeding/foraging/nesting habitat may significantly impact the local population of the species.

Redthroat (*Pyrrholaemus brunneus*)

Introduction

In NSW, the species is confined to the far west of the state, with populations known from four main areas, though the species is probably under-recorded due to its shy habits and low observer numbers within its distribution. In NSW the species has been recorded mainly in chenopod shrublands including old man saltbush, black bluebush and dillon bush shrublands.

Within the locality of the project area 24 NSW Atlas of Wildlife records for the Redthroat exist from open shrubland areas extending from the Waugorah area towards the eastern section of the currently proposed injection borefield area. In addition to these records, Redthroats were recorded from five sites during investigations for the Atlas Campaspe Mine (AMBS 2012) approximately 12 km north-west of the Nepean mine area.

From combined surveys of the survey area Redthroat observations were at 13 sites supporting chenopod shrubland between West Balranald (northern areas) and the injection borefield area.

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

The Redthroat was found throughout shrubland areas within the project area and records are well distributed throughout the locality. The Balranald Project will remove habitat for the Redthroat, which will have an impact on their ability to forage, breed and nest within the locality. However, extensive areas of suitable vegetation exist adjacent to the disturbance footprint and throughout the locality and these species are likely to continue to utilise that habitat. It is therefore considered unlikely that the life cycle of the Redthroat would be adversely affected such that any viable local population of the species 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.

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

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

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

Not applicable.

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

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

(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.

(i) Approximately 1,934 ha of potential habitat (chenopod shrublands) will be removed as part of the Balranald Project.

(ii) The disturbance footprint for the mine and associated infrastructure will likely cause some degree of fragmentation between areas of habitat for the Redthroat ranging from 700 to 1,700 m in width, however as this species is relatively mobile, fragmentation and isolation of the local population is not likely to be significant. Further, the disturbance footprint will be surrounded by contiguous vegetation, confining the issues of fragmentation to the mine disturbance footprint.

(iii) Records from the field surveys for the Redthroat are from habitat with no protection mechanism regarding conservation and as such are currently subject to pressures such as extensive grazing by introduced herbivores. Such habitat is relatively common throughout the locality and NSW Wildlife Atlas records indicate that the species is broadly distributed throughout the region. The species was recorded as frequently outside the project area as it was within it. Therefore, the habitat to be lost from the Balranald Project is considered to be similar in value and importance to similar areas of habitat within the locality which are common. The habitat to be lost is not expected to be particularly important to the long-term survival of the local population of the species. Rehabilitated habitat and offset areas may also provide suitable habitat for use for this species in the medium to long-term.

Therefore, the habitat to be removed as a result of the Balranald Project is assumed to be important to the Redthroat but not such that the species is dependent upon it for its long-term survival in the region.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

The Redthroat has been assigned to the Landscape species management stream under the Office of Environment and Heritage 'Saving our Species program'. The Balranald Project does not directly relate to any of the recovery actions.

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 relevant listed key threatening processes to these woodland bird species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of vegetation. Such areas would be subject to future mine rehabilitation.

This key threatening processes has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

Conclusion

The Balranald Project will remove a large area habitat for the Redthroat. Within the context of the locality, extensive areas of similar habitat occur that will be unaffected by the Balranald Project including large tracts of vegetation that are contiguous with the disturbance footprint. The Redthroat is known to inhabit such habitat and is likely to remain in such areas. As a result, the Balranald Project is unlikely to significantly impact local populations of the Redthroat such that any local population is placed at risk of extinction.

Chestnut Quail-thrush (*Cinclosoma castanotum*)

Introduction

This species is endemic to arid and semi-arid southern Australia, reaching its northern extent in the south of the Northern Territory. Three subspecies have been described with the nominate (castanotum) the only one occurring in NSW. It is probably the most widely recorded of the 'mallee specialists' in NSW where it occurs in two main populations. The population relevant to this assessment occurs from the south west corner of the state where it is widespread in both the Scotia mallee and in areas east of the Darling River as far east as Balranald and north to near Menindee.

Throughout its distribution the Chestnut Quail-thrush occurs in a wide range of arid and semi-arid habitats; mainly in the low shrubs and undergrowth of mallee scrub, but also in Acacia scrubs, dry sclerophyll woodland, heath, and native pine. However, in NSW it seems to occur almost exclusively in mallee habitats, with understorey dominated by spinifex, chenopods or other shrubs including Acacia species.

Within the locality of the project area 44 NSW Atlas of Wildlife records for the Chestnut Quail-thrush exist from mallee woodland areas extending from the Balranald area north to the Nepean area. In addition to these records, Chestnut Quail-thrush were recorded frequently during investigations for the Atlas Campaspe Mine (AMBS 2012) approximately 12-15 km north-west of the Nepean mine area.

From combined surveys of the survey area Chestnut Quail-thrush observations were made at 25 sites supporting mallee woodland between West Balranald and the Nepean mine area.

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

The Chestnut Quail-thrush was found throughout most areas of mallee woodland within the project area and records are well distributed throughout the locality. The Balranald Project will remove habitat for theChestnut Quail-thrush, which will have an impact on their ability to forage, breed and nest within the locality. However, extensive areas of suitable vegetation exist adjacent to the disturbance footprint and throughout the locality and these species are likely to continue to utilise that habitat. It is therefore considered unlikely that the life cycle of the Chestnut Quail-thrush would be adversely affected such that any viable local population of the species 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.

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

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

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

Not applicable.

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

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

(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.

(i) Approximately 2,588 ha of potential habitat (mallee woodlands) will be removed as part of the Balranald Project.

(ii) The disturbance footprint for the mine and associated infrastructure will likely cause some degree of fragmentation between areas of habitat for the Chestnut Quail-thrush ranging from 700 to 1,700 m in width, however as this species is relatively mobile, fragmentation and isolation of the local population is not likely to be significant. Further, the disturbance footprint will be surrounded by contiguous vegetation, confining the issues of fragmentation to the mine disturbance footprint.

(iii) Chestnut Quail-thrush were found from both protected and non-protected habitat within the survey area and their habitat is relatively common throughout the locality. The NSW Wildlife Atlas indicates that the species is broadly distributed throughout the region. The habitat to be lost from the Balranald Project is considered to be similar in value and importance to similar areas of habitat within the locality which are common. The habitat to be lost is not expected to be particularly important to the long-term survival of the local population of the species. Rehabilitated habitat and offset areas may also provide suitable habitat for use for this species in the medium to long-term.

Therefore, the habitat to be removed as a result of the Balranald Project is assumed to be important to the Chestnut Quail-thrush, but not such that the species is dependent upon it for its long-term survival in the region.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

The Chestnut Quail-thrush has been assigned to the Landscape species management stream under the Office of Environment and Heritage 'Saving our Species program'. The Balranald Project does not directly relate to any of the recovery actions.

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 relevant listed key threatening processes to this species include:

- Clearing of native vegetation. The Balranald Project would result in the removal of vegetation. Such areas would be subject to future mine rehabilitation.

This key threatening processes has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

Conclusion

The Balranald Project will remove a large area habitat for the Chestnut Quail-thrush. Within the context of the locality, extensive areas of similar habitat occur that will be unaffected by the Balranald Project including large tracts of vegetation that are contiguous with the disturbance footprint. The Chestnut Quail-thrush is known to inhabit such habitat and is likely to remain in such areas. As a result, the Balranald Project is unlikely to significantly impact local populations of the Chestnut Quail-thrush such that any local population is placed at risk of extinction.

Hollow Dependent Bat Species: Corben's Long-eared Bat (*Nyctophilus corbeni)*, Little Pied Bat (*Chalinolobus picatus*), Inland Forest Bat (*Vespadelus baverstocki*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

Introduction

Hollow dependent bat species rely on tree hollows for breeding, day and night time resting, sheltering from predators protection, social contact and breeding. Tree hollows are located throughout much of the woodland areas within the project area with the density of hollow trees dependant on size and age of trees, time since fire and intensity of fire.

Hollow mapping estimates lead to the conclusion that the Balranald Project is estimated to clear approximately 121,000 hollow bearing trees over the 5,346 ha to be disturbed. Areas with high and medium densities of tree hollows (estimated at 138 and 44 hollow trees/ha respectively) are estimated to make up 30% of disturbance areas whereas areas with low densities of tree hollows (estimated at nine hollow trees/ha) make up the remaining 70 % of disturbance areas.

Corben's Long-eared Bat is found in semi-arid habitats of the far south west and western slopes and plains in NSW. This tree hollow roosting species inhabits a range of forest and woodland types within its range. The species was captured twice during surveys by Niche in 2013 along the Nepean access road and approximately 6 km west of the West Balranald mine area. Both captures were near the interface between woodland and shrubland habitats. Suitable habitat occurs throughout the project area where mature woodland vegetation is present. There are 37 records from the locality for this species within the Atlas of NSW Wildlife, which are concentrated around the Nepean mine area. Regionally (within 50 km of the two mine areas) there are around 50 records for the species. The species is not usually possible to distinguish from other Nyctophilus species via call recording and therefore its distribution and abundance throughout the locality is likely to be under-estimated compared to species that are readily identifiable by call analysis.

The **Little-Pied Bat** is mainly found in semi-arid areas in NSW and roosts in tree hollows, caves and buildings. In the south-west region of NSW this species is often associated with woolsheds. They are known to forage over an area of several km in a night. The species was recorded at the Nepean mine by Ecotone in 2011, and a dead specimen was found outside of the West Balranald project area in Tin Tin shearer's quarters during the same survey. During recent surveys by Niche in 2014 seven individuals of the species were trapped at an injection borefield site concurrently with a large number of echolocation recordings (approximately 50) in an area of Belah Woodland. It is likely that an active roost was near the trap site. Echolocation recordings were also made from other sites throughout the project area, predominantly within mallee woodland habitat.

The **Inland Forest Bat** is confined to arid and semi-arid areas in central Australia extending to western NSW. It is primarily a tree roosting species but may also roost in buildings. Suitable known habitat occurs in both of the Nepean and West Balranald areas. The species was frequently recorded using echolocation recordings throughout the project area and surrounds from 29 sites. A low tree roost, possibly belonging to this species was observed within Nepean mine area in 2013.

The **Yellow-bellied Sheathtail Bat** has been recorded in a wide range of habitats across NSW but is infrequently recorded during surveys. It is a large bat that often forages over the tree canopy as well as open areas such as wetlands and treeless plains. This species primarily roosts in tree hollows, particularly in large dead stags. Ten records of this species were generated through field surveys within and around the project area all consisting of echolocation recordings that were possible, probable or definitive in nature. The species was not recorded more than once on a single night anywhere during the surveys.

Assessment of Significance

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.

For these hollow roosting bat species, all vegetated areas of the Balranald Project disturbance footprint represent potential foraging habitat. Dams and other water bodies provide potential drinking areas. Mallee habitat provides preferred breeding and roosting habitat for the four bat species, however, all hollow-bearing trees and trees with exfoliating bark in the disturbance area have some potential to act as roosting habitat.

Certain potential roost sites (hollow-bearing trees with favourable characteristics) have the potential to act as maternity sites which support key life cycle components for these species, including breeding, gestation, and the birth and rearing of young. Therefore, clearing of hollow-bearing trees within the disturbance area

has the potential to impact key life cycle components for hollow roosting bat species, through disruption of breeding, gestation and the birthing and rearing of young.

Up to 121,000 hollows would be removed by the Project, which is likely to constitute up to 5% of available hollows within the locality. Additionally 3,143 ha of preferred roosting and foraging habitat (mallee) would be removed or modified by the Project. The habitat represents approximately 1 % of woodland habitat present within the locality.

The preferential removal of hollow-bearing trees within areas of medium to high densities of hollow bearing trees during summer to autumn would lessen potential disturbance during periods of hibernation, birth and rearing of young within potential maternity colonies.

Should roost removal occur, all of these species are likely to have some capacity to establish new roosting sites within the locality given the abundance of tree hollows present. It should be noted however that the factors governing roost selection are poorly understood.

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

(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

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

(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.

(i) 3,143has of preferred foraging and roosting habitat, including up to 121,000 hollows, representing up to 5 % of those estimated in the locality will be removed by the Balranald Project.

(ii) Bats are highly mobile and impacts on connectivity as a result of the Project are unlikely to prevent hollow roosting bats from accessing other vegetated areas within the locality. The disturbance footprint is not likely to create any fragmented or isolated patches of habitat for these species.

(iii) The project area represents a large area of habitat for these species and includes a high probability of maternity roost sites for Corben's Long-eared Bat, Little Pied Bat and Inland Forest Bat, which are important features for the survival of these species within the locality. Existing records for the above species indicate that Corben's Long-eared Bat and Inland Forest Bat occur throughout the locality and wider region and therefore while important habitat is present within the project area, such habitat does not appear to be of particularly high importance to the long-term survival of these species within the locality.

There are relatively few records for the Little Pied Bat and therefore habitat within the project area is assumed more likely to be important habitat within the locality, particularly where the species was caught and recorded in high numbers (i.e. along the proposed injection borefield).

The Yellow-bellied Sheathtail Bat undertakes long-range movements and was recorded singularly wherever it was detected. The species also prefers large hollows for roosting and breeding habitat (Churchill 2008), which are uncommon or absent throughout much of the disturbance area. The habitat is therefore not expected to be of particular importance for the Yellow-bellied Sheathtail Bat for its long-term survival with the locality.

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

Critical Habitat, as defined by the TSC Act, has not been declared for any of these species. There is no critical habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

Corben's Long-eared Bat and Yellow-bellied Sheathtail Bat have been assigned to the Landscape species management stream under the Office of Environment and Heritage Saving our Species program. The Inland Forest Bat has been assigned to the keep watch species management stream under the Office of Environment and Heritage Saving our Species program. The Little Pied Bat has been assigned to the data deficient species management stream under the Office of Environment and Heritage Saving our Species program. The Balranald Project does not directly relate to any of the management actions.

A draft National recovery plan exists for the Corben's Long-eared Bat (Schulz and Lumsden 2010) with the following objectives:

- Clarify the current fine-scale distribution patterns and habitat requirements across the species' range.
- Increase the understanding of critical aspects of the biology and ecology of the South-eastern Long-eared Bat that will assist in the long-term management of the species.
- Identify key populations and protect these from habitat loss and fragmentation.
- Identify and alter inappropriate fire regimes.
- Identify and minimise forestry practices that may impact this species.
- Reduce exposure to agrichemicals.
- Identify the extent of population fragmentation and instigate measures to increase habitat connectivity where recent isolation has occurred.

- Identify and reduce the potential impact of feral species on key populations.
- Identify the key threats to the conservation of the species.
- Build community support for the conservation of the species.

The action would be inconsistent with the third objective however survey and establishment of offset areas would assist with contribution towards other objectives.

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 relevant listed key threatening processes to these species include:

- clearing of native vegetation. The Balranald Project would result in the removal of 3,143has of potential foraging habitat
- loss of hollow-bearing trees. The Balranald Project would result in the removal of up to 121,000 hollow-bearing trees
- removal of dead wood and dead trees.

This key threatening process has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

Conclusion

It is considered unlikely that the Balranald Project would significantly impact local populations of the Inland Forest Bat and Corben's Long-eared Bat, such that they are placed at risk of extinction, as these species are known to occur throughout the locality and the wider region and are highly mobile. Therefore, whilst approximately 1% of preferred habitat and up to 5% of potential roost habitat would be removed it is unlikely that the local population will be placed at risk of extinction due to the large expanses of unaffected adjacent habitat which is known to be occupied by these species.

It is considered unlikely that the Balranald Project would significantly impact local populations of the Yellow-bellied Sheathtail Bat, such that they are placed at risk of extinction, as preferred breeding habitat (large hollows) are uncommon throughout the project area and vegetation clearing will be restricted during the hibernation period for the species. Impacts would be confined to foraging habitat and small areas of potential roosting habitat. Preferred habitat occurs along the Murrumbidgee floodplain within the locality.

It is considered possible that the Balranald Project could impact Little Pied Bat such that the local population could be placed at risk of extinction as a large area of foraging, roosting and breeding habitat (in relation to the known utilised habitat) will be removed as a result of vegetation clearing for the Balranald Project and records of the species from the surrounding locality are relatively uncommon. Therefore maternal roosts and breeding habitat within the project area may be of particular local importance.

Raptors: Little Eagle (*Hieraaetus morphnoides*), Spotted Harrier (*Circus assimilis*)

Introduction

The **Little Eagle** Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. This species was recorded during field surveys at

both the West Balranald and Nepean mine areas in 2011 and outside of the project area around the Murrumbidgee River on several occasions.

The **Spotted Harrier** forages low over vegetation in open woodland, saltbush plains and wetlands. Nests are constructed in larger trees within the landscape. This species was observed foraging in the open plains of the project areas during the 2011 surveys and over the proposed haul road corridor and injection borefields in 2012 and 2013.

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.

Potential foraging habitat will be removed for both of these species as a result of vegetation clearing for the Balranald Project. The Balranald Project will also result in the loss of trees suitable for nesting within Belah and Black Box communities for the Little Eagle and Spotted Harrier.

Large raptors have large home ranges, thus the project area will account for only a small proportion of the available habitat in the locality, and individuals have the potential to utilise adjacent unaffected areas, given their high level of mobility. As a result is unlikely to result in an adverse effect on the life cycle of the threatened raptor species such that a viable local population of a species is 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

(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

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

(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.

(i) Approximately 5,161 ha of potential foraging habitat will be removed or modified for Little Eagle, as they have the potential to forage throughout much of the disturbance footprint. The Spotted Harrier will be subject to less habitat loss (approximately 2,028 ha) as it is confined to open habitats.

(ii) The disturbance footprint for the mine and associated infrastructure will fragment areas of habitat for these species however these bird species are highly mobile and areas of their home ranges are likely to fall outside of the disturbance footprint, making it possible for them to continue foraging in adjacent unaffected areas.

(iii) Habitat to be removed for these species is not known to have particular importance within the locality. The most important habitat to be removed is potential breeding and nesting habitat within the project area. Known nesting sites were not observed during survey but may occur. They are not expected to have a high concentration within the project area compared with the remainder of the locality and conversely are more likely to occur in areas with greater canopy heights towards the Murrumbidgee River.

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

No critical habitat, as listed on the TSC Act, would be affected by the Balranald Project. There is no critical habitat listed on the NSW critical habitat register OEH (2011) in the project area or surrounds.

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

The Little Eagle and Spotted Harrier have been assigned to the Landscape species management stream under the Office of Environment and Heritage Saving our Species program. The Balranald Project does not directly relate to any of the recovery actions.

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 relevant listed key threatening processes to these woodland bird species include:

Clearing of native vegetation. The Balranald Project would result in the removal of approximately 5,161 ha of nesting and foraging habitat.
This key threatening processes has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

Conclusion

The Balranald Project will remove habitat for each of these bird species. Within the context of the locality as a whole, similar habitat occurs adjacent to the disturbance footprint. Although habitat will be lost, and remaining habitat will be subject to an increase in fragmentation, these bird species are likely to disperse to suitable areas of habitat which will remain unaffected by the Project Area. As a result, the Balranald Project is unlikely to significantly impact local populations of any of these bird species.

Plains-wanderer (*Pedionomus torquatus*)

Introduction

The Plains-wanderer is found in northern Victoria, NSW and Queensland. The stronghold for this species is in NSW, in the Western Riverina, where it is found between Hay and Narrandera to the north, Cobb Highway to the west, Billabong Creek to the south and Urana in the east. Despite this large area, only 5% is

considered habitat for the Plains-wanderer. Whilst once having quite an extensive distribution, Plains-Wanderer is near extinct in eastern NSW, south-western Victoria and SA. Habitat modification is major threat to this species. Plains-wanderer inhabits native grasslands - where the structure of the grassland is a determining factor. Preferred habitat is sparse native grassland with a structure typically comprising 40-60% bare ground, 30-50% grass, herb and forb cover and 0-10% litter cover (DoE 2015b).

A review of Atlas records for the examined map sheets illustrates single record for the Plains-wanderer from the 1970's approximately 50 km to the south of the project area along the Murray River floodplain.

A bird thought to be a Plains-wanderer responded to call playback near Site 7 at West Balranald. The property owner indicated that Plains-wanderer was present and that it should recorded during surveys. Therefore it is possible that the species could occur in the open blue bush plains, grasslands and grain crops within the study area. Although targeted surveys in Jan 2013 failed to identify this species, it cannot be completely discounted as occurring.

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.

A single unconfirmed recording of this species was made during survey within the West Balranald mine area with further targeted survey failing to find the species. Should the species exist in the locality, it is likely that it uses the project area infrequently rather than to complete important lifecycle stages such as breeding and nesting.

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

(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

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

(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.

(i) Approximately 1,146 ha of potential habitat will be removed or modified for Plains-wanderer, within the project area consisting of Pearl Bluebush Low Open Shrubland and Open Claypans with Derived Shrubland/Grassland.

(ii) The disturbance area for the West Balranald mine and associated infrastructure will fragment an area of potential habitat for the Plains-wanderer predominantly by introduction of a 1200 m wide area (the width of Balranald mine in the vicinity of the potential habitat where a possible recording of the species was made) that would act as a potential barrier to occupation and movement. The potential habitat for this species within the project area is concentrated around the northern end of the West Balranald mine area and it is expected that, despite introduction of proposed access roads north of the mine area, east-west connectivity of habitat would be maintained (i.e. the access roads would not prevent birds from moving north around the mine).

(iii) The potential habitat to be removed for this species is expected to be used infrequently if at all. It is therefore not considered to be of particular importance for the species survival within the locality.

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

No critical habitat, as listed on the TSC Act, would be affected by the Balranald Project. There is no critical habitat listed on the NSW critical habitat register OEH (2011) in the project area or surrounds.

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

The Plains-wanderer has been assigned to the site-managed species management stream under the Office of Environment and Heritage Saving our Species program. The project area is not part of an identified management site.

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 relevant listed key threatening processes to these woodland bird species include:

Clearing of native vegetation.

The Balranald Project would result in the removal of approximately 1,146 ha of potential habitat for this species. This key threatening processes has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

Conclusion

The Balranald Project will remove potential habitat for Plains-wanderer, however the area to be removed is not considered to be of high importance to the species within the context of the locality. Similar habitat occurs adjacent to the disturbance footprint. The removal of potential habitat from the proposal is not considered likely to cause any local population of the species to become extinct.

Regent Parrot (eastern subspecies) (*Polytelis anthopeplus*)

Introduction

The Regent Parrot (eastern subspecies) has a highly restricted distribution and is confined to the arid and semi-arid areas of the south eastern Australia, including NSW, Victoria and South Australia. Within NSW the species is highly restricted along the Murray River and other isolated localities. The total population is estimated to be 1,500 pairs. Primary habitat for this species is River Red Gum forest and woodlands adjoining Black Box woodlands. Mallee, Belah and Buloke also provide habitat for this species, particularly for foraging during the breeding season (DoE 2015c).

Extensive targeted surveys were conducted for this species during assessment of a proposed transmission line, crossing the Murrumbidgee River, which has since been removed from this assessment to be considered separately. Nonetheless, results from those surveys, along with surveys conducted to assess ecological impacts from the Balranald Project presented herein have assisted greatly in understanding the distribution and movement patters of this species within the local area and therefore all such survey is considered for this impact assessment.

The Regent Parrot was not recorded during initial surveys of the West Balranald and Nepean mine areas in 2011 and 2012 (see section 3.1). During November 2013 surveys however, six observations of between one and twenty individual birds were made over the course of a week (Figure 11a).

a). All six observations were of birds flying overhead (usually along vegetated corridors) or foraging on lerp (secretions by leaf-borne insect larvae that were abundant in that season and year) around the Sturt Highway approximately 10 km south of the West Balranald mine area. As a result of the November 2013 observations intensive follow-up surveys were undertaken in December 2013 to investigate Regent Parrot presence and behaviour within the project area and its surrounds. Particular focus was given to determining whether the species was nesting along the Murrumbidgee River in the locality of the project area (approximately 18 km south-east of the West Balranald mine) and the originally proposed transmission line. The December 2013 surveys failed to record the Regent Parrot either near the Murrumbidgee River or around the current project area including where they were previously sighted on multiple occasions and it was concluded that the birds had moved from the area, potentially coincident with the end of the breeding season. A final round of targeted Regent Parrot surveys was conducted between the 29th of September and 1st of October 2013 and these surveys confirmed roosting (and presumably nesting parrots) at a known breeding location at Weimby which is 35 km south-west of the project area closer to the junction between the Murray and Murrumbidgee Rivers and therefore within the known area of breeding habitat for the Regent Parrot (Baker-Gabb and Hurley 2011). Immediately after observations of multiple Regent Parrots (approximated at 20 – 30) at Weimby, two hour long surveys were repeated at the Murrumbidgee River in the location of the then proposed transmission line. Two Regent Parrot sightings (possibly the same bird) were made within an hour of each other at this location (Murrumbidgee River 12 km south-west of Balranald). Both records were of a single bird flying rapidly overhead. Parrots were not seen foraging in the vicinity of the proposed disturbance footprint during this period.

After consideration of past and recent survey results, as well as knowledge of Regent Parrot behaviour (Baker-Gabb and Hurley 2011; pers. comm. Peter Ewin - NSW OEH and Simon Watson - LaTrobe University) it can be stated with reasonable confidence that the Regent Parrot is not breeding within the locality of the project area and there is no reason to believe that an extension of known breeding habitat towards Balranald from the Weimby area has occurred. Breeding parrots from the Weimby area are foraging/travelling along the Murrumbidgee River including within the locality of the project area. Foraging individuals will take advantage of vegetated corridors extending from the Murrumbidgee towards the project area to access mallee and belah vegetation to feed on seasonally available resources including lerp

and wheat. Foraging excursions within the project area, if they occur at all, are likely to be more common during the breeding season (when multiple observations of parrots near to the project area were made) to provide for nesting birds and fledglings. It is however considered that foraging excursions into the project area are likely to be very rare as the distance between the project area and known breeding habitat (conservatively estimated to be 26 km) is beyond the preferred distance of foraging excursions from breeding areas, which is estimated at 20 km (Baker-Gabb and Hurley 2011). This is supported by the absence of Regent Parrot observations within the project area both historically and from recent surveys conducted as part of the EIS for the Balranald Project. Foraging within the project area if it occurs at all is likely to be restricted to the southern end of the West Balranald mine as this area is closest to the known breeding habitat for this species.

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 local population of Regent Parrot is considered to be those individuals that forage within the locality but breed outside of the locality to the west. The potential foraging habitat within the project area (consisting predominantly of mallee vegetation) is beyond the distance of estimated foraging excursions for Regent Parrots (approximately 26 km versus 20 km) and birds were not observed foraging within the project area. Therefore the Balranald Project proposed constitutes the removal of habitat that is considered potential but marginal foraging habitat. This is unlikely to impact the Regent Parrot such that a viable local population of the species is 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

(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

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

(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.

(i) As stated above foraging within the project area if it occurs at all is likely to be restricted to the southern end of the West Balranald mine as this area is closest to the known breeding habitat for this species.

(ii) The Balranald Project would cause fragmentation of Mallee vegetation within the southern end of the project area (West Balranald mine), however in relation to marginal foraging habitat for Regent Parrot such fragmentation is unlikely to be important to the foraging movements or survival of the species.

(iii) Habitat to be removed for these species is unlikely to be important for the species given it has not been recorded within the project area and that the habitat is considered marginal foraging habitat only.

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

No critical habitat, as listed on the TSC Act, would be affected by the Balranald Project. There is no critical habitat listed on the NSW critical habitat register OEH (2011) in the project area or surrounds.

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

Recovery actions stated within the Regent Parrot recovery plan are focussed on breeding habitat or foraging habitat within 20 km of breeding habitat. As the project area is not within a 20 km radius of known breeding habitat the proposal is not inconsistent with such actions.

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 relevant listed key threatening processes to Regent Parrot include:

- Clearing of native vegetation. The Balranald Project would result in the removal of a small area of marginal foraging.

This key threatening processes has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

Conclusion

Vegetation clearing as a result of the Balranald Project will remove a small area of potential foraging habitat for this species which is conservatively considered as marginal foraging habitat. The impact arising from the action is unlikely to be significant for the Regent Parrot.

Malleefowl (*Leipoa ocellata*)

Introduction

Extensive field surveys were performed for the Malleefowl due to the species being Endangered in NSW, listed Federally, and having particular public interest as demonstrated by the active Malleefowl Recovery Team and its listing as an iconic species under the Saving our Species Program in NSW. The species is also known to occur within the project area.

The life cycle of this species is generally carried out within a relatively small area (a few kms at most) and involves foraging within mallee vegetation on a sandy substrate, containing an abundance of leaf litter, and breeding, comprising preparation of nest mounds (autumn to spring), egg laying (spring to summer) and chick emergence (summer) (Benshemesh, 2007). This species predominantly occurs in mallee and associated habitat. Sandy soil and abundant leaf litter are essential for mound building. Studies have found that the presence of spinifex is most important and chenopod mallee on heavier soils is less preferred. Wildfire can cause local extinctions and prevent breeding for many years.

A total of 39 Malleefowl related observations were made during the course of field surveys and these added to Atlas of NSW Wildlife records (Figure 12a - c). The majority of observations (17) made during field survey were of old mounds that had no evidence of recent use, followed by footprints (12) indicating the presence of Malleefowl, recently used mounds (6) then observations of actual birds (2) and active mounds (3). Cameras were placed at active and recently used mounds and confirmed the use or construction of three mounds over the course of the field surveys. The active mounds and recently used mounds recorded during survey were all located within the West Balranald mine areas along with several bird and footprint observations, indicating an area of higher activity. There were no active mounds recorded in the Nepean mine area however a single bird was recorded within 250 m of the proposed mine area, and footprints were recorded on several occasions approximately 10 kms south-west of the mine along the existing road which will be modified and used as an access road. It is not known whether nesting currently occurs within the Nepean mine but there is potential for this to occur at low densities.

Malleefowl habitat potential within the project area was mapped based on the density of records and known habitat preferences (Figure 11a – c) with areas of habitat within each of the habitat quality categories tabled below (Table 43). Mapping revealed that the preferred habitat areas were those situated within the dunal mallee systems of the project area which primarily support Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116). This is consistent with known preferred habitat for Malleefowl (e.g. Benshemesh 2007). Mallee habitat (as well as other woodland habitat) away from the sandy dunal systems did not appear to support Malleefowl and no old or recent mounds were recorded in these areas. It is likely that such vegetation occurs on sediments that do not support mound construction and/or the structure of vegetation communities limits mound building (such communities tended to support less dense vegetation with higher canopies and less leaf litter than mallee communities on dune systems). Nonetheless, woodland vegetation adjacent to areas of preferred habitat where mound building does occur is likely to play a role as foraging and dispersal habitat.

Table 43: Malleefowl habitat quality across disturbance areas for the Balranald project

Habitat Quality Category	Disturbance Area (has)
Very High	1,168
High	403
Moderate	596

Habitat Quality Category	Disturbance Area (has)
Low	377
Total	2,543

Habitat within the project area is adversely affected by grazing goats and (to a lesser extent) livestock (mostly sheep). Predation by foxes (and likely cats) are identified key threatening processes for this species and are likely to have contributed to a decline in Malleefowl within the project area and region.

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 Balranald Project will involve the removal of 3,034 has of potential Malleefowl habitat (most of which is preferred habitat) including at least three active and six recently used Malleefowl mounds, construction of the West Balranald access road and the Nepean access road haul road within known Malleefowl habitat and increases in vehicle movements through Malleefowl habitat have the potential to result in an increase in bird/vehicle interactions and death or significant injury to individual birds. Due primarily to the removal of a large area of current known and potential breeding habitat, it is likely that the local population could 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

(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

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

(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.

i. Approximately 3,034hasof potential Malleefowl habitat (much of which is preferred habitat) will be removed as part of the Balranald Project. Increased edge effects will be experienced adjacent to cleared areas and access tracks may facilitate ease of access for introduced

predators such as the fox. There will also be a significant reduction in overall patch size for the main Malleefowl habitat area in the vicinity of the West Balranald mine. The reduction in patch size will be less significant in the Nepean mine area given the more expansive area of habitat within the connected vegetation patch.

ii. The disturbance footprint for the mine and associated infrastructure will likely cause some fragmentation between areas of habitat for Malleefowl ranging from 700 to 1700 m in width (depending on the width of the disturbance footprint). This is likely to result in some reduced connectivity east and west of the mine areas. A 200 metre corridor of vegetation is being retained at the southern end of the West Balranald mine area which will assist with connectivity and lessen the impacts of reduced patch size for the local Malleefowl population. Management of remaining habitat will assist in reducing existing threats from goat grazing and fox predation.

iii. The mallee habitat to be removed is located within two of three main areas known to contain Malleefowl within the locality: West Balranald; Abbots Tank and Arumpo Road. The area around the West Balranald mine encompasses approximately x has of habitat and is somewhat isolated from the Abbots Tank area (in that the woodland habitat between the areas is sparse or absent), which is the nearest area of habitat to the west of the project area for this species. The area of habitat around Arumpo Road encompasses the proposed Nepean mine area as well as extensive areas of habitat to the north, south and west totalling approximately x has.
All areas of habitat are considered important though the area around the West Balranald mine appears to be particularly important given the density of mounds within that area of habitat and the presence of breeding pairs of birds which will be displaced as a result of the Balranald Project.

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

No critical habitat, as listed on the TSC Act, would be affected by the Project. There is no critical habitat listed on the NSW critical habitat register OEH (2011) in the project area or surrounds.

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

National Recovery Plan for Malleefowl *Leipoa ocellata* (Benshemesh, 2007)

The Balranald Project proposed is not consistent with the objectives of the recovery plan due to the permanent removal of known habitat for this species, the potential for mortality on mine and mine access roads, and the potential for fragmentation of Malleefowl habitat.

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 relevant listed key threatening processes to the Malleefowl include:

- Clearing of native vegetation. The Balranald Project would result in the removal of approximately 3,034 hectares of potential Malleefowl habitat.

This key threatening processes has been considered in this assessment, and mitigation measures and a strategy to secure biodiversity offsets is described in Sections 6 and 7 of the report respectively.

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Conclusion

The Balranald Project will involve the removal of Malleefowl habitat including active Malleefowl mounds around the West Balranald Mine area.

Iluka has agreed to adopt a range of mitigation measures that will reduce the potential for adverse effects on the local population and protect individual birds. These would be incorporated into a management plan for the species and are outlined in Section 6 of the report.

These measures should minimise loss of individual birds and achieve a net regional conservation outcome for mallee vegetation on which this species relies through the in-perpetuity conservation of like for like areas within in offset areas that will be managed for conservation. However, the local population is likely to be adversely affected by loss of existing mounds and by the displacement of breeding pairs from the disturbance footprint and it is likely that the local population could be placed at risk of extinction.

Southern Ningaui (*Niangua yvonneae*)

Introduction

The Southern Ningaui *(Ningaui yvonneae)* is a small, nocturnal, carnivorous marsupial that occurs in semi-arid mallee woodland. Spinifex understory is a key habitat component for this species. The species feeds on a large variety of invertebrates. Southern Ningaui are primarily a sedentary species, capture studies showed the species only moving 100m between recaptures (Carthew and Bos 2001).It was observed in the Nepean mine area during the surveys.

Within a 20 km radius of the Balranald Project area there are 23 records of Southern Niangua from north and west of the Nepean mine area. Six individuals of the species were captured during field surveys from two sites during surveys for the Balranald Project (Figure 11c). All captures were made in or adjacent to the Nepean mine component of the Balranald Project area, mostly within the Wampo Southern Mallee Conservation area.
Habitat for this species within the Balranald Project area is considered to be present within the Nepean mine area within mallee vegetation communities on linear dune systems. The Spinifex Dune Mallee Woodland (LM 130) component of these areas would be favoured habitat. Mallee vegetation further south either does not occur on the linear dune systems and therefore does not include the required spinifex ground layer (in the case of the borehole injection borefields) or does not contain records of the species either historically or after recent surveys (in the case of the West Balranald mine area).

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

The Balranald Project will remove a large area of known and potential mallee habitat on linear dune systems for the Southern Ningaui which will have an impact on their ability to forage and breed within the locality. Approximately 435ha of mallee woodland vegetation which is suitable habitat for this species would be removed as a result of the proposal. It is known that the local population extends outside of the disturbance area into adjoining habitat and there are numerous records from similar habitat further from the Balranald Project area within the locality from the Nepean area. Therefore, while there may be a local loss of individuals within the disturbance footprint, the local population of this species is unlikely to be placed at risk of extinction as a result of the project.

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

(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

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

(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.

(i) While 435 ha of Southern Ningaui habitat will be impacted by the Balranald Project it is estimated that 43,200 ha of known or potential habitat consisting of mallee woodland vegetation on linear dune systems occurs within the vicinity if the Nepean mine. Therefore the Balranald Project will impact approximately 1% of the Southern Ningaui habitat within the locality.

(ii) The disturbance area for the Nepean mine and associated infrastructure will fragment an area of known and potential habitat for the Southern Ningaui by introduction of an approximate 1,200 m wide area that would act as a potential barrier to occupation and movement. Given that contiguous habitat will remain around the Nepean mine project area it is considered that the increased fragmentation would not lead to long term isolation or separation within the local population.

(iv) The Wampo conservation area is considered to be somewhat more important habitat for the species than the surrounding areas within the locality due to the existing conservation covenant. The overwhelming majority of the Wampo conservation area would be retained under the Balranald Project and there is additional habitat with good condition vegetation supporting this species outside of conservation areas within the locality.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

This species has been assigned to the Landscape species management stream under the Office of Environment and Heritage *Saving our Species* program. The Balranald Project does not directly relate to any of the management actions.

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 relevant listed key threatening processes to the Southern Ningaui include:

- clearing of native vegetation. The Balranald Project would result in the removal of a significant amount of habitat for this species
- predation by the European Red Fox. The construction of additional roads and tracks may facilitate the ingress of increased numbers of foxes with the capacity to predate on Southern Ningaui.

These key threatening processes are assessed, and mitigation measures (including offsetting) are provided in Sections 6 and 7, respectively.

Conclusion

The Balranald Project will remove habitat for the Southern Ningaui, including preferred Spinifex Dune Mallee Woodland (LM 130). Within the context of the locality as a whole however, similar habitat occurs adjacent to the disturbance footprint. It is assumed therefore that whilst there will be potential loss of individuals, the local population will be sustained by individuals outside of the Balranald Project area. It is considered unlikely that the Balranald Project will place the local population of Southern Ningaui at risk of extinction.

Western Pygmy Possum (*Cercartetus concinnus*)

Introduction

This nocturnal species is relatively widespread and found in temperate, semi-arid, and arid regions across southern Australia. Preferred habitat is mallee scrub with a spinifex or tea-tree understory. Also found in belah mixed woodland with a well developed saltbush ground cover. The species feeds on nectar, pollen and insects. Nests are constructed in tree hollows, bird nests or on the ground under spinifex, mallee stumps and debris.

Fifty-four records of the species exist from the Atlas of NSW Wildlife database with the greatest densities approximately 4 km north-west of the Nepean mine area and (Wampo conservation area) 18 km west of the West Balranald mine area. Several captures were made in the Wampo Conservation Area to the north in 2000-2001 however subsequent surveys have failed to record the species (James Val, OEH pers. com.), which would indicate either a temporary (or permanent) decline in numbers within the area or a low reliability of detecting the species when present. The species was not recorded in the Balranald Project area or surrounds during recent surveys, however due to the proximity of records (predominantly within the Wampo conservation area) it is assumed that the species may occur within the Nepean or Balranald mine areas in low densities or in some years. Habitat within the Balranald Project area therefore represents potential habitat.

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.

Despite extensive survey, this species was not recorded during the surveys for the Balranald Project. However due to the proximity of records, predominantly within the Wampo conservation area it is assumed that the species may occur within the Nepean or Balranald mine areas in low densities or in some years. Habitat within the Balranald Project area therefore represents potential habitat. The Balranald Project will remove an area of potential habitat for the Western Pygmy Possum including hollows and logs. Based on a lack of records within the Balranald Project area, and the number of records within discrete areas away from the Balranald Project area but within the locality, it is considered unlikely that the Balranald Project will place a local population of Western Pygmy Possum 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

(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

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

(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.

Habitat for the Western Pygmy Possum is represented by the mallee and belah vegetation communities of which 3,118 ha will be adversely impacted by the Balranald Project. Approximately 221,541 ha of this habitat is present within the broader locality. Thus the total loss of Western Pygmy Possum habitat within the locality is 1.4%. Some fragmentation of habitat will occur as a result of the proposal, particularly from the mine footprint and from the proposed haul roads and gravel extraction area.Whilst habitat to be modified includes breeding and foraging habitat – the species was not recorded in the Balranald Project area. Habitat within the Balranald Project area constitutes potential habitat only. It is not considered that the loss/modification of potential habitat will result in the potential extinction of a local population of the Western Pygmy Possum.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the project area or surrounds.

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

NSW Recovery Plan for the Western Pygmy Possum (*Cercartetus concinnus*) (NPWS, 2001)

The action proposed is not inconsistent with any specific objectives of the recovery plan but clearing for the mining areas will reduce the availability of potential habitat for this species.

This species has been assigned to the Landscape species management stream under the Office of Environment and Heritage *Saving our Species* program. The Balranald Project does not directly relate to any of the management actions.

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 relevant listed key threatening processes to this species include:

- clearing of native vegetation -the Balranald Project would result in the removal of habitat for this species
- loss of hollow bearing trees
- removal of dead wood and dead trees
- predation by the European Red Fox.

These key threatening processes are assessed, and mitigation measures (including offsetting) are provided in Sections 6 and 7, respectively.

Conclusion

The Balranald Project will remove 3,118 ha of potential habitat for the Western Pygmy Possum, including preferred spinifex mallee habitat. Within the context of the locality as a whole, similar habitat occurs adjacent to the disturbance footprint. The loss of 3,118 ha of potential habitat represents 1.4% of habitat within the locality.

The known local population of this species is concentrated outside of the Balranald Project area and the removal of the potential habitat within the Balranald Project area is unlikely to have a significant impact on the local population of the species.

Bolam's Mouse (*Pseudomys bolami*)

Introduction

Bolam's Mouse is a nocturnal rodent, inhabiting arid and semi-arid areas of southern and western Australia. The species roosts in burrows, and feeds at night time on plant materials and seeds, invertebrates and small skinks. Core habitat for Bolam's Mouse includes mallee woodlands, belah woodlands and open shrubland. In NSW the species has a highly restricted distribution - records are limited to the far south–west of the state. Bolam's Mouse is listed as endangered in NSW and is presumed extinct in Victoria.

Bolam's Mouse has been recorded in a variety of habitats including mallee-spinifex, mallee shrubland, belah woodland and mixed open shrubland/woodland. Four records for the species exist in the Atlas of NSW Wildlife situated approximately 4 km north-west of the Nepean mine area (Wampo conservation area) and 12 km west of the borehole injection borefields. The species is known to fluctuate in number, particularly in response to rainfall and food availability. Given the known extent of records for this species and the results of field survey, potentially occupied habitat for this species within the project area consists of woodland vegetation within the Nepean mine area and injection borefields totalling 1,294 hectares. Habitat within the Wampo conservation area is more likely to contain the species than the remainder of the area which is more heavily grazed.

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 project area contains 1,294 ha of woodland habitat which is considered potentially occupied habitat for this species. This habitat consists of breeding and foraging habitat and will be removed or modified as part of the Balranald Project. While a significant amount of potential habitat for Bolam's Mouse will be modified, suitable potential habitat (26,293 ha) for breeding, foraging and roosting exists outside the disturbance area within the locality. While the Balranald Project may result in local losses of individuals within the disturbance footprint, the local population of Bolam's Mouse is concentrated outside of the Balranald Project area. It is considered unlikely that the Balranald Project will place a viable local population of Bolam's Mouse 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

(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

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

(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.

Potentially occupied habitat for Bolam's Mouse to be impacted by the proposal includes woodland vegetation communities within the Nepean mine and injection borefield areas, of which 1,294 ha will be adversely impacted by the Balranald Project. At least 26,293 hectares of potentially occupied habitat is present within the broader locality constituting the woodland vegetation area of the Wampo conservation area. Thus the total loss of Bolam's Mouse potentially occupied habitat within the locality is a maximum of4.9%. Some fragmentation of habitat will occur as a result of the proposal, particularly from the mine footprint and from the proposed haul roads and gravel extraction area. Contiguous habitat outside the Balranald Project area is considered to be sufficient to maintain the species within the locality.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the Balranald Project area or surrounds.

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

This species has been assigned to the partnership species management stream under the Office of Environment and Heritage Saving our Species program. The Balranald Project does not directly relate to any of the management actions.

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 relevant listed key threatening processes to Bolam's Mouse include:

- clearing of native vegetation. The Balranald Project would result in the removal of a significant amount of habitat for this species
- predation by the European Red Fox

These key threatening processes are assessed, and mitigation measures (including offsetting) are provided in Sections 6 and 7, respectively.

Conclusion

The Balranald Project will remove 1,294 ha of potential habitat for Bolam's Mouse within the Balranald Project area, including preferred spinifex mallee habitat. Within the context of the locality, 26,293 ha of similar habitat occurs adjacent to the disturbance area and is contiguous with habitat within the disturbance area.

Whilst Bolam's Mouse is limited in the distance it can disperse, if it occurs within the Balranald Project area it is considered that the local population of the Bolam's Mouse would extend outside the Balranald Project area given the known records of the species in relatively close proximity to the Balranald Project area. While there may be a local loss of some individuals within the disturbance footprint, there will be minimal impact to occurrences of this species outside the disturbance area. It is considered that the Balranald Project will not have a significant impact on Bolam's Mouse.

Reptiles: Mallee Worm-lizard (*Aprasia inaurita*), Jewelled Gecko (*Diplodactylus elderi*), Western Blue-tongue (*Tilqua occipitalis*), Bardick (*Echiopsis curta*)

Introduction

The **Mallee Worm-lizard (*Aprasia inaurita*)** or Pink Nosed Worm lizard is a slender legless lizard, which is pale olive brown above with a bright red/orange tail. The species is found in mallee woodland with a spinifex groundcover in red sand plains, and is distributed across all four southern mainland states (OEH 2014). The species is sometimes found under mallee roots. Within NSW, Mallee Worm Lizard is restricted to the south-western corner between Balranald and Gol Gol. There are two Atlas of NSW Wildlife records from a single location within the West Balranald mine area and several records north-east of the proposed Nepean mine area within the Wampo conservation area (the nearest being 5.5 km from the Balranald Project area). The species has low mobility and movements between sub-populations may therefore be limited. For this reason the local population of this species is difficult to define and may be significantly less than 20 km depending on the prevailing landscape, which has been used for most species to define the locality. The Mallee Worm-lizard may be difficult to detect via conventional survey methods.

The **Jewelled Gecko (*Stophurus elderi*)** is a semi arboreal species found in spinifex on red sandy soils. Jewelled Geckos live in spinifex clumps and probably have a low survival rate following fire (Val 2011). The species is small in size, is dark grey to black above, with small white spots with black edges and short tail. Jewelled Geckos are nocturnal, and feed on a variety of invertebrates, including crickets, caterpillars, grubs, termites, spiders, cockroaches and moths. In NSW they are distributed from Menindee in the north, to the Murray River in the South and to the SA/NSW border to the west (OEH 2014b). Intense fires may cause localised population extinctions (Val et. al 2001). Suitable habitat for Jewelled Gecko occurs in both the West Balranald and Nepean project areas however the species was detected only within the Nepean mine area during the 2013 survey period, and Atlas of NSW Wildlife records only exist from this area (two records from the Wampo conservation area approximately 4.5 km to the north-east). After a review of known records of this species within 20 km of the Balranald Project area, the known local population of this species is considered to occur only within the Wampo conservation area. Additional areas of potential habitat are present within the locality and some of these areas may be inhabited by this species, however surveys have either not been performed in such areas or the species has been absent or undetected. Potential habitat is present within the West Balranald mine area but the species has not been found either historically or from recent extensive surveys and is therefore not considered to occur there.

The **Western Blue-tongue (*Tiliqua occipitalis*)** is a diurnal lizard usually associated with mallee and spinifex on red sandy soils. The Western Blue-tongue is a pale brown skink with a series of brown bars on its body and tail. Within NSW it is distributed throughout the central and western regions, with no records from the north west of the state. This species forages for insects, snails, native vegetation and carrion (OEH 2012). No records from the Atlas of NSW Wildlife occur within 20 km of the Balranald Project area however there are numerous records from Mallee Cliffs National Park and between Euston and Balranald (30 – 50 km from

the Balranald Project area). A single recording of the species was made from the Wampo conservation area along a previously proposed Nepean access road that has since been relocated and is therefore outside of the Balranald Project area (approximately 3 km west).Nonetheless, due to the proximity of the recent record it is assumed that the species inhabits the potential habitat within the Nepean mine component of the Balranald Project area and surrounds. Habitat for this species within the Balranald Project area is considered to be present within the Nepean mine area within mallee vegetation communities on linear dune systems. Mallee vegetation further south either does not occur on the linear dune systems and therefore does not support the favoured sandy soils or does not contain records of the species either historically or after recent surveys (in the case of the West Balranald mine area).

The **Bardick (*Echiopsis curta*)** is rare with only three known records from NSW. Whilst rare in NSW, the Bardick has wide distribution occurring form Western Australia through South Australia and into NSW and Victoria. The species is a small snake up to 60 cm, with a large head, thick body and short tail. It ranges through grey-brown, olive brown, and reddish brown above, and is pale grey-brown below. This terrestrial, nocturnal snake is only known from the Balranald area in NSW where it inhabits mallee and spinifex (OEH 2011). Suitable habitat occurs within the Balranald Project Area. There are no recent records of the Bardick within the Balranald Project area, however one record from the proposed injection borefields exists which is more than 25 years old. There is a large amount of potential habitat within the Balranald Project area however this does not appear to be presently inhabited by the species.

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 project area provides an estimated 2,588ha of potential habitat (mallee woodland) for the **Mallee Worm-lizard** which would be removed or modified. The species has been found to occur within the West Balranald mine area and is also assumed to have potential presence within the Nepean mine area given the proximity of records within the Wampo conservation area and contiguous habitat between the mine area and known records. As it is very difficult to estimate the extent of the local population, and as local populations may be small and isolated, it is concluded that the adverse impacts from the Balranald Project may be such that the local population is placed at risk of extinction.

The project area provides an estimated 108 ha and 435 ha of known and potential habitat for the **Jewelled Gecko** and **Western Blue-tongue** respectively within and around the Nepean mine area which would be removed as a result of the Balranald Project. All lifecycle aspects for these species rely upon the presence of preferred habitat. As the currently known local population of this species is confined to a relatively small area, and as a sizeable proportion of that area will be removed it is considered possible that the Balranald Project may have an adverse effect on the species such that the local population could be placed at risk of extinction.

There are no recent records of the **Bardick** within the Balranald Project area, however there is one record in the Atlas of NSW Wildlife from the proposed injection borefields. Establishment of injection borefields will involve the clearing of 50 m linear strips of vegetation spaced 500 m to 2500 m apart, with injection wells established intermittently along the cleared areas. Given the paucity of Bardick records within the Balranald Project area (despite extensive survey) and surrounds, combined with the lesser magnitude of disturbance within the injection borefield area compared with areas to be mined (linear clearing rather than larger scale clearing and mining) it seems unlikely that any viable local population of the Bardick occupying the Balranald Project area.

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

(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

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

(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.

Known and potential habitat for **Mallee Worm-lizard** within the disturbance area equates to 2,588ha, constituting mallee woodland habitat.

Known and potential habitat for the **Jewelled Gecko** within the Balranald Project area equates to an estimated 108 ha within the Nepean mine area, which would be removed under the proposed action. The known and potential habitat constitutes Spinifex Dune Mallee Woodland (LM 130). It is estimated that approximately 2,000 ha of similar habitat occurs outside of the Balranald Project area within the Wampo conservation area. Therefore removal of 108 ha of such habitat constitutes approximately 5% of the habitat within the locality.

Known and potential habitat for the **Western Blue-tongue** within the Balranald Project area equates to an estimated 435 ha within and around the Nepean mine area, which would be removed under the proposed action. The known and potential habitat constitutes mallee woodland on linear sand dunes. It is estimated that approximately 19, 326 ha of similar habitat occurs outside of the Balranald Project area within the Wampo conservation area. Therefore removal of 108 ha of such habitat constitutes approximately 2.3 % of the habitat within the locality.

Potential habitat for the **Bardick** within the Balranald Project area equates to an estimated 2,588 ha which would be removed under the proposed action. The potential habitat constitutes mallee woodland throughout the Balranald Project area. It is estimated that approximately 178,382 ha of similar habitat occurs outside of the Balranald Project area within the locality. Therefore removal of 2,588 ha of such habitat constitutes approximately 1.5 % of the habitat within the locality.

The disturbance area for the Nepean mine and associated infrastructure will fragment an area of known and potential habitat for the **Jewelled Gecko, Mallee Worm-lizard, Western Blue-tongue and Bardick**

predominantly by introduction of a 1200 m – 2,400 m wide area (the width of the Nepean and Balranald mine areas respectively) that would act as a potential barrier to occupation and movement. Given that contiguous habitat will remain around both the Nepean and Balranald mine areas it is considered that the increased fragmentation would not lead to long term isolation or separation within the local population for these species.

Due to the relative scarcity of records for the **Jewelled Gecko, Mallee Worm-lizard, Western Blue-tongue and Bardick** habitat where these species are found to occur is presumed to be important habitat. Due to the relatively small extent of know habitat for Jewelled Gecko, Mallee Worm-lizard and Western Blue-tongue within the locality, the habitat to be removed is considered important to their long-term survival.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the Balranald Project area or surrounds.

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

The Bardick has been assigned to the partnership species management stream under the Office of Environment and Heritage *Saving our Species* program. The remaining reptile species have been assigned to the landscape species management stream under the Office of Environment and Heritage *Saving our Species* program. The Balranald Project does not directly relate to any of the proposed management actions.

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 relevant listed key threatening processes to these reptiles include:

- clearing of native vegetation -The Balranald Project would result in the removal of a significant amount of habitat for this species.

These key threatening processes are assessed, and mitigation measures (including offsetting) are provided in Sections 6 and 7 respectively.

Conclusion

Impacts from the Balranald Project on the **Jewelled Gecko, Mallee Worm-lizard** and **Western Blue-tongue** are considered to be significant due to the relatively small area of known habitat and scarcity of records for these species within the locality and their perceived limited mobility. Thus, it is possible that the significant areas of potential habitat contiguous with the Balranald Project area may not be sufficient to maintain the long-term survival of these species in the locality as it is not readily apparent that the local population inhabit such areas.

A single dated record of the Bardick exists for the locality, and the species has not been recorded despite targeted surveys. The project area contains potential habitat only. It is considered unlikely that the Balranald Project will have an adverse impact on any local population of the Bardick such that it is placed at risk of extinction, therefore the impact of the Balranald Project on this species is not considered significant.

Major Mitchell's Cockatoo (*Cacatua leadbeateri*)

Introduction

Major Mitchell's Cockatoo occurs in pairs or small groups in a variety of treed and treeless habitats. Major Mitchells Cockatoo is salmon pink below and white above, with a white tipped crest banded in red and gold. Pairs nest in larger tree hollows and they predominantly feed on seeds and melons on the ground. Small groups were observed on 14 occasions during the surveys for the Balranald Project throughout the Balranald Project area with some regularity, with the predominant area of occupation being the northern half of the Balranald Project area. The Atlas of NSW Wildlife contains 60 records of this species within the locality and the pattern of observations is consistent with recent field survey observations.

Preferred foraging habitat for this species is considered to be woodland habitat throughout the Balranald Project area however additional areas of chenopod shrubland may also be used by the species. Breeding/nesting habitat would be limited to Black Box and River Red Gum woodland habitat within the Balranald Project area as these were the only areas with suitable sized hollows.

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 project area contains known and potential habitat for Major Mitchell's Cockatoo but limited breeding/nesting habitat. Whilst the Balranald Project will remove a large area of foraging and some potential breeding habitat, large areas of contiguous habitat are available within the locality. The species is highly mobile, which reduces the impacts of habitat fragmentation. It is considered unlikely that the lifecycle of the species would be adversely affected such that the 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.

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

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

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

Not applicable.

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

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

(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.

Approximately 10ha of potential breeding habitat (black box and river red gum) for the Major Mitchell's Cockatoo will be removed as part of the proposal. Potential foraging habitat to be lost includes 5347ha of vegetation for Major Mitchell's Cockatoo. The disturbance area for the mine and associated infrastructure will fragment areas of habitat for these species, particularly associated with the proposed mine areas, however the species is highly mobile.

Given the wide distribution of the species throughout the locality, the limited area of potential breeding habitat within the Balranald Project area and the presence and extent of contiguous foraging habitat, the habitat to be removed is not considered of particular importance to the survival of this species.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the Balranald Project area or surrounds.

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

The Major Mitchell's Cockatoo has been assigned to the Landscape species management stream under the Office of Environment and Heritage *Saving our Species* program. The Regent Parrot has been assigned to the site-managed species management stream under the Office of Environment and Heritage *Saving our Species* program. The Balranald Project does not directly relate to any of the management actions.

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 relevant listed key threatening processes to this species include:

- clearing of native vegetation -he Balranald Project would result in the removal of a small amount potential breeding habitat on the Murrumbidgee River and within Black box communities, as well as large amount of foraging habitat within the disturbance footprint.
- loss of hollow bearing trees.

These key threatening processes are assessed, and mitigation measures (including offsetting) are provided in Sections 6 and 7, respectively.

Conclusion

It is considered unlikely that the Balranald Project will have an adverse impact on any local population of Major Mitchell's Cockatoo such that it is placed at risk of extinction, therefore the impact of the Balranald Project is not considered significant for this species.

Pied Honeyeater (*Certhionyx variegatus*)

Introduction

The Pied Honeyeater is a medium sized honeyeater with a long curved bill and a small blue patch of skin below the eye. Males and females are distinctly different. Males are black and white in colour with a white wing-bar, rump and tail panels. Females are greyish brown with a strong pattern of pale edging feathers (Birdlife 2014). The species is found in Queensland, NSW, South Australia and Western Australia and is the highly nomadic – moving based on availability of flowering and fruiting resources. In NSW this species is found throughout the western half of the state – in arid and semi arid areas, occasionally travelling further east in times of drought. The species is found in a variety of habitats, including shrublands and woodlands, with *Acacia* spp., *Eremophila* spp. and *Grevillea* spp. Pied Honeyeater is listed as vulnerable in NSW (OEH 2012).

The Atlas of NSW Wildlife contains six records of this species from the northern and southern ends of the locality. A single unconfirmed sighting of the species was made during field survey from the West Balranald mine area.

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

The project area provides potential breeding, roosting and foraging habitat, however the species has not been confirmed using this habitat with any frequency and it is more likely that use of the Balranald Project area is confined to nomadic foraging events rather key lifecycle events such as breeding. Within the Balranald Project area, the mallee, belah and black-box woodlands represent habitat for this species – totalling 3,148 ha which will be removed. This area of habitat is estimated to represents only 1.3 % of the habitat available for the Pied Honeyeater within the locality. Pied Honeyeater are a nomadic species, with the capacity to move large distances to forage for food (OEH 2012). For this reason, it is likely that the local population of Pied Honeyeater, extends long distances from the Balranald Project area. It is considered unlikely that a local population of Pied Honeyeater is likely to be placed at risk of extinction as a result of the Balranald Project.

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

(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.

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

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

(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.

Approximately 3,148ha of potential breeding, roosting and foraging habitat will be modified as a result of the Balranald Project, representing approximately 1.3% of similar habitat within the locality. While habitat will be fragmented particularly around the proposed mine areas, the species is highly nomadic and the disturbance is not likely to pose as a significant barrier to movement, particularly considering that habitat connectivity will be retained around the periphery of the disturbance area. For these reasons, it is considered that the habitat outside the Balranald Project area will be sufficient to sustain this species within the broader locality. Habitat within the Balranald Project area is not considered to be of particular importance for the species given the lack of records from the area and the widespread availability of similar habitat within the locality.

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

No Critical Habitat, as listed on the TSC Act, would be affected by the Project. There is no Critical Habitat listed on the NSW Critical Habitat register OEH (2011b) in the Balranald Project area or surrounds.

e) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The Pied Honeyeater has been assigned to the Landscape species management stream under the Office of Environment and Heritage Saving our Species program. The Balranald Project does not directly relate to any of the management actions.

f) 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 relevant listed key threatening processes to these woodland bird species include:

- clearing of native vegetation.

These key threatening processes are assessed, and mitigation measures (including offsetting) are provided in Sections 6 and 7 respectively.

Conclusion

The Pied Honeyeater is a highly nomadic species moving large distances for food resources and its use of the Balranald Project area appears limited. While the Balranald Project will remove 3148 has of potential habitat for the species, extensive similar habitat occurs throughout the locality. It is considered unlikely that the Balranald Project will have a significant impact on a local population of Pied Honeyeater.

Appendix 8: EPBC Act Assessments

Flora - Endangered Species

Lepidium monoplocoides (Winged Peppercress)		
Criteria (Critically Endangered and Endangered Species)	**Address of Criteria**	**Likelihood**
Lepidium monoplocoides (Winged Peppercress) is an erect annual herb 15–20 cm high which can be smooth or have small tubercles, and has angular stems. Small flowers with minute/absent petals form in elongated clusters. Fruit are more conspicuous than flowers, and comprise a flattened circular pod, 5mm long and 4mm wide. It is considered rare though widespread in semi-arid regions of NSW and also occurs in Victoria and South Australia (OEHa). *L. monoplocoides* is listed as endangered under both the Commonwealth EPBC Act 1999 and NSW TSC Act 1995. *L. monoplocoides* is endemic to south-eastern Australia and due to disturbance, its distribution is significantly detracted. At the time of publication of the recovery plan, the species existed as 6,000 plants in 13 populations (DSE 2010). Whilst little is known of the ecology of this species, the number of adult plants varies annually based on environmental conditions, including rainfall. It is therefore likely that seed remains viable in the soil for many years, and that the size of the soil stored seed at known locations is substantial.		
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	Despite adequate survey, this species was not recorded within the Balranald Project area. This species has however been recorded 25km to north of the Balranald Project area. A total of 301 plants have been recorded at 6 different locations. Survey effort was sufficient, such that had the species occurred in the Balranald Project area, it is unlikely to have gone un-identified. Given the Balranald Project area represents potential habitat only, it is unlikely that the Balranald Project will lead to a long-term reduction in the size of a population of *L. monoplocoides*.	Unlikely
• reduce the area of occupancy of the species	There will be no impacts to the known habitat or known of this species, thus the Balranald Project will not reduce the area of occupancy for *L. monoplocoides*.	Unlikely
• fragment an existing population into two or more populations	The closest population of this species is located 25km to the north of the Balranald Project area. The Balranald Project will have no impact on this population and will not result in its fragmentation.	Unlikely
• adversely affect habitat critical to the survival of a species	A recovery Plan exists for this species (Mavromihalis 2010). The Plan details the 10 known populations. None of the known populations for the species occur in the Project Area. The species was not recorded in the Project Area. Potential habitat for the species may be impacted, however this habitat is not considered critical to the survival of the species.	Unlikely
• disrupt the breeding cycle of a population	The Balranald Project will not impact on a known population of this species, and no known pollinators will be impacted by the activity. It is unlikely that the activity will disrupt the breeding cycle of a population.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project area contains the 1,620 ha of potential habitat for *L. monoplocoides*, representing less than 1% of all habitat within the locality. While potential habitat will be fragmented within the Balranald Project area, contiguous habitat will be maintained around the periphery of the Balranald Project area. It is unlikely that the Balranald Project will lead to modification of habitat to the extent that the species is likely to decline.	Unlikely
• result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered	Through truck and plant movements and the increased operation of edge effects, the Balranald Project has the potential to lead to the establishment of invasive species within the Balranald	Unlikely

Lepidium monoplocoides (Winged Peppercress)		
Criteria (Critically Endangered and Endangered Species)	**Address of Criteria**	**Likelihood**
or endangered species' habitat	Project area. However mitigation measures, including weed management will be implemented for the life of the Balranald Project to manage these impacts. Furthermore the Balranald Project area contains potential habitat only.	
• introduce disease that may cause the species to decline, or	The project is not likely to result in the introduction of disease that may lead to the decline of this species.	Unlikely
• interfere substantially with the recovery of the species.	The Balranald Project will not reduce the occupancy of this species within the Balranald Project area and will modify a small portion (less than 1%) of the habitat within the broader locality. It is considered unlikely that the Balranald Project will interfere with the recovery of this species.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the *Lepidium monoplocoides*.		

Flora - Vulnerable Species

***Brachyscome papillosa* (Mossgiel Daisy)**		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
Mossgiel Daisy (*Brachyscome papillosa*) is a multi-stemmed perennial herb which grows to 40cm high. Between June and December, solitary flowers occur on a peduncle up to 25cm long. Flowers are mauve in colour with a yellow centre. Leaves are sessile and up to 7cm long. (DoE 2008). *B. papillosa* is endemic to NSW, and primarily found within the Riverina Bioregion. The species is distributed between Mossgiel in the north, Yanga National Park to the south west and Urana to the south east.		
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
• lead to a long-term decrease in the size of an important population of a species	This species was not recorded within the Balranald Project area. Survey effort was extensive, thus it seems likely that the species would have been recorded, should it have occurred. No important population will be impacted within the Balranald Project area. A large population (comprising several thousand plants), has been recorded about 25km north of the Balranald Project area (AMBS 2012). The Balranald Project will have no impact on this population and will not result in its fragmentation.	None
• reduce the area of occupancy of an important population	The Balranald Project area does not contain an important population, nor will it impact on the potential habitat of an important population.	None
• fragment an existing important population into two or more populations	The action will not lead to the fragmentation of an important population as the Balranald Project area contains no known habitat for this species.	None
• adversely affect habitat critical to the survival of a species	Suitable habitat identified for this species within the project area is not occupied by this species and is not regarded as habitat critical to the survival of this species.	Unlikely
• disrupt the breeding cycle of an important population	The Balranald Project would not remove any known occurrences of this species. It is considered that the action is unlikely to disrupt the breeding cycles of an important population.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Suitable habitat is present within the Balranald Project area in Bladder Saltbush and Low Open Shrubland habitats. The modification of suitable habitat identified within the site would not decrease the availability or quality of habitat to the extent that the species is likely to decline, were it present.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The Balranald Project will not result in an increase in the presence and establishment of invasive species. Mitigation strategies, including weed management will be implemented during the life of the Balranald Project to manage potential impacts from invasive species.	Unlikely
• introduce disease that may cause the species to decline, or	The Balranald Project will not introduce disease which may lead to the declines of this species.	Unlikely
• interfere substantially with the recovery of the species.	The modification of suitable unoccupied habitat from the development site would be small and isolated within a large area of potential occurrence for this species. There would be no reduction in the area of occupancy for this species. Accordingly, it is concluded that Balranald Project would not interfere substantially with the recovery of the species.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on *Brachyscome papillosa.*		

***Maireana cheelii* (Chariot Wheels)**		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
Maireana cheelii (Chariot Wheels) is a small tufted perennial which grow to 20cm tall. Woolly erect branches, with fleshy linear alternate leaves 5-9cm long, grow from a swollen tap root. This species produces flower and fruit in spring time. Flowers are green and 1mm wide, growing in the leaf axial. The fruit is 6mm in diameter and has 5 distinct wings, giving rise to the common name of Chariot Wheels (OEH 2014d). *M. cheelii* once had a large distribution, including Queensland, NSW and Victoria, however is now extinct in northern NSW and Queensland. There are 17 populations of the species, with a total number of individual plants estimated at approximately 700 000. In NSW the species is found within the Western Riverina Bioregion, which is primarily to the east of the Balranald Project area. Most records in NSW are located between Hay and Deniliquin (DSE2010).		
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
• lead to a long-term decrease in the size of an important population of a species	Despite adequate survey effort, the species was not identified within the Balranald Project area. The species is often found in large populations – 700 000 individuals are found in 17 populations. Given this, and the extensive survey effort employed, it is assumed that had the species been present in the project area, it would have been identified. Therefore it is considered that no population of *M. cheelii* exists within the Balranald Project area and thus an important population of this species will not be impacted by the proposal.	None
• reduce the area of occupancy of an important population	The project area does not contain an important population, nor will it impact on the potential habitat of an important population.	None
• fragment an existing important population into two or more populations	The Balranald Project will not lead to the fragmentation of an important population, as the Balranald Project area contains no known habitat for this species. Furthermore, whilst some habitat fragmentation may occur within the mine footprint, contiguous habitat will be maintained around the periphery of the mine.	None
• adversely affect habitat critical to the survival of a species	Suitable habitat for this species is represented by the Bladder Saltbush, Black Bluebush and Old Man Saltbush communities. Suitable habitat identified for this species within the development site is not occupied by this species and is not regarded as habitat critical to the survival of this species. The Balranald Project will therefore not adversely affect habitat critical to the survival of the species.	Unlikely
• disrupt the breeding cycle of an important population	The Balranald Project would not remove any known occurrences of this species. It is considered that the Balranald Project is unlikely to disrupt the breeding cycles of an important population of this species	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Balranald Project will not isolate or decrease habitat to an extent that leads to a decline in the species. The project area represents potential habitat only.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The Balranald Project will not likely result in an increase in the presence and establishment of invasive species. Mitigation strategies, including weed management will be implemented during the life of the Balranald Project to manage potential impacts from invasive species.	Unlikely
• introduce disease that may cause the species to decline, or	The Balranald Project will not likely introduce diseases which may lead to a decline of this species.	Unlikely
• interfere substantially with the recovery of the species.	The modification of suitable unoccupied habitat for this species in the Balranald Project area would be small and isolated within a large area of potential habitat. There would be no	Unlikely

Maireana cheelii (Chariot Wheels)		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
	reduction in the area of occupancy for this species. Accordingly, it is concluded that the Balranald Project would not interfere substantially with the recovery of the species.	
Conclusion: The proposed action is unlikely to have a significant impact on *Maireana cheelii.*		

Swainsona murrayana (Slender Darling Pea)		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
Swainsona murrayana (Slender Darling Pea) is a prostrate, ascending to erect perennial to 25 cm high, with pubescent stems. Leaves are 5-10cm long, comprising between 3 and 11 leaflets. Flowers are pink or purple, distinguished by a strongly twisted hypanthium and a keel with a retracted tip. Plants flower in spring and summer and dieback following flowering. They reshoot readily and can be found en masse after winter rain (OEH 2014g).		
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
• lead to a long-term decrease in the size of an important population of a species	This species was not recorded within the Balranald Project area despite adequate targeted survey. There are records of this species between 30-50km to the west and south west of the Balranald Project area. The Balranald Project will not likely impact on an important population of this species, as there are no records of the species within the Balranald Project area.	None
• reduce the area of occupancy of an important population	*Swainsona murrayana* does not occupy the Balranald Project area, thus the Balranald Project will not likely reduce the area of occupancy for any population of this species.	None
• fragment an existing important population into two or more populations	The Balranald Project will not lead to the fragmentation of an important population, as the Balranald Project area contains no known habitat for this species. Whilst some fragmentation of potential habitat may occur as a result of the activity, contiguous habitat will be maintained around the periphery of the Balranald Project area.	None
• adversely affect habitat critical to the survival of a species	Suitable habitat for this species is present in the Balranald Project area and comprises the Mallee Woodland communities. Approximately 2498.9 ha of this habitat is present within the Balranald Project area, representing 1% of this same habitat within the broader locality. Suitable habitat identified for this species within the development site is not occupied by this species and is not regarded as habitat critical to the survival of this species. Given this, it is considered that the Balranald Project will not adversely affect habitat critical to the survival of the species.	Unlikely
• disrupt the breeding cycle of an important population	The Balranald Project would not remove any known occurrences of this species, or affect any known pollinators of this species. The Balranald Project is unlikely to affect the breeding cycle of an important population.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Balranald Project will not isolate or decrease habitat to an extent that leads to a decline in the species. The project area represents potential habitat only. The Balranald Project will not lead to a decline in the species.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The Balranald Project will not result in an increase in the presence and establishment of invasive species. Mitigation strategies, including weed management will be implemented during the life of the Balranald Project to manage potential impacts from invasive species.	Unlikely
• introduce disease that may cause the species to decline, or	The Balranald Project will not introduce disease which may lead to the declines of this species.	Unlikely
• interfere substantially with the recovery of the species.	There would be no reduction in the area of occupancy for this species and only 1% of potential habitat within the Balranald Project area will be removed as a result of the activity. Accordingly, it is concluded that the Balranald Project would not interfere substantially with the recovery of the species.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on *Swainsona murrayana*.		

***Swainsona pyrophila* (Yellow Swainson-pea)**		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
Swainsona pyrophila (Yellow Swainson-pea) is an erect, sub-shrub, soft-wooded perennial, which grows to 1m high. Leaves are 5-10cm long and composed of 15-19 leaflets. Flowers are yellow, 10mm long, and emerge between September and December. Pods are 2-3.6cm long OEH 2014h). *S. pyrophila* is distributed on the south-western plains of NSW and into Victoria and South Australia. In Victoria and South Australia, *S. pyrophila* is distributed along the Murray River. The species grows in association with mallee woodland and scrub on sandy and loamy soil and is often only found after fire or disturbance. Previously recorded sites include cleared and burnt mallee scrub on red loam to sand, previously burnt *E. dumosa* mallee and disturbed woodland.		
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
• lead to a long-term decrease in the size of an important population of a species	There are no records of this species within the locality and it was not observed within the Balranald Project area despite adequate survey. The Balranald Project will not likely decrease the size of an important population of this species.	None
• reduce the area of occupancy of an important population	*S. pyrophila* is not present within the Balranald Project area, thus the Balranald Project will not likely reduce the occupancy of a population of this species.	None
• fragment an existing important population into two or more populations	The Balranald Project will not likely lead to the fragmentation of an important population, as the Balranald Project area contains no known habitat for this species. Whilst some fragmentation of potential habitat may occur as a result of the activity, contiguous habitat will be maintained around the periphery of the Balranald Project area.	None
• adversely affect habitat critical to the survival of a species	Suitable habitat for this species is present in the Balranald Project area and comprises the Mallee Woodland communities. Approximately 2,498.9ha of this habitat is present within the Balranald Project area, representing 1% of this same habitat within the broader locality. Suitable habitat identified for this species within the development site is not occupied by this species and is not regarded as habitat critical to the survival of this species. It is therefore considered unlikely that the Balranald Project would adversely affect habitat critical to the survival of the species.	Unlikely
• disrupt the breeding cycle of an important population	The Balranald Project would not remove any known occurrences of this species, or affect any known pollinators of this species. The Balranald Project is unlikely to affect the breeding cycle of an important population.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Balranald Project will not isolate or decrease habitat to an extent that leads to a decline in the species. The project area represents potential habitat only. It is unlikely that the Balranald Project will lead to a decline in this species.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The Balranald Project will not result in an increase in the presence and establishment of invasive species. Mitigation strategies, including weed management will be implemented during the life of the Balranald Project to manage potential impacts from invasive species.	Unlikely
• introduce disease that may cause the species to decline, or	The Balranald Project will not introduce disease which may lead to declines of this species.	Unlikely
• interfere substantially with the recovery of the species.	There would be no reduction in the area of occupancy for this species and only 1.5% of	Unlikely

***Swainsona pyrophila* (Yellow Swainson-pea)**		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
	potential habitat within the locality will be removed as a result of the activity. Accordingly, it is concluded that the Balranald Project will not interfere substantially with the recovery of the species.	
Conclusion: The proposed action is unlikely to have a significant impact on *Swainsona pyrophila*.		

Fauna - Migratory Species

Rainbow Bee-eater (Merops ornatus)		
A medium sized bird (22-25cm long) with green-blue colouring on the forehead and chestnut colouring on the back of the head. The species has a long, slender decurved bill, a red iris and grey legs and feet. Rainbow Bee-eaters are often seen in pairs or small flocks, although have been known to migrate in flocks of up to 500 birds. The species is distributed throughout most of Australia, although arid areas are very sparsely populated. Primarily birds will reside close to permanent water, particularly when breeding. The total population of this species within Australia is considered to be large – 30 000 records have been submitted to Birds Australia since 1998 (DoE 2015).		
Criteria (Migratory Species)	**Address of Criteria**	**Likelihood**
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:		
• substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Rainbow Bee-eater is a widespread and relatively common species. Habitat within the Balranald Project area is largely restricted to areas of woodland and Forest within the Balranald Project area. The species was recorded through opportunistic observations. Rainbow Bee-eaters are a highly mobile species, distributed throughout Australia. The habitat within the Balranald Project area is not important habitat for this species in a broader context. Therefore, it is considered unlikely that the Balranald Project will substantially modify, destroy or isolate an important area of habitat for this migratory species.	Unlikely
• 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 Balranald Project will not lead to the incursion of an invasive species which is harmful to the Rainbow Bee-eater.	Unlikely
• seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The Rainbow Bee-eater is a common species that is widely distributed throughout Australia and eastern Indonesia. It is not known if the total population of the Rainbow Bee-eater is divided into a series of discrete subpopulations. However, the mobility of the species suggests that it is unlikely that any local or regional population would be genetically isolated from the remainder of the Australian population and therefore the Balranald Project would not seriously disrupt the lifecycle of an ecologically significant proportion of the population.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the Rainbow Bee-eater		

***Great Egret*(*Ardea modesta*)**		
A moderately large sized bird (83-103cm long) with white plumage, a black or yellow bill and long reddish and black legs. Whilst they often forage in pairs or as individuals, they roost and nest in large colonies from hundreds to thousands of individuals. The Great Egret is found in all states and territories and is a vagrant species on offshore islands. Breeding colonies are found throughout its range, the greatest number of colonies with the highest number of birds are located along the coast of the Northern Territory and in south-western Queensland. The species inhabits a range of wetland environments including saline, brackish and freshwater habitats (DoE 2015b).		
Criteria (Migratory Species)	**Address of Criteria**	**Likelihood**
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:		
• substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Habitat for the Great Egret within the Balranald Project area is restricted to the oxbow lakes on the Murrumbidgee River in the south-east of the Balranald Project area. The site represents foraging habitat for this species. The site is not a core breeding or roosting site. Given the distribution of this species throughout Australia, it is unlikely that the habitat to be modified is important to this species.	Unlikely
• result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Additional roads and tracks may facilitate the egress of feral cats and foxes that may prey on this species. These predator species are already present within the Balranald Project area and the Balranald Project is not likely to provide a mechanism for the increased presence of these predator species within the oxbow habitats within the Balranald Project area.	Unlikely
• seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The Great Egret is a common species that is widely dispersed throughout Australia. Given the mobility of the species it is unlikely that any local or regional population would be genetically isolated from the remainder of the Australian population and therefore Balranald Project would not seriously disrupt the lifecycle of an ecologically significant proportion of the population.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on the Great Egret.		

Fauna - Vulnerable species

Southern Bell Frog (*Litoria raniformis*)		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
The Southern Bell Frog inhabits permanent and ephemeral wetlands and within NSW is found in six Catchment Management Authority regions including the Lower Murray Darling, Murrumbidgee, Murray, Lachlan, Central West and South East (NSW DEC 2005). The species inhabits a range of aquatic habitat types including Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps, River Red Gum swamps, billabongs and river valleys. The species was not recorded within the Balranald Project area during field surveys and Atlas of NSW Wildlife records are primarily restricted to within Yanga National Park (20km south east) with one additional record from the township of Balranald. Habitat within the Balranald Project area and surrounds is restricted to permanent and ephemeral waterbodies in close proximity to the Murrumbidgee River system which includes approximately 2.5 km along the eastern end of the proposed water pipeline.		
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
• lead to a long-term decrease in the size of an important population of a species	There are no records of this species within the Balranald Project area and it was not recorded during survey. Notwithstanding, potential habitat exists within the Balranald Project area around the oxbow lakes and wetlands of the Murrumbidgee River which are adjacent to a section of the proposed water supply pipeline. The species may occasionally occur in this area during favourable conditions/seasons. Approximately 2 ha of potential habitat along a 2.5km stretch of pipeline will be modified by the proposal. The habitat present is unlikely to be used for breeding, rather, it represents potential foraging and dispersal habitat. Any population of this species is considered to constitute an important population, however, as the area of potential habitat within the Balranald Project area is minimal and of limited utility to the species a long-term decrease in any surrounding population would not occur.	None
• reduce the area of occupancy of an important population	The Balranald Project would not impact the area of occupancy of any population of the Southern Bell Frog for the following reasons: • the impacted area is potential habitat only with limited utility for the species (marginal foraging and dispersal habitat) • there would be no barrier introduced from the Balranald Project limiting dispersal or foraging activities for any population of the species which may infrequently utilise the potential habitat within the Balranald Project area.	None
• fragment an existing important population into two or more populations	The Balranald Project will not lead to the fragmentation of an important population, as the Balranald Project area contains limited habitat for this species and there would be no barrier introduced from the action limiting dispersal or foraging activities for any population of the species which may infrequently utilise the potential habitat within the Balranald Project area.	None
• adversely affect habitat critical to the survival of a species	Habitat present within the Balranald Project area is suitable for foraging and dispersal and is unlikely to be used by this species during more critical parts of its lifecycle. The habitat to be modified is not critical to the survival of the species, furthermore, extensive additional similar or better habitat is contiguous with the habitat to be modified.	Unlikely
• disrupt the breeding cycle of an important population	The potential habitat within the Balranald Project area is suitable for foraging and potential	None

Southern Bell Frog (*Litoria raniformis*)		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
	dispersal of frogs only, and would not be used as a breeding site. As fragmentation would not occur as a result of the Balranald Project it would not limit the connectivity of breeding individuals.	
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Balranald Project will not isolate or decrease habitat to an extent that leads to a decline in the species. The Balranald Project area represents potential habitat only. It is unlikely that the Balranald Project will lead to a decline in this species.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	It is unlikely that the Balranald Project will result in an increase in the presence and establishment of invasive species which may impact on the Southern Bell Frog. The area of potential habitat is already affected by weeds where soil disturbance has occurred and experiences frequent vehicular access. Mitigation strategies, including weed management will be implemented during the life of the Balranald Project to manage potential impacts from invasive species. Water from other watercourses which may contain contaminants or harbour disease would not be transported to the site and the Balranald Project area is already known to contain the introduced Mosquito Fish - *Gambusia holbrooki* which is a known threat to the Southern Bell Frog.	Unlikely
• introduce disease that may cause the species to decline, or	The Balranald Project is unlikely to introduce disease which may lead to declines of this species. A Chytrid protocol would be in place during construction of the proposed pipeline which would assist in reducing the risk of the spread of Chytrid fungus.	Unlikely
• interfere substantially with the recovery of the species.	There would be no reduction in the area of occupancy for this species. Additional habitat for this species is available in habitat adjacent to the areas to be impacted. No known targeted recovery actions for this species are occurring within the Balranald Project area.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on Southern Bell Frog.		

Malleefowl (*Leipoa ocellata*)		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**

National and Regional Context

Malleefowl are an endangered species in NSW and listed as vulnerable under the EPBC Act. The species predominantly occurs in mallee and associated habitat. Sandy soil and abundant leaf litter are essential for mound building and thus breeding. Wildfire can cause local extinctions and prevent breeding for many years. The life cycle of this species is generally carried out within a relatively small area (a few kms at most) and involves foraging within mallee vegetation on a sandy substrate containing an abundance of leaf litter, and breeding, comprising preparation of nest mounds (autumn to spring), egg laying (spring to summer) and chick emergence (summer) (Benshemesh 2007).

Within NSW and Australia the distribution of Malleefowl has reduced markedly – the south-western Mallee region of NSW is a stronghold for this species within the State (OEH 2014). The Malleefowl population within the project area and surrounds is considered to be important to the species.

Occurrence within the Project Area and Surrounds

A total of 39 Malleefowl related observations were made during the course of field surveys and these added to or confirmed Atlas of NSW Wildlife records (Figure 12a - c). The majority of observations (17) made during field survey were of old mounds that had no evidence of recent use, followed by observations indicating the presence of Malleefowl: footprints (12); recently used mounds (6); observations of actual birds (2) and active mounds (3).Surveys within the proposed West Balranald mine area (Figure 12a) highlighted a number of active mounds within the project area and a high density of old mounds. Surveys for the Nepean mine area (Figure 12c) were sufficient to highlight the presence of the species 1 km from the proposed mine area (footprint) and the species is considered to occupy at least the northern half of the proposed Nepean mine area based on potential breeding habitat occurring within this area and the proximity of the recorded Malleefowl footprints. Malleefowl were also found to occur along sections of the Nepean access road. The species was not found within the proposed reinjection borefield areas, there are no previous records for the species in this area (either formally documented or anecdotal records, despite discussions with the long-term landholder), and preferred breeding habitat for the species is not considered present. The proposed reinjection borefield areas are considered low potential Malleefowl habitat (move-through habitat) due to its proximity to areas with Malleefowl records and has been incorporated into the overall area considered for impact assessment and offsetting calculations.

Table 44: Malleefowl habitat quality and total disturbance calculations for the Balranald project

Habitat Quality Category	Disturbance Area (hectares)
Very High	1,168
High	403
Moderate	596
Low	377
Total	2,543

Survey results therefore highlighted two main areas of known and potential Malleefowl habitat within the project area (Figure 12a-c) with impacts to occur within parts of two identified regional

Malleefowl sub-populations: referred to hereafter as the West Balranald Malleefowl Sub-population (WBMS - Figure 12b) and the Nepean Malleefowl Sub-population (NMS - Figure 12c). These areas are described in more detail below.

The area considered potentially occupied by the West Balranald Malleefowl Sub-population (WBMS) encompasses a core area estimated at107,009 hectares of Spinifex Mallee and Chenopod Mallee vegetation, mapped as very high and high potential Malleefowl habitat (Figure 12 (a-c)),of Mallee along linear dune systems where habitat is considered suitable for nesting. The WBMS areas constitutes core habitat areas east and west of Box Creek with established Malleefowl records within dedicated conservation areas and their surrounds either side of Box Creek (Figure 12 b). The area considered core habitat for Malleefowl within the Nepean area (mapped as high and very high) constitutes a much larger contiguous area (Figure 12b), though records within the locality are less dense (either due to survey effort or a less dense population).

The proposal was assessed by assuming the clearing of 1,306 hectares of known and potential WBMS habitat (Figure 12a-c) of which 1,169 hectares is considered core habitat (very high and high). This would constitute removal of approximately 13% of the core area of habitat for the WBMS east of Box Creek but less than 2% of the WMBS overall core habitat (combined areas east and west of Box Creek).A further 858 hectares would be cleared for the NMS consisting of high and moderate potential habitat.
The assessed scenario has purposely overestimated the extent of direct impacts, as the exact position and extent of direct impacts (clearing) is not yet known. Indirect impacts would also occur from the proposal via edge effects (predominantly within core habitat) and may also occur due to increases in threats listed in the table below. It is estimated that the maximal area impacted by edge effects for the WBMS would be 395 hectares, calculated by applying a 200 m buffer to areas adjacent to the mine footprint. In addition to edge effects

Key threats (and threatening processes) potentially increased by the proposal (information from DOE threatened species profileshttp://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl):

1. **Land Clearance:** The impacts of land clearance on Malleefowl, traditionally from agriculture and more recently from mineral sands mining have been identified a number of proposed sites for mineral sand mining are located in mallee regions of New South Wales, Victoria, South Australia and Western Australia. These sites, which collectively cover an area of many thousands of hectares, are likely to be severely degraded if mining is commenced" (DOE 2015). In addition, land clearance may exacerbate other key threats "Clearing also increases exposure of Malleefowl to other threats, for example to predation by foxes, as individuals may spend more time foraging or foraging over greater areas to meet nutritional requirements (Priddel et al. 2007)."
2. **Fragmentation and Isolation of Populations and Remnant Habitats: "**The fragmentation and isolation of the remaining Malleefowl populations and their habitats (due to extensive clearing) is likely to increase the risk of extinction" (DOE 2015).
   As detailed within section 5 of this report the proposal would increase fragmentation. Isolation from the proposal is less of an issue and is addressed in the assessment of significance below.
3. **Predation: "**Predation is a major cause of mortality for the Malleefowl (Benshemesh 2005b) and, as such, has been considered to be one of the major threats to the long term survival of the species (DOE 2015)".As noted above, land clearing and increased fragmentation have the capacity to facilitate predation in areas adjacent to the mine site, however this impact is already occurring and can be managed.

Impacts and control measures

Impact	Risk of increase/severity of impact	Avoidance	Mitigation
Land Clearance	Certain/High	Reduction in clearing areas (see section 6.1.2/ 6.1.3)	Pre clearance surveys or remote sensing in very high - moderate potential habitat to detect active mounds. 200 m buffer established around active mounds until hatching occurs which will be determined through monitoring protocol.

Fragmentation	Certain/Moderate to High	Maintenance of corridor at southern end of West Balranald mine area (see section 6.1.2/ 6.1.3). Identified corridors to be specifically targeted in predator control programs. Offsets to be targeted to areas close to impacted areas.	Management of vegetation and development of BMP and Fire Management Plans for impact and offset areas to reduce the risk of high intensity/frequency fire. Consolidation of vegetation and removal of tracks where appropriate within offset areas as per offset management plans to be established.
Predation (fox and cat)	Likely to be reduced given management introduction	Unavoidable	Develop and implement BMP focussing on feral management. Inclusion of predator control programs within the Balranald Project area including fox and cat baiting. Trapping, shooting or poisoning programs depending on the most effective identified methods or combination of methods.
Road strike	Moderate-low after controls are introduced.	Largely unavoidable	Communications protocols to inform staff and contractors of the presence and importance of Malleefowl and controls in place for impact minimisation. Planning to minimise road-strike for Malleefowl by limiting truck speeds and provision of appropriately sized signage along access roads, particularly areas close to active or recently active mounds, or where Malleefowl prints are observed. Development of methods and communication tools to monitor road-strike and mortality of Malleefowl and disseminate such information to the public and appropriate state and local authorities/interest groups.
Competition and land degradation by rabbits	Moderate/Low	Unavoidable	Rabbit control including burrow ripping within offset areas and Iluka managed areas.
Competition and land degradation by unmanaged goats	Likely to be reduced given management introduction	Unavoidable	Develop and implement BMP focussing on feral management. Removal of watering points, fencing and collecting of goats (e.g. via one way gate systems) will be features of offset management plans. Ongoing monitoring of response of vegetation to goat exclusion in offset areas.
Edge effects	Likely with low severity - predominantly weed impacts and predator access facilitation	Unavoidable	Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to the rehabilitation area) and also within the rehabilitation area.
Weeds	Moderate/likely to be limited	Unavoidable	Management protocols for the identification of noxious or

	increases given appropriate control measures. Receiving environment (Malleefowl habitat) not particularly vulnerable		important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to the rehabilitation area) and also within the rehabilitation area.	
Dust	High/likely to be limited increases given appropriate control measures. Receiving environment (Malleefowl habitat) not particularly vulnerable.	Unavoidable	Establishment of dust control procedures and monitoring within site management plan. Special measures to be taken (e.g. increased frequency of road wetting) where active mounds occur within 200 m of roads or other dust sources and outside of clearing areas.	
Noise	High/likely to be increases in specific areas adjacent to mining operations. Receiving environment (Malleefowl habitat) may not be particularly vulnerable (Malleefowl have been known to continue breeding close to areas with noise).	Mostly unavoidable	Once the mine layout and position of active Malleefowl mounds is established measures can be investigated to lower machinery and vehicle noise in areas adjacent to Malleefowl nesting.	
Loss of connectivity	High/Moderate	Maintenance of corridor at southern end of West Balranald mine area (see section 6.1.2/ 6.1.3)	Identified corridors within the Balranald Project area to be specifically targeted in predator control programs. Offsets to be targeted to areas close to impacted areas.	
Fire	Low/Potentially very high impacts if significant areas are burnt due to mine activities.	Establishment of fire management planning and exclusion measures within construction and offset areas	Establishment of fire management planning and exclusion measures within construction and offset areas	
Generation of light	Moderate for areas adjacent to certain mine areas/low given local impacts	Largely unavoidable	Special measures to be taken (e.g. blocking or diminishing of night light) where mounds occur within 200 m of roads or other dust sources and outside of clearing areas.	

Assessment of Significance

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

• lead to a long-term decrease in the size of an important population of a species	The population of Malleefowl within the Balranald Project area and surrounds is considered to be an important population. Observations of active mounds, footprints, recently used mounds and preferred vegetation communities led to identification of 3,034 ha of Malleefowl habitat within the disturbance area for the project. This constitutes a large area of habitat and a notable proportion of Malleefowl records within the region. The species is relatively immobile	Likely

	compared to most other birds and has specific habitat requirements linked to mound construction. There is a reasonable chance that removal of this habitat would cause a long-term decrease in the size of the overall population of the species. It is likely that an initial decrease in the size of the Malleefowl population would be effectively offset by establishment of conservation areas adjacent to and within the region of the Balranald Project area. Such conservation areas would be established over a significantly larger area of potential Malleefowl habitat compared with the area to be impacted by the Balranald Project and would be managed to improve the quality of habitat present via feral animal control. Effective management of offset areas is likely to increase the density or halt decline of existing Malleefowl populations within the nominated areas.	
• reduce the area of occupancy of an important population	The Balranald Project will disturb 3,042 ha of potential Malleefowl habitat most of which would be removed and therefore uninhabited by the species. The area of occupancy is therefore considered to reduce by at least this amount for the species. A further reduction in the area of occupancy may occur if areas that are left fragmented to the east of the West Balranald mine are too small to maintain a viable sub-population of the species.	Likely
• fragment an existing important population into two or more populations	There would be some potential east-west fragmentation of the existing West Balranald Malleefowl population however a 200 metre corridor of vegetation is being retained at the southern end of the West Balranald mine area which will assist with connectivity and lessen the impacts of reduced patch size for the local Malleefowl population. Management of remaining habitat will assist in reducing existing threats from goat grazing and fox predation. The action is unlikely to cause loss of long-term gene flow between any two populations.	Possible
• adversely affect habitat critical to the survival of a species	The Balranald Project will have adverse impacts on known breeding habitat within the West Balranald mine area and probable breeding habitat within the Nepean mine area. This habitat may be critical to the survival of the population in this location. There is similar habitat within the wider Nepean area and in other areas within the region. Thus, this habitat is not considered critical to the survival of the species at a National level or regional level but is considered critical to survival at the local level.	Likely
• disrupt the breeding cycle of an important population	Some breeding habitat will be impacted as part of the proposal, including three known active mounds. It is likely that other mounds also exist within the Balranald Project area. Contiguous habitat is present that may make suitable alternate nesting sites for individuals nesting within the Balranald Project area. Temporal clearing controls will assist with avoiding impacts to eggs during the incubation period and will also deter advanced mound preparation within the Balranald Project area. However such controls will only assist with nesting and hatching success over a single breeding season.	Likely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Approximately 3, 034 ha of Malleefowl habitat will be impacted by the proposal, much of which is considered preferred habitat. A large area of contiguous habitat is available at the Nepean mine area and some contiguous habitat is available around the West Balranald area. Notwithstanding, the Balranald Project may lead to the decline of the population of Malleefowl in these locations particularly within the West Balranald mine area where Malleefowl records are denser and the proportion of available habitat to be removed is large compared with contiguous suitable habitat.	Possible

	Extensive areas of mallee woodland habitat is present within the region and offset areas will be established to mitigate against loses of habitat from the Balranald Project, which should assist in securing Malleefowl populations regionally. It seems unlikely therefore that the removal and modification of habitat from the action would lead to significant declines of the species overall, however such declines are likely to occur at a local level.	
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Additional areas of roads and tracks may promote the egress of foxes and feral cats. These species (foxes in particular) have the capacity to predate on hatchlings, juvenile and adult birds. The action would not lead to establishment of foxes or cats within the Balranald Project area as they are already known to exist throughout, however their ability to frequent areas far from currently established tracks may be enhanced.	Unlikely
• introduce disease that may cause the species to decline, or	The Balranald Project is unlikely to introduce disease which may lead to a decline of this species as there are no known diseases that are currently impacting on the species in a significant manner.	Unlikely
• interfere substantially with the recovery of the species.	The Balranald Project will result in a reduced area of occupancy for this species in this location. Whilst there is additional contiguous habitat, the Balranald Project may contribute towards the extinction of the local population of Malleefowl. Given widespread distribution of Malleefowl within the region and at a National level combined with offset requirements from the Balranald Project it appears unlikely that the Balranald Project would interfere substantially with the recovery of this species at a National level. There is likely to be short-term setbacks to recovery of the species within the locality if activities such as establishment of the Southern Mallee Conservation Areas that form part of the Balranald Project area and which are likely to have contributed to recovery of the species in the locality.	Unlikely
Conclusion: The proposed action is likely to have a significant impact on Malleefowl.		

Plains-Wanderer (*Pedionomus torquatus)*		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**

Preamble:

Habitat preferences and availability within the study area

The Plains-Wanderer is found in northern Victoria, NSW and Queensland. The stronghold for this species is in NSW, in the Western Riverina, where it is found between Hay and Narrandera to the north, Cobb Highway to the west, Billabong Creek to the south and Urana in the east. Despite this large area, only 5% is considered habitat for the Plains-wanderer. Whilst once having quite an extensive distribution, Plains-Wanderer is near extinct in eastern NSW, south-western Victoria and SA. Habitat modification is major threat to this species. Plains-wanderer inhabits native grasslands - where the structure of the grassland is a determining factor. Preferred habitat is sparse native grassland with a structure typically comprising 40-60% bare ground, 30-50% grass, herb and forb cover and 0-10% litter cover (DoE 2015b). The grass height is often < 5 cm although taller vegetation is required as cover from predators. Also reported using low stubble in croplands and sparse chenopod shrublands (NPWS 2002). Habitat within the project area generally consists of non-grassy areas dominated by saltbush. While historically grass cover between the saltbush in such areas may have been higher (NPWS 2002) this is not the case any longer since long-term grazing has occurred.

Pearl Bluebush Low Open Shrubland areas have been included as possible habitat within this biodiversity assessment as indicated in Figure 10 (a - b) but these areas are expected to act only as marginal foraging or shelter areas for the Plains Wanderer where adjacent preferred grassy habitat occurs. Preferred grassy habitat is represented within the project area by the Cleared/Derived Native Grassland/Shrubland Community and the Flat Open Claypan/Derived Sparse Shrubland Communities. Data from Biometric habitat plots conducted within the project area from Pearl Bluebush Shrubland was examined and demonstrates that the average and median cover of native grasses was 22% and 15% respectively which is well below the percentage cover of native grasses preferred by the species as described above. As such the potential for the project area to support Plains Wanderer is very limited.

Previous records and field survey results

Recent (post 1980) records for the species do not occur within the region, with the nearest records (1992) being 80 km from identified potential habitat within the project area. The nearest historic record is from 1977 and is 56 km south of the potential habitat within the project area (Figure 10a). During the course of the biodiversity assessment a property owner indicated that the Plains-wanderer was present east of Burke and Wills Road within the Pitarpunga Lake bed approximately 5 km east of the project area. The landholder stated that he has only ever seen the bird within the open grass-dominated areas (more so when the grass is short) rather than in the saltbush plains away from the lake bed where he would not expect them to occur. This description of preferred habitat accords with known habitat preferences for the species (NPWS 2002). No part of the project area extends into Pitarpunga Lake and no part of the project area provides consistent habitat similar to that of the Pitarpunga Lake or suiting preferred habitat descriptions for the species (including the Department's species profile and the NSW recovery plan).

During field survey for the Balranald Project a bird thought to be a Plains-wanderer responded to call playback near Site 7 at West Balranald, however the possible recording was unable to be confirmed during the survey or follow-up survey in the same area and additional areas of potential habitat. The movement habits of Plains Wanderer have been described by DEWHA (2010) as follows: Sedentary, unless displaced by changes to habitat (e.g. burning, cultivation, overgrazing, and drought) (Baker-Gabb et al. 1990). Although the longest distance a banded bird has been recorded moving is 40 km (Baker-Gabb et al. 1990), the majority of birds are recaptured within 400 m of their banding site. On occasions, such as during and after droughts, some birds must move considerably greater distances to survive and then recolonise grasslands in better times (Baker-Gabb 2002). Thus on balance given the known habitat requirements and the known movement behaviour of the species, if the bird that responded to the call play back for the species near Site 7 at West Balranald was the Plains-wanderer it should have been re-recorded and confirmed in later surveys specific to the species at the same site. The species was not re-recorded at the site despite targeted survey for it.

Survey details and findings

Plains Wanderer surveys were conducted at primary survey sites within the West Balranald mine areas where possible habitat for the species occurred and adjacent areas, i.e. Low Open Shrubland and Open Claypans with Derived Shrubland/Grassland as well as adjacent Pearl Bluebush Shrublands. Appropriate methods for the species employed at primary survey sites included diurnal bird census and call playback, nocturnal survey (spotlighting) and remote cameras. Targeted call playback was performed at six sites for 15 minutes each at West Balranald in November 2011 (Figure 10 a)).Additional survey techniques and effort comprising driven spotlight transects targeting the Plains Wanderer occurred in 2011 and 2013.Nocturnal vehicle based transects were conducted at seven

Plains-Wanderer (*Pedionomus torquatus)*		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
locations on seven nights within potential habitat covering approximately 120km over a 13.5 hour period. Given the above described habits, it is considered that if the Plains Wanderer possible recording was a correct recording the bird would have been detected in follow-up surveys if the species was using the habitat within the development area on anything other than a very rare basis. Therefore it is considered that the record was a false record or that the habitat has limited value and that the species is unlikely to use the habitat on the site on a regular basis and the species is highly unlikely to be reliant on the highly marginal habitat within the study area. **Key threats (and threatening processes) potentially increased by the proposal (information from DOE threatened species profileshttp://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl):** "The major factor in the decline of the Plains-wanderer has been the loss of habitat due to the cultivation and conversion of sparse native grasslands into croplands and dense introduced pasture" (Baker-Gabb 1998; Bennett 1983). Other references to relevant threatening processes for the Balranald project and mentioned for the species include: "Predation by foxes and feral cats had been considered a major threat to the species (D'Ombrain 1926; Llewellyn 1975), but a study in the Riverina region of NSW found no evidence for this (Harrington et al. 1988). Even so, it is possible that predation could pose a threat to the Plains-wanderer around cultivated land, where greater numbers of mice might help to sustain larger populations of the potential predators listed above (Baker-Gabb 1998, 2002b; NPWS 2002b). Analysis of pre-1750 mapping for the region indicates that native grassland areas were not predicted to occur anywhere within the project area. Limited areas of native grasslands are mapped within the locality and these occur some distance from the project area. As described below, derived grasslands within the project area are very limited and represent marginal habitat for Plains Wanderer. Predation by foxes or other identified potential predators is unlikely to increase within the identified areas of potential habitat for Plains Wanderer adjacent to the proposed mine as these areas are already impacted by these predators and their access would not be further facilitated due to their already relatively open nature and proximity to trails and roads (i.e. as opposed to more consolidated woodland remnants).		
Assessment of Significance: An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
• lead to a long-term decrease in the size of an important population of a species	A single unconfirmed recording of this species was made during field survey with follow-up targeted survey within the same area and nearby project area failing to confirm the presence of the species Figure 10a. Survey results along with the lack of preferred habitat within the project area indicate that the Plains Wanderer would use the project area rarely if at all and the removal of the potential habitat within the project area would not cause a long-term decrease of any population that may occur within the area.	Unlikely
• reduce the area of occupancy of an important population	The potential habitat found within the project area is surrounded by extensive areas of similar habitat including areas closer to Pitarpunga Lake east of Burke and Wills Road where the Plains Wanderer has been said to occur (pers. comm. with landholder). There is some possibility that the proposed mine development would reduce the available habitat, but the reduction is likely to be of marginal habitat that is rarely, if ever, used.	Possible but of limited significance
• fragment an existing important population into two or more populations	The disturbance area for the West Balranald mine and associated infrastructure will fragment an area of potential but marginal habitat for the Plains-wanderer predominantly by	Unlikely

Plains-Wanderer (*Pedionomus torquatus)*		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
	introduction of a 1200 m wide area (the width of Balranald mine in the vicinity of the potential habitat where a possible recording of the species was made) that would act as a potential barrier to occupation and movement. The potential habitat for this species within the project area is concentrated around the northern end of the West Balranald mine area and it is expected that, despite introduction of proposed access roads north of the mine area, east-west connectivity of habitat would be maintained via the presence of habitat to the north of the mine area (i.e. the access roads would not prevent birds from moving north around the mine). While some fragmentation of habitat might occur from the proposal it is considered unlikely that an existing population would be split into two or more populations. There is a single suspected population of Plains Wanderer centred within preferred habitat approximately 5 km east of the project area. The population would not be split into two from the proposed mine.	
• adversely affect habitat critical to the survival of a species	No specific critical habitat has been listed for this species under Commonwealth or State legislation. 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community. Habitat within the project area is not considered critical to the survival of this species as there has been no confirmation of its use despite extensive surveys and the area is of limited utility. The species has better established, known populations outside of the project area.	Unlikely
• disrupt the breeding cycle of an important population	It is considered unlikely that the breeding cycle of this species would be impacted by the proposal given that no confirmed recording of the species was made despite extensive targeted survey. Should the species inhabit potential habitat within the project area such are not expected to be important in maintaining the breeding cycle of any population present.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Impacts to Plains-wanderer from the proposal are confined to the removal of potential habitat that is considered marginal and which is well represented around the project area. Therefore removal of the potential habitat from the action is considered unlikely to cause the species to decline.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Additional areas of roads and tracks may promote the egress of foxes and feral cats. These species (foxes in particular) have the capacity to predate on hatchlings, juvenile and adult birds.	Unlikely

Plains-Wanderer (*Pedionomus torquatus)*		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
	The action would not lead to establishment of foxes or cats within the Balranald Project area as they are already known to exist throughout. Potential habitat for Plains-wanderer within the project area is already easily accessible to foxes and other predatory animals.	
• introduce disease that may cause the species to decline, or	The Balranald Project will not introduce diseases which may lead to declines in this species.	Unlikely
• interfere substantially with the recovery of the species.	The Balranald Project will not impact areas of known habitat and is unlikely to reduce the area of occupancy for this species in a notable way. It is unlikely that the Balranald Project would interfere with the recovery of this species.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on Plains-wanderer.		

Regent Parrot (eastern) (*Polytelis anthopeplus monarchoides)*		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**

The Regent Parrot (eastern subspecies) has a highly restricted distribution and is confined to the arid and semi-arid areas of the south eastern Australia, including NSW, Victoria and South Australia. Within NSW the species is highly restricted along the Murray River and other isolated localities. The total population is estimated to be 1500 pairs. Primary habitat for this species is River Red Gum forest and woodlands adjoining Black Box woodlands. Mallee, Belah and Buloke also provide habitat for this species, particularly for foraging during the breeding season (DoE 2015c).

Extensive targeted surveys were conducted for this species during assessment of a proposed transmission line crossing the Murrumbidgee River (as well as other ancillary mine infrastructure since dropped from the proposal or relocated), which has since been removed from this assessment to be considered separately. Nonetheless, results from those surveys, along with surveys conducted to assess ecological impacts from the current Balranald project presented herein (Figure 10c) have assisted greatly in understanding the distribution and movement patters of this species within the local area and therefore all such survey is considered for this impact assessment.

The Regent Parrot was not recorded during initial surveys of the West Balranald and Nepean mine areas in 2011 and 2012 (see section 3.1). During November 2013 surveys however, six observations of between one and twenty individual birds were made over the course of a week (Figure 10c and Figure 11a). All six observations were of birds flying overhead (usually along vegetated corridors) or foraging on lerp (secretions by leaf-borne insect larvae that were abundant in that season and year) around the Sturt Highway approximately 10 km south of the West Balranald mine area. The species was not recorded closer to the proposed West Balranald mine area during concurrent bird surveys or other survey activities (Figure 10c), despite personnel conducting the surveys targeting the species and being aware of observations made close to the highway (i.e. being the same ecologists or having communicated with those ecologists who made the recordings).

As a result of the November 2013 observations intensive follow-up surveys were undertaken in December 2013 to investigate Regent Parrot presence and behaviour within the Balranald Project area surrounds, including whether the species was nesting along the Murrumbidgee River in the locality of the Balranald Project and the originally proposed transmission line crossing. The December 2013 surveys failed to record the Regent Parrot either near the Murrumbidgee River or around the current project area including where they were previously sighted on multiple occasions and it was concluded that the birds had moved from the area, potentially coincident with the end of the breeding season. A final round of targeted Regent Parrot surveys was conducted between the 29th of September and 1st of October 2014 and these surveys confirmed roosting (and presumably nesting parrots) at a known breeding location at Weimby which is 35 km south-west of the Balranald Project area towards the junction between the Murray and Murrumbidgee Rivers (Figure 10d) and therefore within the known area of breeding habitat for the Regent Parrot (Baker-Gabb and Hurley 2011). Immediately after observations of multiple Regent Parrots (approximated at 20 – 30) at Weimby, two hour long surveys were repeated at the Murrumbidgee River in the location of the then proposed transmission line and at another site between the two locations. Two Regent Parrot sightings (possibly the same bird) were made within an hour of each other at the proposed transmission line location (Murrumbidgee River 12 km south-west of Balranald). Both records were of a single bird flying rapidly overhead. Parrots were not seen foraging in the vicinity of the proposed mine during this period however targeted survey was not performed there.

After consideration of past and recent survey results, as well as knowledge of Regent Parrot behaviour (Baker-Gabb and Hurley 2011; pers. comm. Peter Ewin - NSW OEH and Simon Watson - LaTrobe University) it can be stated with reasonable confidence that the Regent Parrot is not breeding within the locality of the Balranald Project area and there is no reason to believe that an extension of known breeding habitat towards Balranald from the Weimby area has occurred. Breeding parrots from the Weimby area are foraging/travelling along the Murrumbidgee River including within the locality of the Balranald Project area. Foraging individuals will take advantage of vegetated corridors extending from the Murrumbidgee towards the Balranald Project area to access Mallee and Belah vegetation to feed on seasonally available resources including lerp and wheat. Foraging excursions within the Balranald Project area, if they occur at all, are likely to be more common during the breeding season (when multiple observations of parrots near to the Balranald Project area were made) to provide for nesting birds and fledglings. It is however considered that foraging excursions into the Balranald Project area are likely to be very rare as the distance between the Balranald Project area and known breeding habitat (conservatively estimated to be 26 km) is beyond the preferred distance of foraging excursions from breeding areas, which is estimated at 20 km (Baker-Gabb and Hurley 2011). This is supported by the absence of Regent Parrot observations within the

Regent Parrot (eastern) (*Polytelis anthopeplus monarchoides)*		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
Balranald Project area both historically and from recent surveys conducted as part of the EIS for the Balranald Project. Foraging within the Balranald Project area if it occurs at all is likely to be restricted to the southern end of the West Balranald mine as this area is closest to the known breeding habitat for this species. **Key threats (and threatening processes) potentially increased by the proposal (information from DOE threatened species profiles):** "The main threats to the Regent Parrot (eastern) are the clearing, fragmentation and modification of riparian River Red Gum and Black Box woodlands that are used for breeding and adjacent mallee areas that are used for foraging (Garnett & Crowley 2000; Webster & Leslie 1998)." "The Regent Parrot (eastern) relies on the specific combination of breeding habitat (usually River Red Gum forests and woodlands, and occasionally adjacent Black Box woodlands) and foraging habitat (mallee woodlands) to be located no more than 20 km from each other for successful reproduction. The clearance or degradation of either habitat type threatens the survival of the subspecies (Garnett & Crowley 2000)." None of the above threats are considered to be exacerbated by the proposal, as explained below. Mallee habitat within the project area is likely to have minimal if any importance for the species due to its distance and direction from breeding areas.		
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
• lead to a long-term decrease in the size of an important population of a species	All populations of this subspecies are considered important. The population of Regent Parrot potentially affected by the action is considered to be those individuals that forage within the locality but breed outside of the locality to the west. The potential foraging habitat within the Balranald Project area (consisting predominantly of mallee vegetation) is beyond the distance of estimated foraging excursions for Regent Parrots (approximately 26 km versus 20 km) and birds were not observed foraging within the Balranald Project area. Therefore the action proposed constitutes the removal of habitat that is considered potential but marginal foraging habitat. This is unlikely to lead to a long-term decrease in the size of an important population.	Unlikely
• reduce the area of occupancy of an important population	The potential habitat found within the project area is surrounded by extensive areas of similar habitat. Therefore it is considered unlikely that the proposed action would lead to a reduction in the overall area of occupancy for the species.	Unlikely
• fragment an existing important population into two or more populations	The action would not fragment the existing population of Regent Parrot as it will not affect breeding/nesting congregations of the species.	Unlikely
• adversely affect habitat critical to the survival of a species	Habitat to be impacted by the Balranald Project is considered to be marginal foraging habitat only. Such habitat is not considered critical to the survival of the species.	Unlikely
• disrupt the breeding cycle of an important population	Breeding habitat for the species would not be impacted by the Balranald Project. Foraging activities would not be impacted such that the breeding/nesting cycle would be disrupted by the action.	Unlikely
• modify, destroy, remove or isolate or decrease the availability or	Habitat to be impacted by the Balranald Project is considered to be marginal foraging habitat	Unlikely

Regent Parrot (eastern) (*Polytelis anthopeplus monarchoides)*		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
quality of habitat to the extent that the species is likely to decline	only, primarily on the basis of the distance from known breeding sites and the known distances that the species forages from the nesting habitat. Impacts on such habitat is not considered to cause the species to decline.	
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Additional areas of roads and tracks may promote the egress of feral cats and foxes however due to the very low visitation rates to the Balranald Project area and the timing of visitation (diurnal) this is unlikely to impact the Regent Parrot.	Unlikely
• introduce disease that may cause the species to decline, or	The Balranald Project is unlikely to introduce disease which may lead to declines in this species. No such diseases have been identified in the literature consulted for Regent Parrot.	Unlikely
• interfere substantially with the recovery of the species.	The Balranald Project will not impact areas of breeding or preferred foraging habitat or reduce the area of occupancy for this species. It is unlikely that the Balranald Project would interfere with the recovery of this species.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on Regent Parrot.		

Corben's Long-eared Bat (*Nyctophilus corbeni*)		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**

Corben's Long-eared Bat is found in semi-arid habitats of the far south west and western slopes and plains in NSW. This tree hollow roosting species inhabits a range of forest and woodland types within its range. The species was captured twice during surveys by Niche in 2013 along the Nepean access road and approximately 6 km west of the West Balranald mine area (Figure 10f and Figure 10g). Both captures were near the interface between woodland and shrubland habitats. Suitable habitat occurs throughout the project area where mature woodland vegetation is present. There are 37 records from the locality for this species within the Atlas of NSW Wildlife (Figure 10h), which are concentrated around the Nepean mine area. Regionally (within 50 km of the two mine areas) there are around 50 records for the species (Figure 10h). The species is not usually possible to distinguish from other Nyctophilus species via call recording and therefore its distribution and abundance throughout the locality is likely to be under-estimated compared to species that are readily identifiable by call analysis.

Key threats (and threatening processes) potentially increased by the proposal (information from DOE threatened species profiles):

1. **Habitat loss**: "Agriculture, open cut coal, natural gas and mineral sand mining proposals are the main reasons behind the clearing of mallee and woodland habitats. This of particular concern as the South-eastern Long-eared Bat is found exclusively in such environments."
2. **Habitat fragmentation**: "Prior to European settlement, mallee and woodland habitats were extensive across inland eastern Australia. Agriculture is the main cause of habitat fragmentation; this is a threat as trapping surveys show the species displays a preference for larger habitats. Furthermore feral predators are often concentrated in open areas near cleared habitats."
3. **Predation by feral species: "**The impact of feral predation is unknown but has been documented as a threat for the Lesser Long-eared Bat, Nyctophilus geoffroyi (Dickman et al. 1993)."

Threat abatement from the proposal:

As detailed in section 6 of this report, abatement of the above three key threats will occur via avoidance, mitigation and offsetting measures. The detail of these measures will be finalised within a Biodiversity Management Plan (BMP) for the development area and surrounds as well as within individual management plans for offset areas.

Impacts and control measures

Impact	Risk of increase/Severity	Avoidance	Mitigation
Land Clearance	Certain/High	Reduction in clearing areas (see section 6.1.2/ 6.1.3)	See section 6.2.1 – 6.2.3. Avoidance of clearing during hibernation period (1st May – 31st of July) or pre-clearance survey and exclusion techniques. Employment of two-stage clearing methods. Offsets targeted at areas including hollow bearing trees.
Loss of roost and breeding habitat (tree hollows)	Certain/High	Reduction in clearing areas (see section 6.1.2/ 6.1.3)	Offsets targeted at areas including hollow bearing trees. Retention of hollow bearing trees within areas to be cleared wherever practicable.
Fragmentation	Certain/Moderate	Maintenance of corridor at southern end of West Balranald mine area (see section 6.1.2/ 6.1.3). Offsets to be targeted to areas close to impacted areas.	Management of vegetation and development of BMP and Fire Management Plans for impact and offset areas to reduce the risk of high intensity/frequency fire. Consolidation of vegetation and removal of tracks where appropriate within offset areas as per offset

Corben's Long-eared Bat (*Nyctophilus corbeni*)			
Criteria (Vulnerable Species)	**Address of Criteria**		**Likelihood**
			management plans to be established.
Predation (fox and cat)	Likely to be reduced given management introduction	Unavoidable	Develop and implement BMP focussing on feral management. Inclusion of predator control programs within Iluka managed areas adjacent to mining areas including fox and cat baiting. Trapping, shooting or poisoning programs depending on the most effective identified methods or combination of methods.
Competition and land degradation by rabbits	Moderate/Low	Unavoidable	Rabbit control including burrow ripping within offset areas and Iluka managed areas.
Competition and land degradation by unmanaged goats	Likely to be reduced given management introduction	Unavoidable	Develop and implement BMP focussing on feral management. Removal of watering points, fencing and collecting of goats (via one way gate systems) will be features of offset management plans. Ongoing monitoring of response of vegetation to goat exclusion in offset areas.
Edge effects	Likely with low severity – predominantly weed impacts and predator access facilitation.	Unavoidable	Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to the rehabilitation area) and also within the rehabilitation area.
Dust	High/likely to be increases in specific areas adjacent to mining operations. Severity low.	Unavoidable	Establishment of dust control procedures and monitoring within site management plan.
Noise	High/likely to be increases in specific areas adjacent to mining operations.	Mostly unavoidable	None proposed as difficult to define roost areas for the species given multiple roost use.
Loss of connectivity	Moderate/Moderate	Maintenance of corridor at southern end of West Balranald mine area (see section 6.1.2/ 6.1.3)	Identified corridors to be specifically targeted in predator control programs. Offsets to be targeted to areas close to impacted areas.
Fire	Low – mining activities unlikely to increase existing threat given controls/Potentially very high impacts if significant areas are burnt due	Establishment of fire management planning and exclusion measures within construction and offset areas	Establishment of fire management planning and exclusion measures within construction and offset areas

Corben's Long-eared Bat (*Nyctophilus corbeni*)			
Criteria (Vulnerable Species)	**Address of Criteria**		**Likelihood**
	to mine activities.		
Generation of light	Moderate for areas adjacent to certain mine areas/moderate to low given local impacts and species roost choice plasticity. May provide some foraging benefits.	Largely unavoidable	None proposed as difficult to define roost areas for the species given multiple roost use.
Assessment of Significance An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:			
• lead to a long-term decrease in the size of an important population of a species	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: • key source populations either for breeding or dispersal • populations that are necessary for maintaining genetic diversity, and/or • populations that are near the limit of the species range. Corben's Long-eared Bat was found at two locations (one location inside the project area the other 6 km west) after extensive harp-trapping throughout the project area (Figure 10f-g and Figure 9a-c) and surrounds. Habitat for the species is centred around large, consolidated forest patches with long-unburnt areas supporting tree hollows which constitute potential roost areas (Schulz and Lumsden 2010; Turbill and Ellis 2006). The species is known to frequently switch roosts and also roost individually (Lumsden et. Al 2008). No important populations of Corben's Long-eared Bat are identified in the draft recovery plan for the species (Schulz and Lumsden 2010). The affected population is part of a broad-ranging regional population which is assumed to be an important population due to its size and range. The regional population is considered within this assessment to comprise of a series of interconnected local populations covering an extensive area of approximately 8 million hectares from Menindee (north) to Ouyen (south) Hatfield/Ivanhoe (east) and Morgan in the west (Figure 10h). Within this substantial area the species is likely to be most abundant in mature woodland habitat that provides abundant roosting resources. 3,143 hectares of preferred foraging and roosting habitat, including up to an estimated 121,000		Unlikely

Corben's Long-eared Bat (*Nyctophilus corbeni*)		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
	hollows, representing up to 5 % of those estimated in the locality (20 km radius) will be removed by the Balranald Project. The proportion of the regional population's available habitat to be impacted would be significantly less given its wide ranging distribution. The clearing of habitat is likely to result in displacement of individuals from the 3,143 hectare area over the life of the mine (estimated 15 – 20 years). The displacement of individuals is likely to lead to some level of mortality within the local population, however the species' ability to change roosts is highly likely to assist with lowering mortality and the majority of bats inhabiting the project area could be expected to persist, particularly given mitigation measures including the prevention of clearing during hibernation periods (between 1st May and 31st of July), two stage clearing practices and measures to exclude bats from hollow trees soon to be cleared via exclusion from hollows where feasible. Given the extensive range of the regional population of Corben's Long-eared Bat, the short-medium mortality caused by the project is expected to be comparatively localised and spread over the project area. It is considered that the level of decline would be small and not significant in relation to the regional population of the species. The addition of extensive offsetting areas to the region as part of the project is likely to compensate for the short to medium decline of the species, particularly given measures to control the risk of intense fires within offset areas and improvements in the condition of vegetation.	
• reduce the area of occupancy of an important population	The project would lead to localised reductions in occupancy for the species. Potential habitat found within the project area is surrounded by extensive areas of similar habitat. The reductions in occupancy would be small at the regional population scale and, due to the largely linear nature of the proposed clearing, would be likely to result in very small overall reductions in occupancy at the 2 km grid scale (which is that standard measure of area of occupancy used by the IUCN) depending on the final buffers for the project,.	Possible
• fragment an existing important population into two or more populations	The disturbance area for the West Balranald mine and associated infrastructure will fragment an area of potential habitat for Corben's Long-eared Bat, predominantly by introduction of a 1200 – 2400 m wide area (the maximal width of the Nepean and Balranald mine areas) in the vicinity of potential habitat. While some fragmentation effects will result, given the mobility of the species it is considered very unlikely that an existing population would be split into two or more populations.	Unlikely
• adversely affect habitat critical to the survival of a species	No critical habitat has been listed for Corben's Long-eared Bat under any recovery plan or legislation. Important habitat for the species would include large, consolidated woodland patches with long-unburnt areas supporting tree hollows which constitute potential roost areas (Schulz and Lumsden 2010; Turbill and Ellis 2006). While such areas are important to the species, the habitat within the project area is not considered critical to the survival of the	Unlikely

Corben's Long-eared Bat (*Nyctophilus corbeni*)		
Criteria (Vulnerable Species)	**Address of Criteria**	**Likelihood**
	species due to the abundance of similar habitat throughout the area covered by the regional population.	
• disrupt the breeding cycle of an important population	The breeding cycle of the species may be impacted by the proposal through roost loss within the project area. The nature of maternity roosts for this species are not well known, however it is likely that small maternity roosts in tree-hollows are established. Within areas to be cleared where roost habitat is present, the action would potentially disturb maternity roosting for a single breeding season if bats were unable to find a suitable roost in which to continue maternity activities.	Possible
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Short-medium term mortality caused by the project and concurrent loss of habitat is expected to be comparatively localised in relation to the regional and overall distribution and abundance of the species. The addition of extensive offsetting areas to the region as part of the project is likely to compensate for the short to medium decline of the species, particularly given measures to control the risk of intense fires within offset areas and improvements in the condition of vegetation.	Unlikely
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Additional areas of roads and tracks may promote the egress of foxes and feral cats. These species (foxes in particular) have an unknown capacity to predate on this species, however the threat is not considered significant. The action would not lead to establishment of foxes or cats within the Balranald Project area as they are already known to exist throughout.	Unlikely
• introduce disease that may cause the species to decline, or	The Balranald Project is unlikely to introduce disease which may lead to declines in this species. No such diseases have been identified in the literature consulted for this species.	Unlikely
• interfere substantially with the recovery of the species.	The Balranald Project is unlikely to interfere with the recovery of this species.	Unlikely
Conclusion: The proposed action is unlikely to have a significant impact on Corben's Long-eared Batas it is not expected to cause a long-term decline in the population of the species. Short-medium term localised impacts such as the potential abandonment or loss of a number of maternity roost sites may occur, and there would be a reduction of foraging and roosting habitat within the locality (albeit a small proportion of the overall habitat available). Offsetting and mitigation measures would assist in mitigating impacts or confining them to the short-medium term.		

Appendix 9: Offset calculations under the NSW BBAM

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 2/10/2015 Time: 4:38:53PM Calculator version: v4.0

Major Project details

Proposal ID:	0112/2015/1719MP
Proposal name:	1684 Balranald South Olary (Part 2 of 2)
Proposal address:	19 Sorrel Street Parramatta NSW 2150
Proponent name:	Iluka
Proponent address:	11 Dequetteville Terrace Kent Town SA 5067
Proponent phone:	61 8 8300 2016
Assessor name:	Luke Baker
Assessor address:	8 Joseph Street BLACKTOWN NSW 2148
Assessor phone:	0488 224 008
Assessor accreditation:	0112

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	171.40	5,771.00
Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	4.00	167.00
Black Oak - Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	98.30	4,867.00
Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	422.90	22,754.00
Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones	1,991.32	93,852.00
Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	0.70	27.00
Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW)	0.50	21.00
Pearl Bluebush low open shrubland of the arid and semi-arid plains	239.60	8,948.00
Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion	536.40	23,433.00
Total	3,465.12	159,840

Credit profiles

1. Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion), (LM105)

Number of ecosystem credits created	167
IBRA sub-region	South Olary Plain, MU Basin Sands (Part E)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion), (LM103) Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion), (LM104) Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion), (LM105) Black Box - Silver Saltbush chenopod open woodland on terrace rises on alluvial plains in the lower Darling River and lower Murray River region of the Murray Darling Depression Bioregion, (LM162)	South Olary Plain, MU Basin Sands (Part E) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Black Oak - Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones, (LM107)

Number of ecosystem credits created	4,867
IBRA sub-region	South Olary Plain, MU Basin Sands (Part E)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Black Oak - Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones, (LM107) Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion, (LM108) Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion, (LM158)	South Olary Plain, MU Basin Sands (Part E) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion, (LM108)

Number of ecosystem credits created	22,754
IBRA sub-region	South Olary Plain, MU Basin Sands (Part E)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Black Oak - Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones, (LM107) Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion, (LM108) Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion, (LM158)	South Olary Plain, MU Basin Sands (Part E) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones, (LM116)

Number of ecosystem credits created	93,852
IBRA sub-region	South Olary Plain, MU Basin Sands (Part E)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones, (LM116)	South Olary Plain, MU Basin Sands (Part E) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

5. Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion, (LM130)

Number of ecosystem credits created	23,433
IBRA sub-region	South Olary Plain, MU Basin Sands (Part E)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Deep sand mallee of irregular dunefields of the semi-arid (warm) zone, (LM121) Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion, (LM130) Snap and Rattle Mallee - Moonah open mallee shrubland in the Murray Darling Depression Bioregion, (LM155)	South Olary Plain, MU Basin Sands (Part E) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

6. Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW, (LM124)

Number of ecosystem credits created	27
IBRA sub-region	South Olary Plain, MU Basin Sands (Part E)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW, (LM124) Ephemeral forbland wetland of low-saline lake-beds of the arid and semi-arid (warm) climate zones, (LM125) Gypseous shrubland on rises in the semi-arid and arid plains, (LM126)	South Olary Plain, MU Basin Sands (Part E) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

7. Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones, (LM102)

Number of ecosystem credits created	5,771
IBRA sub-region	South Olary Plain, MU Basin Sands (Part E)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones , (LM102) Lunette chenopod shrubland mainly of the Murray Darling Depression Bioregion, (LM131) Pearl Bluebush low open shrubland of the arid and semi-arid plains, (LM138) Sandhill Cane Grass hummock grassland on siliceous sands on dune crests of the arid zone, (LM146)	South Olary Plain, MU Basin Sands (Part E) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

8. Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW), (LM137)

Number of ecosystem credits created	21
IBRA sub-region	South Olary Plain, MU Basin Sands (Part E)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW), (LM137)	South Olary Plain, MU Basin Sands (Part E) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

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Environment and Heritage

Balranald Mineral Sands Project

EPBC Act Biodiversity Offset Package

Prepared for Iluka Resources

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Locations

Sydney
Central Coast
Illawarra
Armidale
Newcastle
Mudgee
Port Macquarie
Brisbane
Cairns

Cover photograph: Malleefowl mound within the offset site

Executive summary

Niche Environment and Heritage Pty Ltd was commissioned by Iluka Resources Limited (Iluka) to develop a Biodiversity Offset Package for the Balranald Mineral Sands Project (the Balranald Project) in order to satisfy requirements under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)and consistent with the EPBC Act Environmental Offsets Policy (2012).

The Commonwealth Department of the Environment (DoE) has determined that the Balranald Project is a controlled action and that approval under the EPBC Act is required. Biodiversity offsets to compensate for the impacts on two MNES (Matters of National Environmental Significance) are required. They include:

- Malleefowl (*Leipoa ocellata*), which is listed as a vulnerable species.
- Corben's Long-eared Bat (*Nyctophilus corbeni*), which is listed as a vulnerable species.

Significant impacts on a MNES require the development of a Biodiversity Offset Package (BOP). This report outlines Iluka's approach to the development of the BOP and has been prepared in consultation with the DoE.

This document demonstrates the adequacy of the identified offset site through application of the Commonwealth Environmental Offsets Policy (2012). Establishment of the subject offset site described within this document will address residual impacts from the Balranald Project through application of a 100% direct offset scenario. The direct offset will involve the establishment of a biobank site over the subject offset site with a range of measures incorporated into the BioBanking agreement to improve habitat for significantly impacted MNES.

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1. Introduction

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Iluka Resources Limited (Iluka) to develop a Biodiversity Offset Package (BOP) for the proposed Balranald Mineral Sands Project (the Balranald Project) in order to satisfy requirements under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and consistent with the EPBC Act Environmental Offsets Policy (2012).

A suitable offset site for the Balranald Project was identified, and this BOP formulated, after targeted survey and habitat mapping for Malleefowl and Corben's Long-eared Bat across the development area and identified offset site confirmed the presence of these two species within the offset site. This document demonstrates the adequacy of the identified offset site through application of the Commonwealth Environmental Offsets Policy (2012). Additional information regarding the offset site described in this BOP including details of its location, mapping of habitat for Malleefowl and Corben's Long-eared Bat, and maps of survey locations and results conducted to inform this BOP has been submitted to the Commonwealth Department of the Environment (DoE). This information has not been included within this report due to privacy restrictions.

1.1 Background

Iluka proposes to develop a mineral sands mine in south-western New South Wales (NSW), known as the Balranald Mineral Sands Project (the Balranald Project). The Balranald Project includes construction, mining and rehabilitation of two linear mineral sand deposits, known as the West Balranald and Nepean deposits, located approximately 12 km and 66 km north-west of the town of Balranald, respectively. Clearing of vegetation for the development and mining of the two deposits will occur in two stages with clearing for the West Balranald mine likely to commence in 2017 and clearing for the Nepean mine and associated access predicted to commence around 2022 (Figure 1). Additional details regarding the Balranald Project, including the approach to identifying candidate offset sites are contained within the Biodiversity Assessment for the Balranald Project (Niche 2015) which was submitted to the Commonwealth Department of the Environment (DoE) in 2016 as part of the draft Commonwealth Environmental Impact Statement (EIS) for the Balranald Project and which has been subject to public exhibition and comment (EMM 2016).

Matters of National Environmental Significance (MNES) were specifically addressed in a Referral submitted to the Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC) (now DoE) on 16 August 2012. DoE subsequently prepared the Guidelines for the Content of a Draft Environmental Impact Statement for the Balranald Project (Reference: 2012/6509) which identified species that may be impacted by the Balranald Project. A Biodiversity Assessment was prepared by Niche (2015) to accompany the draft EIS for the Balranald Project (EMM 2016). *Significant impact criteria* under the EPBC Act were addressed within the Niche (2015) report for eleven affected threatened and migratory species listed under the EPBC Act. The assessment determined that one threatened species (the Malleefowl) would be significantly impacted.

On 25 October 2012 the DoE determined that the Balranald Project was a controlled action and that approval under the EPBC Act was required. It was further concluded that biodiversity offsets were required to compensate for significant impacts on two MNES, both threatened species listed as vulnerable. Those species include:

- Malleefowl (*Leipoa ocellata*), as identified as significantly impacted in the Biodiversity Assessment (Niche 2015); and

- Corben's Long-eared Bat (*Nyctophilus corbeni*), which although not identified as significantly impacted within the Biodiversity Assessment, was added by DoE as a significantly impacted species after consideration of impacts to the species outlined within the Biodiversity Assessment (Niche 2015).

A Biodiversity Offset Strategy for the Balranald Project was provided in the Niche (2015) report, which outlined the approach to offsetting. The strategy primarily relied upon securing suitable lands using offset mechanisms which are then managed for conservation in-perpetuity. The strategy also outlined initial investigations into numerous candidate offset properties. This BOP presents further detailed investigations into one specific property (hereafter referred to as the offset site) to satisfy the Commonwealth offset requirements for significant impacts to Malleefowl and Corben's Long-eared Bat.

The Balranald Project EIS (EMM 2015) was submitted to the NSW Department of Planning in May 2015 and received development consent on 6 April 2016 under the *NSW Environmental Planning and Assessment Act 1979*. Required mitigation measures for Malleefowl and Corben's Long-eared Bat, as well as NSW general offsetting requirements are stipulated within the development consent for the project (NSW Planning and Environment 2016).

1.2 Environment Protection and Biodiversity Conservation Act 1999 Offsets Policy

Offsets are to be determined having regard to the EPBC Act Offsets Policy. Similar to the NSW Biodiversity Offsets Policy for Major Projects, environmental offsets are provided as measures that compensate for the residual adverse impacts of an action under the EPBC Act Offsets Policy. Offsets should counterbalance the impacts that remain after avoidance and mitigation measures have been implemented. For assessments under the EPBC Act, offsets are only required if residual impacts are significant on MNES.

An offsets package is defined in the EPBC Offsets Policy as a suite of actions that a proponent undertakes in order to compensate for the residual significant impacts of a project. An offsets package can comprise of a combination of direct offsets and other compensatory measures. Direct offsets are actions that deliver a measurable conservation gain for an impacted protected matter. Conservation gains 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 values of a heritage place.
- Averting the loss of a protected matter or its habitat that are under threat.

Under the EPBC Act Offsets Policy, biodiversity offsets may be secured through a number of mechanisms including:

1. Developing offsets of public lands.
2. Developing offsets on private lands.
3. Developing offsets on Indigenous owned lands.
4. Developing offsets in the marine environment (not applicable to this project).
5. Providing indirect measures to supplement a direct offsets site (s).

Indirect measures or other compensatory measures that are not directly related to securing land based, otherwise unprotected, habitat for those MNES which will be significantly impacted by a proposal, may include measures that are anticipated to lead to benefits for the impacted protected matter. Other compensatory measures may include funding for suitable research or education programs. Under the EPBC

Offsets Policy, a minimum of 90% of the offset requirements for any given impact must be met through direct offsets.

The offset described herein to address residual impacts from the Balranald Project will implement a 100% direct offset scenario rather than any indirect offset measures. The direct offset will involve the establishment of a biobank site over the subject offset site with a range of measures incorporated into the BioBanking agreement to improve habitat for significantly impacted MNES.

1.3 Habitat impacted by the Balranald Project

The Biodiversity Assessment for the Balranald Project provides a detailed assessment of impacts on Malleefowl and Corben's Long-eared Bat arising from the project (Niche 2016). The nature and extent of predicted impacts has also been considered in calculating the overall offset requirement for the project in sections6 and 7 of this document, while a summary of impacts for key MNES is provided below. The Balranald Project will result in:

- Impacts on 2,543 hectares of Malleefowl habitat, ranging in quality from low to very high;
- Impacts on 3,143 hectares of preferred foraging and roosting habitat for Corben's Long-eared Bat, including up to an estimated 121,000 hollows.

1.4 Offset staging and options

As the Balranald Project has two distinct impact stages associated with development of the separate West Balranald and Nepean mines, DoE has agreed to a staged offset should this be required. The overall offset plan is presented in Table 1 with different staging options.

1.5 Additional offsetting requirements and overall offset scheme

Offsetting requirements for the Balranald Project under the EPBC Act have arisen due to the identification of potentially significant impacts on two listed MNES. The Commonwealth offset requirements are separate to offset requirements for the project under the New South Wales *Threatened Species Conservation Act 1995* (TSC Act), which requires offsets for clearing of all native vegetation types within the Project area. The NSW offset requirements, and commitments towards satisfying those requirements, are outlined in the Biodiversity Assessment for the project (Niche 2016) and in the NSW planning approval for the Balranald Project. Establishment of the offset site described herein will satisfy the entire Commonwealth offsetting requirement as well as some of the NSW offset requirements. Additional offsetting requirements under the NSW approval for the project are also highly likely to contain areas of habitat for both Malleefowl and Corben's Long-eared Bat, however this additional benefit has not been considered within the offsetting calculations included herein to address the EPBC Act offset requirements.

Table 1: Planned offset events to address Commonwealth and NSW offset requirements for the Balranald Project to address

	West Balranald Mine Development (Stage 1)		Nepean Mine Development (Stage 2)	
	Offset Event 1: Establishment of subject offset site	Offset Event 2: fulfilment of NSW stage 1 offset requirement	Offset Event 3: Commonwealth Stage 2 requirement	Offset Event 2: fulfilment of NSW stage 2 offset requirement
Relationship with Commonwealth offset requirement	Subject offset area established to account for impacts on Malleefowl and Corben's Long-eared Bat arising from the development of the West Balranald Mine and associated infrastructure (Figure 1). Iluka may opt to also satisfy part or all of the Stage 2 Commonwealth requirement within this event (this is the likely and preferred scenario). The offset is required to be established prior to commencement of any construction of the West Balranald mine.		Any outstanding offset requirement from clearing of the Nepean mine and associated infrastructure (and consequent impacts on Malleefowl and Corben's Long-eared Bat) will need to be addressed prior to development of the Nepean mine (Figure 1) i.e. by expansion of the subject offset area towards its maximum capacity. Only required if Event 1 has not been sufficient to satisfy the total Commonwealth offset requirement for both mines (Stage 1 and 2).	
Relationship with NSW offset requirement	Fulfilment of the Commonwealth Stage 1 requirement will contribute to reducing the NSW credit requirement generated from clearing of native vegetation communities.	Any outstanding offset requirement from clearing associated with the West Balranald mine (i.e. not addressed by Event 1) will need to be addressed within 3 years of the commencement of the construction of the West Balranald mine. This will be achieved by further direct offsets or payment into an established offset fund.	Fulfilment of the Commonwealth Stage 2 requirement will contribute to reducing the NSW credit requirement generated from clearing of native vegetation communities.	Any outstanding offset requirement from clearing of the Nepean mine and associated infrastructure (and consequent impacts on native vegetation types) will need to be addressed prior to development of the Nepean mine, should previous offset site(s) or measures not have been sufficient to satisfy the entire offset requirement as documented within the NSW development consent (NSW Planning and Environment 2016). Timing must be prior to commencement of the development of the Nepean mine.

1.6 Approach and purpose of the BOP

The approach and purpose of this BOP is to:

- Explain the approach to offsetting as consistent with relevant guidelines and as agreed to through agency consultation;
- Use previous knowledge gathered from a review of potential offset properties to select the most favourable offset available to achieve conservation improvements for Malleefowl and Corben's Long-eared Bat in order to offset residual impacts from the Balranald Project;
- Conduct targeted field surveys and habitat assessment using recognised methods to assess and describe habitat suitability and document comparative densities of Malleefowl and Corben's Long-eared Bat within the Balranald Project and offset sites;
- Use the NSW BioBanking assessment methodology to conduct vegetation surveys and assess condition throughout the subject offset site;
- Determine the adequacy of the potential offset site to offset the impacts associated with the Balranald Project;
- Use information from field surveys and other sources to compare values within the Balranald Project site and subject offset site within the Commonwealth's Offsets Assessment Guide (DoE 2016) so that an improve or maintain outcome can be quantified; and
- Conduct additional investigations into the potential impacts on local and regional Malleefowl populations in response to submissions made on the draft Commonwealth EIS and in order to justify parameters used within the Commonwealth offsets assessment guide.

1.7 Definitions and abbreviations

BOP	Biodiversity Offset Package
DoE	Commonwealth Department of the Environment
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
Ha	Hectare
MNES	Matters of National Environmental Significance, as listed in the EPBC Act
OEH	NSW Office of Environment and Heritage
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now DoE)
Subject offset site	The offset site targeted at addressing impacts on Malleefowl and Corben's Long-eared Bat as described within this report which will be subject to a NSW BioBanking agreement.

2. Offset site identification

An extensive process was undertaken to identify appropriate offset sites as described below:

1. Phase 1: Regional desktop investigations using GIS analysis to identify potential offset sites by scoring the sites against a series of criteria identified as desirable for potential offset sites including:
    a. Absence of existing National Park tenure or long-term conservation covenant.
    b. Absence of mining tenements.
    c. Regional vegetation types and formations consistent with vegetation types and formations to be removed within the development area and therefore requiring offsets.
    d. Proximity to National Parks.
    e. Proximity to the project area.
    f. Known records for threatened species.
    g. The size of the potential biodiversity offset area.
    h. The shape of the proposed biodiversity offset area in relation to the spatial arrangement of existing vegetation in the landscape.

    Phase 1 of the analysis resulted in the identification of approximately 430,000 hectares of vegetation on a total of 21 candidate properties which may be considered as potential offset sites.
2. Phase 2 involved rapid ground reconnaissance of the 21 candidate properties (public access and public vantage points only) to validate the desktop GIS exercise in phase 1.
3. Phase 3 involved the refinement of the 21 candidate sites into a shortlist of 10 properties with a collective vegetated area of approximately 273,000 hectares of vegetation.
4. Phase 4 involved preliminary field investigations of the shortlisted 10 potential offset properties to further refine the vegetation mapping and condition assessment of the sites prior to undertaking further detailed assessments of the potential offset sites for the development of the final offset package.

The subject offset site described in this report scored very highly during the site identification process and has therefore been subject to additional detailed field survey and allocated as the subject offset site for addressing DoE offset requirements.

3. Survey Methods

Fauna survey methods and survey effort for the development area of the Balranald Project have been documented in Section 3 of the Biodiversity Assessment for the Balranald Project (Niche 2016). Equivalent survey techniques and effort was applied throughout the offset site for Malleefowl and Corben's Long-eared Bat and is documented below. A comparison of survey effort between the Balranald Project site and offset site is presented along with results in Section 4 of this document.

3.1 Timing

A summary of survey activities and their timing for the offset site is provided in Table 2 below. Survey techniques are described in more details in the sections that follow.

Table 2: Description of survey activities and timing for the offset site

Survey Activities	Purpose	Date
Site reconnaissance	Initial information gathering on habitat and comparisons with other candidate offset properties within the locality	30/04/2014
BioBanking survey methods and habitat appraisal	Gathering of BioBanking data and confirmation of suitable habitat for MNES throughout offset site	31/08/2015 – 3/09/2015
Malleefowl and Corben's Long-eared Bat survey, harp trapping and BioBanking survey methods	Initial surveys targeted towards DoE MNES potentially determined as significantly impacted as well as information gathering for BioBanking requirements	23/11/2015 -29/11/2015
Malleefowl and Corben's Long-eared Bat survey, harp trapping and BioBanking survey methods	Further targeted surveys for Malleefowl and Corben's Long-eared Bat in response to submissions and DoE comments and completion of BioBanking data gathering	10/03/2016 – 17/03/2016

3.2 Vegetation and habitat

The vegetation and habitat survey for the Balranald Project area is detailed within the Biodiversity Assessment for the project (Niche 2016), with consistent methods employed over the offset site. Initial habitat assessment was performed via gathering of rapid data points during a reconnaissance of the site (Table 2). BioBanking plots were then used to gather more specific information on vegetation condition and habitat availability throughout the site (see Niche 2016 section 3.2 for details of BioBanking plot information) with concurrent observations made regarding maturity of vegetation/likely time since fire, signs of feral animals and other disturbance factors. The methodology was applied over the offset site on the various dates given above. The aim was to adequately sample each of the vegetation community types.

3.3 Malleefowl

3.3.1 Targeted surveys

Targeted surveys for Malleefowl were performed throughout the offset site and consisted of the following activities:

- Walking transects along Spinifex Mallee covered dunes and adjacent areas with Chenopod Mallee and locating Malleefowl mounds or confirming the status of previously mapped mounds; and
- Inspecting roadsides for Malleefowl footprints where sand was prevalent (typically around dune tops).

Surveys were performed over nine days in November 2015 and March 2016 by ecologists with previous experience in identification of Malleefowl mounds.

3.3.2 Survey effort

A total of sixty-six hours were spent searching for Malleefowl mounds within the subject offset site. A comparison with survey effort employed within the Balranald Project site is provided in below.

Table 3: Comparison of Malleefowl survey effort between the Balranald Project site and the offset site

Survey method	Inside project area (or < 1 km distant)				Proposed Offset Site
	Nepean mine	West Balranald mine	Nepean access road	Total survey effort (Development area)	Total
Malleefowl Transects (hours)	38	23	7	68	66
Malleefowl Mound Checks		4		4	

3.3.3 Habitat mapping

Habitat mapping for Malleefowl within the Balranald Project site and offset areas considered the prevalence of known and historic records of the species, the presence of east-west dune systems, and vegetation condition indicators measured during the field surveys. Very high and high potential habitat areas are comprised of dunal areas with breeding habitat for Malleefowl along with recent records of the species or continuity and close proximity with such areas. Moderate and low areas occurred away from dunal systems with habitat potential decreasing with distance from dunal systems and the occurrence of recent and historic Malleefowl observations.

3.4 Corben's Long-eared Bat

3.4.1 Targeted surveys

Survey effort for Corben's Long-eared Bat focused on woodland habitat within the subject offset site, which is preferred habitat for the species. Survey effort was somewhat biased towards areas with greater densities of tree hollows typically within areas of Chenopod Sandplain/Swale Mallee Woodland and Belah – Chenopod Woodland.

Harp traps were set at 12 sites throughout the offset site (Table 4). The traps were generally set between trees, particularly where overhanging branches formed a constricted flyway, and traps were checked in early morning and occasionally in the evening. Echolocation surveys were not employed as the species cannot be identified from other species within the *Nyctophilus* species common within the locality.

3.4.2 Survey effort

Survey effort for the Corben's Long-eared Bat at the offset site is detailed in Table 4 below. A comparison of the survey effort undertaken on the subject offset site with that undertaken in the Balranald Project site is shown in Table 4.

3.4.3 Habitat mapping

Habitat mapping for Corben's Long-eared Bat was not undertaken due to its distribution throughout all woodland vegetation types within the Balranald Project site and subject offset site.

Table 4: Survey effort for Corben's Long-eared Bat at the offset site

Trap	No of traps	Vegetation	Start Date	End Date	Corben's Long-eared Bat Recorded Y/N	Nights	Effort
Harp 1	2	Mallee dense	24/11/2015	26/11/2015	No	2	4
Harp 2	2	Mallee dense	24/11/2015	26/11/2015	No	2	4
Harp 3	2	Mallee dense	24/11/2015	27/11/2015	No	3	6
Harp 4a	1	*Acacia melvillei* shrubland	24/11/2015	29/11/2015	No	5	5
Harp 4b	1	Mixed Mallee and Belah	24/11/2015	29/11/2015	No	5	5
Harp 5a	1	Belah moderately sparse/clumps	25/11/2015	29/11/2015	Yes	4	4
Harp 5b	1	Belah moderately dense	25/11/2015	29/11/2015	Yes	4	4
Harp 6a	1	Young Mallee with spinifex	26/11/2015	28/11/2015	No	2	2
Harp 6b	1	Young Mallee with spinifex	26/11/2015	28/11/2015	No	2	2
Harp 7a	1	Mixed Mallee and Rosewood (sparse) around watering point and clumped tracks placed within clumps	27/11/2015	29/11/2015	No	2	2
Harp 7b	1	Mixed Mallee and Rosewood (sparse) around watering point and clumped tracks placed within clumps	27/11/2015	29/11/2015	No	2	2
Harp 8a	1	Chenopod Mallee with hollows near small patch of belah	10/03/2016	13/03/2016	No	3	3
Harp 8b	1	Chenopod Mallee with hollows near small patch of belah	10/03/2016	13/03/2016	No	3	3
Harp 9a	1	Chenopod Mallee with hollows	10/03/2016	15/03/2016	Yes	5	5
Harp 9b	1	Chenopod Mallee with hollows	10/03/2016	15/03/2016	No	5	5
Harp 10a	1	Chenopod mallee proper around dam	13/03/2016	15/03/2016	No	2	2

Harp 10b	1	Chenopod mallee proper around dam	13/03/2016	15/03/2016	No	2	2
Harp 11a,b	2	Chenopod mallee mature with plentiful hollows adjacent to belah	15/03/2016	16/03/2016	Yes	1	2
Harp 12a,b	2	Chenopod mallee mature w plentiful hollows.	15/03/2016	16/03/2016	No	1	2
				Totals	4	55	64

Table 5: Comparison of survey effort: Balranald Project site and the subject offset site

Survey method	Balranald Project Area (2011, 2012, 2013 surveys)		Proposed offset site (2015, 2016 surveys)
	Inside project area (or < 1 km distant)	Outside of project area (> 1 km)	
Harp traps (nights)	38	40	64

4. Comparison of the Subject Offset Site and Balranald Project Site

A maximum area of approximately 10,900 hectares of vegetation is available for offsetting within the subject offset site making the property an excellent prospective offset site, as it represents a large consolidated offset with extensive patch size. The property is less than 50 km from the Balranald Project area and has good continuity with the project area through the predominance of native vegetation communities and lack of hard barriers that occur between the two areas. Additional features of the subject offset site are tabled below.

Table 6: Features of the subject offset site

Subject offset site feature	Description
CMA/Subregion	Lower Murray Darling (LMD) South Olary Plain, Murray Basin Sands subregion, which is Identical to the majority of the Balranald Project site.
Zoning	As with the majority of lands in the western division, the site is subject to a Western Lands Lease, with a primary focus towards agricultural activities but also enabling other activities that are either development related (e.g. charcoaling) or conservation related (e.g. establishment of conservation areas under a BioBanking or other conservation agreement).
Land use history	The site has historically been used for sheep and cattle grazing, however more recently had a conservation covenant in operation.
Conservation areas	A Property Vegetation Plan (PVP) operated over the site until May 2016. Operation of the PVP involved destocking of the property, removal of selected watering points and some goat harvesting. The removal of watering points is likely to have reduced the carrying capacity of the goat population. It has been observed that goat harvesting in PVP areas is unlikely to have significantly reduced goat numbers.
Fire history	Woodland within the site is mapped as unburnt since at least 1972. There was no contradictory evidence to this witnessed during field surveys.

A summary of aspects relating to the ecology of Malleefowl and Corben's Long-eared bat within the offset site and the Balranald Project site is provided below. Other features of the subject offset site and the Balranald Project site are compared in Section 6.

4.1 Vegetation

Vegetation within the subject offset site is predominantly Chenopod Sandplain/Swale Mallee Woodland with significant areas of Spinifex Dune Mallee Woodland interspersed between the Chenopod Mallee. There are two forms of Chenopod Sandplain/Swale Mallee within the locality and throughout the subject offset site and Balranald Project site those areas that occur on predominantly east-west orientated sand dunes and those areas on lower-lying sediments which generally have a higher clay content and increased fertility. Chenopod Sandplain/Swale Mallee Woodland on dunal systems, and interspersed with Spinifex Dune Mallee Woodland, are habitat areas for Malleefowl.

Areas of Chenopod Sandplain/Swale Mallee on lower-lying sediments and adjacent areas of Belah – Chenopod Woodland also occur throughout the subject offset site and Balranald Project site, and these

areas typically support higher densities of tree hollows (provided areas are long unburnt) and so are considered important for bats including Corben's Long-eared Bat (Lumsden et al. 2008). An additional vegetation type: *Acacia melvillei* Woodland (listed as an EEC under the State TSC Act) also occurs in southern parts of the offset site. A table of vegetation types and extent within the subject offset site is provided below.

Table 7: Vegetation types and extent within the subject offset site

BioMetric Vegetation Type abbreviation for this ecological assessment	Listed as Threatened Ecological Community	Total maximum area within offset	Percent already cleared in CMA
1. Spinifex Dune Mallee Woodland (LM130)	Not listed	1,331	5
2.Chenopod Sandplain/Swale Mallee Woodland (LM116)	Not listed	9,230	30
3. Belah – Chenopod Woodland (LM108)	Not listed	243	20
4. Yarran shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones (LM 160)	*Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions (NSW TSC Act)	84	60
TOTAL		10,888	

4.1.1 Vegetation condition

Prevailing vegetation condition within the property is similar to better quality parts of the project area. The property is largely ungrazed by domestic livestock, however goats are common. There is significant room for improvement in regard to vegetation condition via management of goats and other feral animals as well as potentially overabundant native herbivores.

4.2 Malleefowl

4.2.1 Lifecycle

The breeding cycle of the Malleefowl is generally carried out within a relatively small area (a few kms) and involves preparation of nest mounds (autumn to spring), egg laying (spring to summer) and chick emergence (summer) (Benshemesh 2007). Breeding and foraging primarily occurs within mallee vegetation on sandy substrates which is present on the un-cleared east-west dunal systems within the locality. Sandy soil and abundant leaf litter are essential for mound building and thus breeding. Wildfire can cause local extinctions and prevent breeding for many years.

4.2.2 Habitat

Preferred habitat for Malleefowl within the Balranald Project site and the offset site consists of dunal mallee systems which primarily support Spinifex Dune Mallee Woodland (LM130) and Chenopod Sandplain/Swale Mallee Woodland (LM116). This is consistent with known preferred habitat for Malleefowl (e.g. Benshemesh 2007). Mallee habitat (as well as other woodland habitat) away from the sandy dunal systems were not found to support Malleefowl breeding within the Balranald Project site and subject offset site as no old or recent mounds were recorded in these areas. It is likely that such vegetation occurs on sediments that do not support mound construction and/or the structure of vegetation communities limits mound building (such communities tended to support less dense vegetation with higher canopies and less

leaf litter than mallee communities on dune systems). Nonetheless, woodland vegetation adjacent to areas of preferred habitat where mound building does occur is likely to play a role as foraging and dispersal habitat.

4.2.3 Populations and records

Within the Balranald survey area (constituting the Balranald Project site and adjacent surveyed areas as illustrated in Niche 2016) a total of 39 Malleefowl related observations were made during the course of field surveys. The majority of observations (17) made during field survey were of old mounds that had no evidence of recent use, followed by footprints (12) indicating the presence of Malleefowl, recently used mounds (6), then observations of actual birds (2) and active mounds (3). Malleefowl related observations within the Balranald Project area are tabled below (Table 8) along with Malleefowl related observations within the subject offset site.

The subject offset site has confirmed records of Malleefowl with numerous mounds having been identified within the property over the last two decades. Confirmation of recently active mounds and current Malleefowl activity (via footprints) occurred during field survey of the property in November 2015. Mound densities within the subject offset site are similar to mound densities within the West Balranald mine area but much higher than within the Nepean mine area.

Table 8: Comparison of confirmed Malleefowl observations within subject offset site and Balranald Project site

Observation type	Offset Site	Development Area
Active mounds	2	3
Recent mounds	14	2
Prints	5	2
Old mounds	25	4
Total observations	46	11

Malleefowl habitat within the subject offset site has connectivity with a large proportion of the Malleefowl habitat to be impacted from the Balranald Project, with habitat between the two areas being predominantly native vegetation. Vegetated corridors are restricted in some areas to approximately 800m (Malleefowl are known to use even narrow corridors including linear roadside strips of vegetation from time to time (Benshemesh 2007). Overall there is expected to be some migration of Malleefowl individuals (albeit infrequent) between the Balranald Project and subject offset areas.

4.3 Corben's Long-eared Bat

4.3.1 Lifecycle

Corben's Long-eared Bat roosts in tree hollows, crevices, and under loose bark. The species is known to frequently switch roosts and also roost individually (Lumsden et al. 2008). The species is a slow flying agile bat, utilising the understorey to hunt non-flying prey, especially caterpillars and beetles. Corben's long-eared Bat is known to even hunt on the ground (OEH 2016). Mating takes place in autumn with one or two young born in late spring to early summer (OEH 2016).

4.3.2 Habitat

Corben's Long-eared Bat is found in semi-arid habitats of the far south west and western slopes and plains in NSW. This tree hollow roosting species inhabits a range of forest and woodland types within its range. Habitat for the species is centred around large, consolidated forest patches with long-unburnt areas

supporting tree hollows which constitute potential roost areas (Schulz and Lumsden 2010; Turbill and Ellis 2006).

Corben's Long-eared Bat inhabits a variety of vegetation types, including mallee, bulloak and box 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.

Suitable habitat occurs throughout the Balranald Project area and offset site where mature woodland vegetation is present. Within the Project area and the offset site, areas with high densities of tree hollows, are thought to be important due to their greater capacity to offer opportunities for roosting and breeding. All woodland areas provide foraging habitat for the species with prey densities likely to be highest in better condition vegetation with a variety of microhabitats for insects such as deep leaf litter and logs.

4.3.3 Populations and records

The regional population is considered to comprise of a series of interconnected local populations covering an extensive area of approximately 8 million hectares from Menindee (north) to Ouyen (south) Hatfield/Ivanhoe (east) and Morgan in the west. Within this substantial area the species is likely to be most abundant in mature woodland habitat that provides abundant roosting resources.

There were 37 records of Corben's Long-eared Bat from the Balranald Project site locality (50 km radius from the boundaries of the Nepean and West Balranald mines) within the Atlas of NSW Wildlife (Niche 2016), which were concentrated around the Nepean mine area. The species is not usually possible to distinguish from other Nyctophilus species via call recording and therefore its distribution and abundance throughout the locality is likely to be under-estimated compared to species that are readily identifiable by call analysis.

Table 9 shows the results of harp trapping surveys undertaken at the subject offset site, and compares those to the results of targeted surveys at the Balranald Project site. The species was captured twice within or near to the Project area during surveys by Niche in 2013 - along the Nepean access road and approximately 6 km west of the West Balranald mine area. Both captures were near the interface between woodland and shrubland habitats.

Surveys of the offset site confirmed the presence of Corben's long-eared Bat, with seven individuals recorded at three separate locations during 2015 and 2016 (Table 9).

Table 9: Comparison of harp trap survey results for Corben's Long-eared Bat: Balranald Project area and surrounds compared with the subject offset site

Site	No. Corben's Long-eared Bat recorded	Total survey effort	Vegetation type
Balranald Project Site			
Within Balranald Project site	1		Chenopod-Mallee Woodland
Off-site to the west of Project site	1		East-west Dunal Mallee
Total	*2*	78 trap nights	
Proposed Offset Site			
5a/b	4		Belah-Chenopod Woodland
9a	1		Chenopod-Mallee Woodland
11a/b	2		Chenopod-Mallee Woodland
Total	*7*	64 trap nights	

4.4 Other threatened species within the subject offset site

The following threatened species have been recorded at the subject offset site during current or previous surveys:

- Chestnut Quail-thrush (TSC Act – confirmed during recent field survey)
- Gilbert's Whistler (TSC Act – confirmed during recent field survey)
- Hooded Robin (south-eastern form)
- Inland Forest Bat (TSC Act – confirmed during recent field survey)
- Little Pied Bat (TSC Act)
- Major Mitchell's Cockatoo (TSC Act)
- Mallee Worm-lizard (TSC Act)
- Regent Parrot - eastern subspecies (TSC Act and EPBC Act – note foraging habitat only)
- Varied Sittella (TSC Act)
- Western Pygmy Possum (TSC Act)
- *Acacia melvillei* shrubland (TSC Act).

5. Proposed Management of the Biodiversity Offset Site

5.1 Management plan

A management plan will be developed for the subject offset site to ensure that the site is managed for the improvement of habitat condition for Malleefowl and Corben's Long-eared Bat. Specifications for management activities within the management plan will be developed in consultation with DoE, NSW OEH and NSW NPWS with consideration of successful programs being carried out within the nearby National Parks or other reserves.

The focus issues of the management plan will include:

- Livestock exclusion –livestock exclusion would occur. The current restriction in this regard which was facilitated by an active Property Vegetation Plan for the property, has recently expired (May 2016).
- Fox control – a baiting programs for fox control will be developed and implemented to reduce the numbers of foxes over the property and therefore the risk of fox predation for Malleefowl and Corben's Long-eared Bat.
- Cat control – Cat control methods will be developed and included within the offset site management plan, which will reduce the risk of predation to Malleefowl and Corben's Long-eared Bat.
- Feral goat control – at present feral goats are harvested annually from the subject offset site however there is no concerted effort to minimise the numbers of goats in the long-term nor permanently exclude them from the site. The management plan would ensure that the goat population within the subject offset site is dramatically reduced and prevented from re-establishing. Removal of the goats would lead to improvements in habitat condition, with an increase in density and diversity of ground-covering vegetation and understorey- midstorey shrubs, thereby increasing food availability and providing shelter from predation for Malleefowl. It is also expected that improvements in foraging habitat for the Corben's long-eared Bat would occur, via increases in the availability and diversity of flowering resources leading to an increased abundance of insect prey for the species.
- Weed management – weeds are relatively uncommon throughout the subject offset site with weed infestations limited to heavily disturbed areas that are either very limited in size within the subject offset area or would not be included within the overall offset. Weeds will be monitored as part of offset management with a list of target species developed for control should they be found to occur.
- High frequency/high intensity fire – fire is seen as a threat to the hollows that Corben's long-eared Bat use as habitat. High intensity fire would likely lead to a significant reduction in the availability of hollows for the bats. In addition, Malleefowl are associated with long unburnt areas of Mallee (e.g. Clarke 2005). The management plan will implement fire controls to reduce the likelihood of fire having negative impacts on the habitat for both Malleefowl and Corben's Long-eared Bat. Total fire exclusion (more likely) or limited prescribed burning will be implemented after consultation with NSW OEH and NSW NPWS and others including LaTrobe University and the Malleefowl recovery group regarding preferences for burn practices.
- Fencing – fencing does exist around the subject offset site, however existing fencing will be upgraded or retro-fitted to allow for goat-proofing. Goat capture enclosures or corridors will also be incorporated into the overall fencing.
- Monitoring – the management plan would also detail a monitoring program to ensure management measures being undertaken on the subject offset site are achieving their goals and that the habitats on site are being improved and maintained.

6. Offset calculations (Niche 2016)

6.1 EPBC Act offset assessment guide summary of calculations

In order to quantify the offset requirement for the Balranald Project, the EPBC Act Offset Assessment Guide (hereafter also referred to as the Offset Calculator) was applied. The Offset Calculator requires an assessment for each MNES that must be offset (in this case two species) via entry of a range of measurements which relate to the ecology of the MNES and characteristics of both the impact site and subject offset site. A calculation of the indicative offset requirement was undertaken by Niche using the calculator and with reference to the subject offset site. These scores are presented and justified within this section, however the scoring later employed by DoE and presented in Section 6 was the basis for the final DoE offset requirement.

Scores used within the Offset Calculator for each species are presented in Table 10 below. Further explanation for the scoring is provided in Section 6.2 which follows the summary table.

Table 10: Summary of scores used/generated within the EPBC Offset Assessment Guide for Malleefowl and Corben's Long-eared Bat

	Malleefowl		Corben's Long-eared Bat	
	Development Site	Proposed Offset Site	Development Site	Proposed Offset Site
Calculator inputs				
Area impacted (hectares)	2,543	N/A	3,143	N/A
Annual probability of extinction	0.2	0.2	0.2	0.2
Habitat Quality (site condition, site context and species stocking rate)	7	7	7	7
Time over which loss is averted (years)	20	20	20	20
Time until ecological benefit (years)	10	10	10	10
Risk of loss (%) – without offset	N/A	20%	N/A	20%
Risk of loss (%) – with offset	3%	3%		3%
Future quality – with offset	N/A	9	N/A	9
Future quality – without offset	N/A	5	N/A	5
Confidence in result (%)	N/A	75%	N/A	75%
Calculator-generated outputs				
Approximate area required to satisfy 100% of the offset requirement (hectares)	N/A	6,400	N/A	6,400

6.2 Scoring used in the offset calculator

6.2.1 A. Annual probability of extinction

Malleefowl and Corben's Long-eared Bat

This figure was not changed from the default value of 0.2 for Vulnerable Species within the offset calculator. The value of 0.2 is derived from the International Union for the Conservation of Nature (IUCN) Red List for threatened species (DoE 2016).

6.2.2 B. Protected matters attributes

Malleefowl and Corben's Long-eared Bat

The area of habitat has been used as the metric in the calculator to quantify impacts for the Malleefowl and Corben's Long-eared Bat. Other parameters such as the occurrence of breeding and roosting sites have been used to assist with habitat mapping and area calculations.

6.2.3 C. Habitat quality

A key component of the assessment is an estimation of the current condition of both the Balranald Project site and the subject offset site and the potential improvement in condition of habitat over time within the subject offset site. Condition values must be scored from 0 (lowest quality) to 10 (highest quality) before and after the offset has been provided. Habitat condition for the subject species was estimated after considering three parameters: site condition, site context and the species stocking rates. Importantly, it was acknowledged that whilst there were some differences between the Balranald Project and offset sites, overall the condition parameters were similar between the Balranald Project and offset sites and therefore the condition score in the calculator was the same.

Malleefowl

- For the Balranald Project site 2,543 hectares of Malleefowl habitat has been identified within the project area. This area was divided into two separate quality classes based on habitat mapping performed during the Biodiversity Assessment for the project.
- Site Condition (Balranald Project site) - of the 2,543 hectares of potential Malleefowl habitat approximately 1,000 hectares is low and moderate quality Malleefowl habitat due to unfavourable structural characteristics of vegetation and the complete absence of recent or historic Malleefowl records despite survey (see Appendix 8 and Figures 12a-c of Niche 2015). As such, these areas would reduce the quality of habitat score. The very high and high Malleefowl habitat potential areas are considered to be 7/10 in quality due to the level of goat (and potentially kangaroo) activity witnessed throughout the project area which has limited the condition (cover and diversity) of ground covering shrubs which Malleefowl use for foraging and shelter. The 7/10 condition score is consistent with the appraisal of the BioBanking calculator which scored the predominant vegetation communities for Malleefowl at 66 and 61 out of 100 for the Chenopod Mallee and Spinifex Mallee habitats respectively. The areas identified as moderate and low habitat potential have been allocated the same score as the high and very high habitat potential areas in order to present a conservative case in regard to calculating the overall offset requirement.
- Site Condition (subject offset site) – An equivalent approach to the Balranald Project site was used to score the subject offset site. In comparison to the Balranald Project area the majority of habitat within the subject offset site is high or very high potential habitat. Condition of vegetation within these areas was similar to the high and very high potential habitat within the Balranald Project site. The BioBanking condition scores were also similar between the Balranald Project site and subject offset sites, although slightly lower for the subject offset site. The subject offset site BioBanking score for the dominant Malleefowl habitat communities (Chenopod Mallee and Spinifex Mallee) were 56 and 65 respectively. The reason for the lower scoring within the offset site was investigated and found to be caused by a

number of BioBanking transects performed within the Balranald Project recording very high numbers of trees with hollows (a highly weighted condition indicator in the BioBanking calculator) increasing the overall value of the condition score. As tree hollows are not important for Malleefowl and as there was no observed or measured difference in the more important condition indicators for Malleefowl (ground cover and diversity of ground covering shrubs) a score consistent with the Balranald Project site score was deemed appropriate.

Table 11: Condition scores for vegetation plots performed within the Balranald Project and subject offset sites

Vegetation Type/Area	Native plant species	Native over-storey cover	Native mid-storey cover	Native ground cover grass	Native ground cover shrubs	Native ground cover other	Exotic plant cover	No. trees with hollow	Over-storey regen	Total length of fallen logs
Chenopod Mallee Development Site	10	18	0	2	14	11	0	4	1	25
Chenopod Mallee Offset Site	12	12	7	0	14	0	0	1	1	20
Spinifex Mallee Development Site South Olary	14	24	0	20	2	13	0	1	1	8
Spinifex Mallee Offset Site	10	9	8	24	2	2	0	1	1	18

NB: Bold numbers are condition parameters important for Malleefowl

- Site Context (Balranald Project site and subject offset site) –The West Balranald mine and the subject offset site are both part of larger woodland areas on the South Olary Plain dominated by east-west linear sand dune areas and with adjacent areas of Chenopod Mallee and Belah communities on lower areas with increased clay content. For the Balranald Project site, the more important and extensive area of Malleefowl habitat is associated with the West Balranald mine site. The Nepean mine area has a comparatively smaller and more fragmented area of core Malleefowl habitat within it (Figures 12a-c Niche 2016) owing to its position on the edge of the east-west dune mallee system within the Nepean mine. It is considered that there is a high probability that the subject offset site and the West Balranald mine site are parts of the same Malleefowl population area (referred to as the West Balranald Malleefowl Sub Population (see Section 7 below and Appendix 8 of Biodiversity Assessment 6) separated by Box Creek. The core Malleefowl habitat area east of Box Creek is estimated at approximately 9,000 hectares with the core habitat associated with the West Balranald mine area representing approximately 13% of this area. The subject offset site constitutes approximately 50% of the habitat available within a large area of core habitat west of Box Creek estimated at approximately 20,000 hectares. The Balranald Project site has been scored at 7 and the subject offset site at 8 given their proportional contribution to habitat that makes up the West Balranald Malleefowl population. There are similar large areas of habitat for Malleefowl within the region which makes up one region for Malleefowl with other populations present across Victoria, South Australia and Western Australia.
- Species Stocking Rate (Balranald Project site and subject offset site) - Comparisons of records for Malleefowl across the West Balranald mine habitat area and the subject offset site are similar in terms of overall numbers and densities of active and old mounds. This is unsurprising given the other similarities between the sites and likely linkage between the two sites. The Nepean site has far fewer records and no active mounds were found in this area. Records for Malleefowl observations are presented in Table 8. Both the Balranald Project and subject offset sites are expected to be similarly impacted by fox predation and goat grazing and therefore the sites would not be operating at full stocking rate. Both sites have been given a 6 out of 10 for stocking rate.
- Overall Score – Both the Balranald Project and subject offset sites were given a score of 7 out of 10 despite the recognition that the Nepean site was not as important to Malleefowl as either the West Balranald mine site or the offset site. This presents a conservative approach consistent with other elements of the assessment.

Corben's Long-eared Bat

- For the Balranald Project site, 3,143 hectares of Corben's Long-eared Bat habitat has been identified within the project area.
- Site Condition (Balranald Project site). All Corben's Long-eared Bat potential habitat is considered to be 7/10 in quality due to the level of goat (and potentially kangaroo) activity witnessed throughout the project area which has limited the condition (cover and diversity) of ground covering shrubs as well as midstorey cover and diversity, which is likely to impact on insect prey availability for Corben's Long-eared Bat. The 7/10 condition score is consistent with the appraisal of the BioBanking calculator which scored the potential habitat vegetation communities for Corben's Long-eared Bat at 66, 61, 82 and 90 out of 100 for the Chenopod Mallee, Spinifex Mallee, Belah Chenopod and Belah Pearl Bluebush habitats respectively. Since more than two-thirds of the habitat to be impacted is Chenopod Mallee and Spinifex Mallee rather than the higher scoring Belah communities a weighted average for condition scoring was applied with 7/10 being the result.
- Site Condition (subject offset site) – An equivalent approach to the Balranald Project site was used to score the subject offset site. The BioBanking condition scores were similar between the Balranald Project site and subject offset sites, although slightly lower for the subject offset site. The subject offset site BioBanking score for Corben's Long-eared Bat habitat communities (Chenopod Mallee, Spinifex Mallee and Belah Chenopod) were 56, 65 and 82 respectively.
- Site Context (Balranald Project site and subject offset site) –The West Balranald mine, the Nepean mine and the subject offset site are all part of larger woodland areas on the South Olary Plain dominated by east-west linear sand dune areas and with adjacent areas of Chenopod Mallee and Belah communities on lower areas with increased clay content. The proposed offset site is considered to be linked with woodland areas within the West Balranald and Nepean mine areas since Corben's Long-eared Bat is a highly mobile species. Given the limited knowledge of the ecology of Corben's Long-eared Bat all areas that are part of large consolidated vegetation patches with no recent significant burns such that hollows are significantly reduced are considered to be equally important for the species.
- Species Stocking Rate (Balranald Project site and subject offset site) - Comparisons of records for Corben's Long-eared Bat across the Balranald Project site and the subject offset site are similar in terms of numbers recorded, however more individuals have been recorded over the subject offset site compared with the Balranald Project site after a similar survey effort was employed. This is unsurprising given the other similarities between the sites and likely linkage between the two sites. Both sites have been given a 7 out of 10 for stocking rate.
- Overall Score – Both the Balranald Project and subject offset sites were given a score of 7 out of 10. There was a slightly lower condition score recorded using BioBanking data gathered within the subject offset site compared with the Balranald Project site however there were a greater number of Corben's Long-eared Bat recorded within the subject offset site compared with the Balranald Project site.

6.2.4 D. Time over which loss is averted

Malleefowl and Corben's Long-eared Bat

Time over which loss is averted (offset site only) was scored at 20 years. It is assumed that offset sites would be protected and managed in perpetuity, however twenty years is the maximum timeframe for averting loss in the EPBC Act Policy guide.

6.2.5 E. Time until ecological benefit

Malleefowl and Corben's Long-eared Bat

Time until ecological benefit: scored at 10 years. The vegetation within the subject offset site would be managed through the offset management actions, being the minimum actions required under BioBanking as well as specific actions for Malleefowl and Corben's Long-eared Bat as described in section 5.

Improvements in the quality of vegetation and levels of predation are expected to occur immediately after management actions begin in year 1 but it is likely that the cumulative ecological benefits would take some time to result in increased numbers or fitness for the affected Malleefowl and Corben's Long-eared Bat populations. A period of 10 years has therefore been used in the calculator. This also allows for progressive implementation of fencing and other labour-intensive activities. It is noted that, within the guidelines for how to use the offset calculator (DoE 2016) the value for this parameter refers to when the improvement in the condition of the habitat occurs rather than when the corresponding increase in fitness for the target species is measured or expected[1].

- Future quality without offset (scale of 0-10): scored at five as the subject site is likely to decline without management, due to grazing influences and feral animal populations within the locality. The subject offset site will soon undergo a change in status in terms of habitat protection which is currently facilitated by an active PVP which has recently expired (May 2016). The expiration of the PVP will allow for grazing of livestock (likely sheep) to recommence.
- Future quality with offset (scale of 0-10): scored at nine. A 20% increase in quality for Malleefowl and Corben's Long-eared Bat is anticipated to occur through targeted management of threats to these species. Management of the subject offset site will draw on similar management that has occurred within the Mallee Cliffs National Park which has demonstrated success in improving quality of habitat for Malleefowl (Benshemesh 2007). The proposed management activities will reduce currently documented threats for both Malleefowl and Corben's Long-eared Bat (e.g. Benshemesh 2007; Schulz and Lumsden 2010; Lunney et. al 2011) as outlined in State and National profiles and recovery plans for these species.

6.2.6 F. Risk of loss (%)

Malleefowl and Corben's Long-eared Bat

Risk of loss (%) without offset: 20%. The offset site is likely to be fairly secure in its tenure however there is pressure on Chenopod Mallee vegetation throughout the region. Many of the land holdings in the local area are subject to Western Lands Leases which generally require land to be used for agricultural purposes or pursuits. Landholders without in-perpetuity conservation mechanisms on their property are able to apply to clear such areas for agriculture (or other economic activities such as charcoaling) subject to obtaining relevant approvals. As part of the preliminary investigation of suitable offset areas it was highlighted that many landowners in the region are investigating clearing of mallee and Malleefowl habitat, including lands which have had temporary protection under conservation agreements.

Current offsetting arrangements that allow for clearing of mallee habitat administered by Local Lands Services appear to allow for clearing to offset ratios of between 1:2.5 to 1:4. Therefore, we have considered a moderately high probability (c. 67%) of the loss of approximately one quarter of the subject offset site. There is also some risk of major degradation (considered loss) of the site through intense fire or other unanticipated activity which has been factored into the 20% score (approximated at 3%).

Risk of loss (%) with offset: scored at 3%. Loss is highly unlikely as an offset covenant will be placed on the title of the land and the land managed in perpetuity. Compliance monitoring and enforcement of the agreed management actions will be part of the BioBanking agreement. The 3% risk of loss pertains to a residual risk of major degradation (considered loss) of the site through intense fire or other unanticipated activity.

[1]The example used within the guidelines is the time it takes for nest box erection, as opposed to nest box use or inhabitation by a target species.

6.2.7 G. Confidence in result (%)

Malleefowl

Confidence in result: 75%. There is a known population of Malleefowl in the offset area and the threats to this species are relatively well known and manageable. Goat exclusion will provide significant benefits in terms of food availability and shelter and may assist with lowering predation risk both through provision of shelter and potentially via reduced movements and reliance on access roadways for foraging. Direct control of foxes will also reduce the risk of predation. Methods of goat exclusion will be based on proven successful trials conducted, for example, in the Lachlan CMA (Lewis et al. 2012). The landholders of the subject offset site have working knowledge of goat trapping and harvesting as well as managing a conservation area (due to the current PVP in operation on the subject site). The fox control program will be established in consultation with NSW OEH and NSW Local Land Services and implement best-practice management. The landholder will also need to pass the 'fit and proper person' test applied by NSW OEH under the NSW BioBanking Scheme.

Corben's Long-eared Bat

There is a known population of Corben's Long-eared Bat in the offset area and the threats to this species are manageable. The most important management requirement for Corben's Long-eared Bat will be the retention of hollow trees and increases in shrub and ground-cover condition which is likely to be beneficial for prey availability. Fire exclusion and goat control will provide benefits in both of these areas. There may also be benefits for the species from fox control, however the predation threat for Corben's Long-eared Bat is largely unknown.

The landholders of the subject offset site have working knowledge of goat trapping and harvesting as well as managing a conservation area (due to the current PVP in operation on the subject site). The fox control program will be established in consultation with NSW OEH and NSW Local Land Services and implement best-practice management. The landholder will also need to pass the 'fit and proper person' test applied by NSW OEH under the NSW BioBanking Scheme.

7. Offset Calculations (DoE) and Finalised Offset Commitments

A similar process of offset calculation was conducted internally by DoE for the Balranald Project and subject offset sites, however there were differences in approach between Niche and DoE in terms of determining the scoring within the calculator. Significant consultation occurred between Niche (on behalf of Iluka) and DoE in regards to numbers that should be entered into the calculator for different parameters.

A major difference in determining the offset requirement generated from the Balranald Project was the perceived level of improvement (and potential degradation) that could be experienced within the offset site after management was applied, and the potential degradation of the offset site without the establishment of a conservation covenant over the land (given the current conservation mechanism over the property is due to expire). The different approach to scoring in this area translated into higher offset requirements when the DoE scoring was applied. The DoE assessment also split Malleefowl habitat into two habitat categories within the Balranald Project area to recognize the lower importance of moderate and low potential habitat to Malleefowl (as compared with high and very high potential habitat). This was done after consultation with Niche who agreed this approach would be beneficial in better quantifying impacts within the Balranald Project site.

The original scoring performed by Niche and presented to DoE within the draft Biodiversity Assessment report (Niche 2015) and during address of submissions as presented in Section 6 of this document is considered to be a correct and reasonable interpretation of the DoE offsets assessments guide. However it is acknowledged that operation of the guide has a certain level of subjectivity and that the scoring by DoE has generated a different outcome in regard to the total offset required (partly in seeking to maintain a consistent application of the tool between projects). The scoring by DoE is therefore agreed to as a basis for determining the overall Commonwealth offset requirement for both Malleefowl and Corben's Long-eared Bat in order to progress the project approval.

The final offset requirement as calculated by DoE is therefore presented below (Table 12) and is accepted as the basis for project approval. The offset requirement is separated into two stages to reflect the stages of the Balranald Project site as discussed in Section 1.4. Habitat within the offset area as presented to DoE has been given a quality score of 7 out of 10 for both Malleefowl and Corben's Long-eared Bat. Other scoring parameters used by DoE can be found in Appendix 1.

It has been communicated to Iluka that (consistent with DoE policy) the offset requirement can be satisfied through either a 100% direct offset arrangement; or a 90% direct offset and 10% indirect offset arrangement. Iluka's preference for the nature of the offset at this stage is to satisfy 100% of the offset through establishment of a BioBanking agreement over the required area of the subject offset site.

Table 12: Staged offset requirement calculated by DoE for the Balranald Project using the offsets assessment guide

Species/Habitat Class	Development area total (ha)	Balranald mine (stage 1) area (ha)	Nepean mine (stage 2) area (ha)	Total (100%) DoE Offset Requirement (ha)	Stage 1 offset requirement (ha)	Stage 2 offset requirement (ha)
Malleefowl High/Very High	1,571	1,218	353	5,250	4,070	1,180
Malleefowl Low/Moderate	973	521	452	1,850	991	859
Combined Malleefowl	2,544	1,739	805	7,100	5,061	2,039
Corben's Long-eared Bat	3,143	2,338	805	10,430	6,052	2,898

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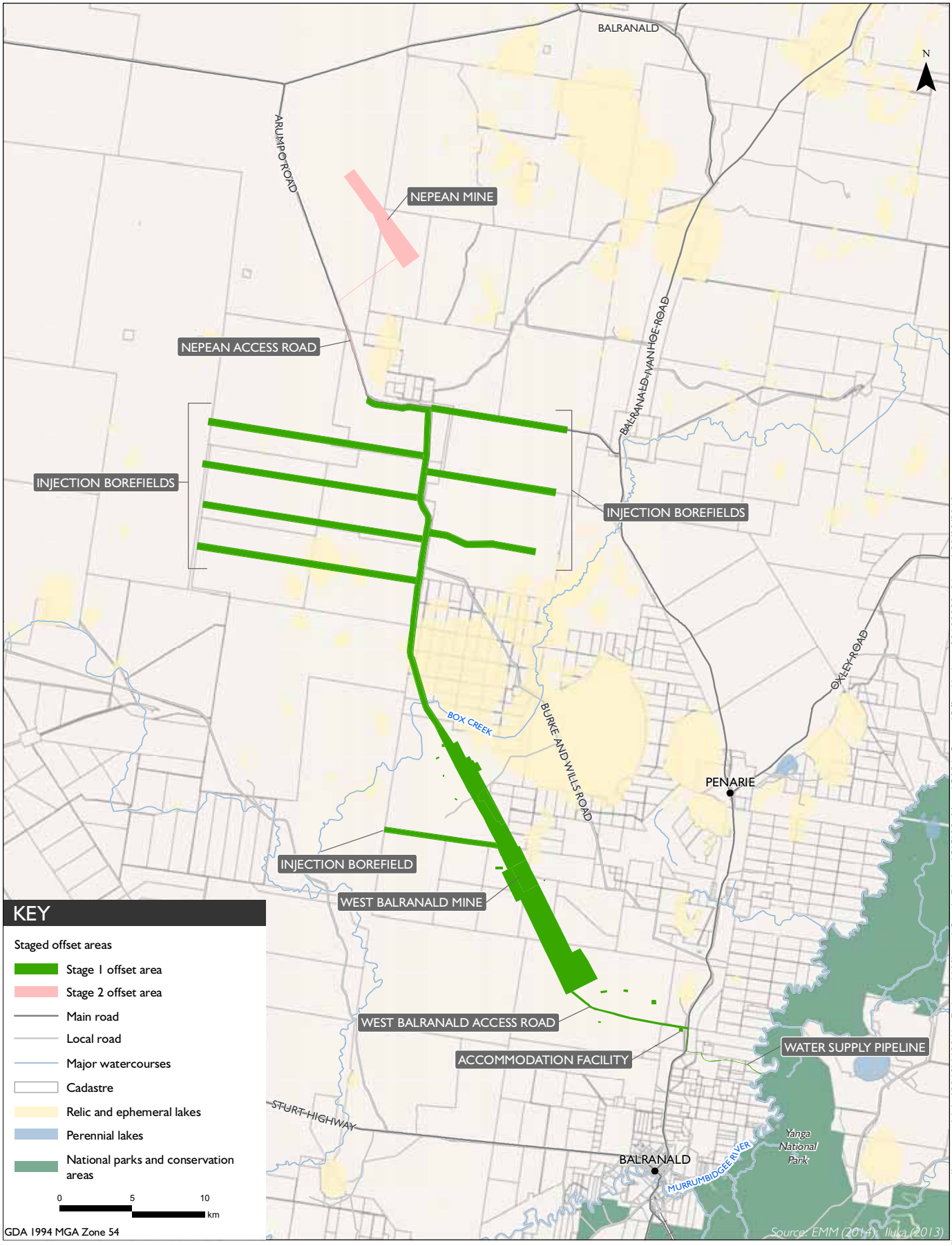
Figures



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Staged offset approach

Balranald Mineral Sands Project

Figure 1

Appendix 1: DoE EPBC Act Policy calculations

Malleefowl

Table 13: Attribute values entered in the offset assessment guide calculations by DoE (Malleefowl – high and very high potential habitat)

Offset assessment guide attribute	Proposed offset Property
Impact Calculator - Quantum of impact - Area	1,571 hectares
Impact Calculator - Quantum of impact – Quality	7
Offset calculator – Time horizon –Risk related time horizon	20 years
Offset calculator – Time horizon – Time until ecological benefit	10 years
Offset calculator - Future area and quality without offset – Risk of loss without offset	20%
Offset calculator - Future area and quality with offset – Risk of loss with offset	1%
Confidence in result – averted loss of offset	80%
Offset calculator – Start area and quality – Start quality	7
Offset calculator - Future quality without offset (1-10)	6
Offset calculator - Future area and quality with offset – Future quality with offset (1- 10)	8
Confidence in result – change in quality	60%
Minimum (90%) requirement	4,725 hectares
100% offset requirement	5,250 hectares

Table 14: Attribute values entered in the offset assessment guide calculations by DoE (Malleefowl – moderate and low potential habitat)

Offset assessment guide attribute	Proposed offset Property
Impact Calculator - Quantum of impact - Area	973 hectares
Impact Calculator - Quantum of impact – Quality	4
Offset calculator – Time horizon –Risk related time horizon	20 years
Offset calculator – Time horizon – Time until ecological benefit	10 years
Offset calculator - Future area and quality without offset – Risk of loss without offset	20%
Offset calculator - Future area and quality with offset – Risk of loss with offset	1%
Confidence in result – averted loss of offset	80%
Offset calculator –Start quality	7
Offset calculator - Future quality without offset (1-10)	6
Offset calculator - Future area and quality with offset – Future quality with offset (1- 10)	8
Confidence in result – change in quality	60%
Minimum (90%) requirement	1,665 hectares
100% offset requirement	1,850 hectares

Corben's Long-eared Bat

Table 15: Attribute values entered in the offset assessment guide calculations by DoE (Malleefowl – high and very high potential habitat)

Offset assessment guide attribute	Proposed offset Property
Impact Calculator - Quantum of impact - Area	3,143 hectares
Impact Calculator - Quantum of impact – Quality	7
Offset calculator – Time horizon –Risk related time horizon	20 years
Offset calculator – Time horizon – Time until ecological benefit	10 years
Offset calculator - Future area and quality without offset – Risk of loss without offset	20%
Offset calculator - Future area and quality with offset – Risk of loss with offset	1%
Confidence in result – averted loss of offset	80%
Offset calculator –Start quality	7
Offset calculator - Future quality without offset (1-10)	6
Offset calculator - Future area and quality with offset – Future quality with offset (1- 10)	8
Confidence in result – change in quality	60%
Minimum (90%) requirement	9,387 hectares
100% offset requirement	10,430 hectares

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