

Appendix 9



Flora & Fauna Assessment



FLORA AND FAUNA ASSESSMENT

Northparkes Mines Step Change Project

July 2013



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Prepared by
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on behalf of
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Executive Summary

Northparkes Mines (NPM) is a copper-gold mine located approximately 27 kilometres north-west of Parkes in central New South Wales. NPM currently operates under PA06_0026 issued in February 2007 by the NSW Department of Planning pursuant to Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). PA06_0026 allows for the continuation of existing operations as well as the E48 block cave extension. NPM was granted a modification to PA06_0026 in October 2009. The modification to PA06_0026 allows for the construction of an additional Tailings Storage Facility (TSF), a mine and mill upgrade to increase production to 8.5 million tonnes per annum (Mtpa) and an extension to the mine life until 2025. NPM are seeking approval for the Step Change Project (the Project) which encompasses the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases and an extended mine life of 7 years until 2032.

The Project is a State significant development under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as coal mining is listed in Schedule 1 of the NSW State Environmental Planning Policy (State and Regional Development) 2011. As a State significant development, the Project will be assessed under the provisions of the former Part 3A of the EP&A Act. This document provides an ecological assessment for the Project and forms part of the Environmental Impact Statement that will accompany the Development Application for the Project.

Project Area

The NPM landholdings comprise approximately 6400 hectares which encompass the existing NPM site as well as agricultural landholdings within the adjacent areas. The NPM landholdings include areas of active mining operations which cover an area of approximately 1150 hectares of the remaining NPM landholdings adjacent to the NPM site is owned and managed by NPM. NPM farms large areas of these landholdings with cropping for wheat and canola being the most common agricultural land uses.

The surrounding locality and region consists of mostly cleared agricultural land with patches of remnant vegetation associated with State Forests. The Limestone State Forest is located within the Project Area and is currently managed by NPM in consultation with Forests NSW in accordance with land swap and management agreements developed as part of the E48 Project.

Prior to the beginning of mining in 1993, the Project Area was dominated by cropping land with scattered and fragmented patches of remnant woodland.

Methods

A detailed ecological survey methodology was designed and executed in order to gain a thorough understanding of the ecological features of the Project Area and surrounds. The methods included a review of relevant literature, reports and vegetation mapping, as well as searches of relevant ecological databases. Information gathered from the literature reviews and database searches was then used to design the ecological surveys to target threatened species, endangered populations, threatened ecological communities and their habitats.

A large amount of ecological studies had already been undertaken within the Project Area since 1997 and included ecological impact assessments, pre-clearance surveys and annual biodiversity offset monitoring.

Detailed ecological surveys were conducted across the Wider Study Area (including the proposed disturbance area) during all four seasons throughout 2011 and 2012. Flora field surveys were carried out in July and September 2011 and January, February and May 2012. In total, 56 vegetation survey quadrats, 79 semi-quantitative rapid assessments, 453 qualitative rapid assessments and approximately 151 kilometres of meander transects and field reconnaissance contributed to the ground-truthing of vegetation community boundaries, refinement of community descriptions, and providing a comprehensive understanding of the floristic features across the Wider Study Area.

General fauna surveys and species specific surveys were undertaken across the Wider Study Area (including the proposed disturbance area) in July and September 2011 and January, February and May 2012. Surveys included the use of trapping surveys, hair funnel sampling, spotlighting, call playback, Anabat echolocation call detection and analysis, reptile searches, amphibian searches, bird searches, koala searches and analysis of scats, scratches, tracks and characteristic calls. Targeted winter bird surveys for the regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*) were undertaken during July 2011.

Flora Results

A total of 277 species were recorded in the Wider Study Area during field surveys for the Project, of which 214 (77 per cent) were native and 61 (23 per cent) were introduced species. Surveys of the proposed disturbance area identified a total five native vegetation communities and four disturbed or non-vegetated communities.

The following two Threatened Ecological Communities (TECs) listed under the *Threatened Species Conservation Act 1995* (TSC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were identified in the Project Area:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grassland of South-eastern Australia (EEC – EPBC Act)/Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (EEC – TSC Act); and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC – EPBC Act)/White Box Yellow Box Blakely's Red Gum Woodland (EEC – TSC Act).

Pine donkey orchid (*Diuris tricolor*), which is listed as a vulnerable species under the TSC Act, was recorded within the Wider Study Area.

No endangered populations were recorded within the proposed disturbance area or Wider Study Area.

Fauna Results

A total of 141 fauna species were recorded in the Wider Study Area, comprising 12 frog species, 13 reptiles, 91 birds and 25 mammals. Seven (5 per cent) of these species were introduced species (birds and mammals).

A total of 15 fauna species listed as threatened under the TSC Act were recorded in the Wider Study Area, including one species, the swift parrot (*Lathamus discolor*), that is also listed under the EPBC Act. In addition, one migratory species as listed under the EPBC Act was recorded within the Wider Study Area.

Impacts

The Project will result in the removal of 37 hectares of native woodland communities, 15 hectares of derived native grassland communities and 25 hectares of plantation, 39 hectares of exotic grassland, 112 hectares of cultivated land and 11 hectares of disturbed land. Of these communities, two TECs will be impacted with the removal of:

- 23 hectares of Grey Box Grassy Woodland EEC (TSC and EPBC Act);
- 15 hectares of Grey Box Grassy Woodland - DNG EEC (TSC and EPBC Act); and
- 0.28 hectare of White Box – Yellow Box – Blakely's Red Gum Woodland EEC (TSC Act)/CEEC (EPBC Act).

The impact of the Project on these TEC's is not considered to be significant.

Potential habitat for the pine donkey orchid (*Diuris tricolor*) will be removed by the Project. Given the level of uncertainty surrounding the potential presence of this species within the proposed disturbance area and the fact that areas of potential habitat to be removed may support a local population, the removal of up to 37 hectares of suitable habitat may result in a potentially significant impact on the species by the Project (without consideration of mitigation and offsetting measures).

The Project is likely to impact known habitat of 15 threatened fauna species recorded in the Wider Study Area. Of those, one species, Sloanes froglet (*Crinia sloanei*) has potential habitat within the proposed disturbance area and may potentially be significantly impacted by the Project (without consideration of mitigation and offsetting measures).

Impact Mitigation Strategy

NPM has sought to avoid and minimise potential impacts on the ecological values of the proposed disturbance area throughout the Project planning process. This has included avoidance and minimisation of disturbance of key vegetation communities, particularly the White Box – Yellow Box – Blakely's Red Gum Woodland EEC and Grey Box Grassy Woodland EEC.

A range of management strategies will be used by NPM to limit impacts on native flora and fauna species in the Project Area and in adjacent habitats and these key impact mitigation strategies will be detailed in revision to relevant management strategies and plans. These revised strategies and plans include the Land Use Management Plan (LUMP) (NPM 2006) and Flora and Fauna Management Plan (FFMP) (NPM 2008), and will be expanded to include areas to be impacted by the Project.

Key impact mitigation strategies will include weed and feral animal control, general operation controls such as dust, noise, fugitive light and surface water, tree hollow replacement with nest boxes, salvage of ground habitat features (logs, boulders, etc) for the creation of habitat features in nearby areas, a comprehensive tree felling procedure to limit impacts on hollow-dependent threatened species and the establishment of an annual ecological monitoring program.

Following the completion of mining activities, the proposed disturbance area will be progressively rehabilitated to create areas of native vegetation (with open grassland areas) and for agricultural use.

Biodiversity Offset Strategy

Throughout the Project design phase, NPM have actively investigated a range of land based and other non-land based strategies that would effectively contribute to a Biodiversity Offset Strategy (BOS) for the Project. This process has included targeted searches and inspections of a range of properties that have the potential to contain target vegetation communities and habitat values required for the Project. In addition, NPM have consulted with the Lachlan CMA and Department of Lands to identify potential offset properties and also other regional biodiversity conservation programs being implemented in regard to the target vegetation communities and species.

NPM propose a comprehensive BOS to compensate for the likely residual impacts of the Project that could not be avoided or mitigated. The aim of the BOS is to maintain and enhance the biodiversity values of the region in the medium to long term. The proposed BOS comprises the establishment of the Kokoda Offset Site, a land based offset that provides for both the immediate protection and conservation of relevant ecological values impacted by the Project and also enhancement of these values through active re-establishment of EEC and threatened species habitat across the landholdings.

The Kokoda Offset Site provides conservation of, 106 hectares of Grey Box Grassy Woodland EEC (including 96 hectares of DNG that will be returned to woodland form), 2.2 hectares of White Box – Yellow Box – Blakely's Red Gum Woodland EEC/CEEC, known habitat areas for the grey-crowned babbler, little lorikeet and Eastern bentwing-bat, and potential habitat for a number of threatened fauna species. This represents an environmental gain and a net improvement in the conservation of these species in the region, and more broadly in the South Western Slopes bioregion.

Together, the Kokoda Offset Site and the proposed mitigation measures ensure that the residual ecological impacts of the Project are adequately mitigated, offset and counterbalanced.

Summary and Conclusion

Pre-mitigation, and prior to the implementation of the BOS, the Project will result in residual impacts on some TECs, threatened flora and fauna species, including a potentially significant impact on the pine donkey orchid (*Diuris tricolor*) and Sloane's froglet (*Crinia sloanei*). In order to reduce the residual impacts, where possible the Project was modified to reduce impacts on ecological communities and threatened species. An impact mitigation strategy and BOS are proposed to compensate for the residual impacts of the Project. Together, the proposed BOS and the proposed mitigation measures ensure that the residual ecological impacts of the Project are adequately mitigated, offset and counterbalanced.

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Abbreviations

API	Aerial Photograph Interpretation
BOM	Bureau of Meteorology
BOS	Biodiversity Offset Strategy
DBH	Diameter at Breast Height
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DEH	Department of Environment and Heritage
DEWHA	Department of Environment, Water, Heritage and the Arts
DFS	Distance From Source
DGRs	Director-General's Requirements
DLWC	Department of Land and Water Conservation
DP&I	Department of Planning and Infrastructure
DPI	Department of Primary Industries
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP	Endangered Population
EP&A	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	NSW <i>Fisheries Management Act 1994</i>
GIS	Geographical Information System
GPS	Geographic Positioning System
LFA	Landscape Function Analysis
LGA	Local Government Area
MIA	Mine Infrastructure Area
MNES	Matter of National Environmental Significance
NPM	Northparkes Mine
NPWS	National Parks and Wildlife Service
O/E	Observed/Expected
OEH	NSW Office of Environment and Heritage
ROTAP	Rare or Threatened Australian Plant
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community
the Project	Northparkes Mine Modification Project
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
TSR	Travelling Stock Reserve
Umwelt	Umwelt (Australia) Pty Limited

1.0 Introduction

Northparkes Mines (NPM) is a copper-gold mine located approximately 27 kilometres north-west of Parkes in central New South Wales (NSW) (refer to **Figure 1.1**). The NPM landholdings comprise approximately 6217 hectares, which encompass the existing NPM site as well as agricultural landholdings within the adjacent areas.

NPM is a joint venture between Rio Tinto (80 per cent), Sumitomo Metal Oceania Pty Ltd. (13.3 per cent) and Sumitomo Corporation (6.7 per cent). Mining operations at NPM commenced in 1993 following an extensive exploration program and the granting of the original development consent. Since that time, NPM has progressed with the development of open cut and underground mining operations, and associated infrastructure, in accordance with previously granted development consents. NPM currently employs over 700 full time equivalent staff, and has established a strong relationship with the local community.

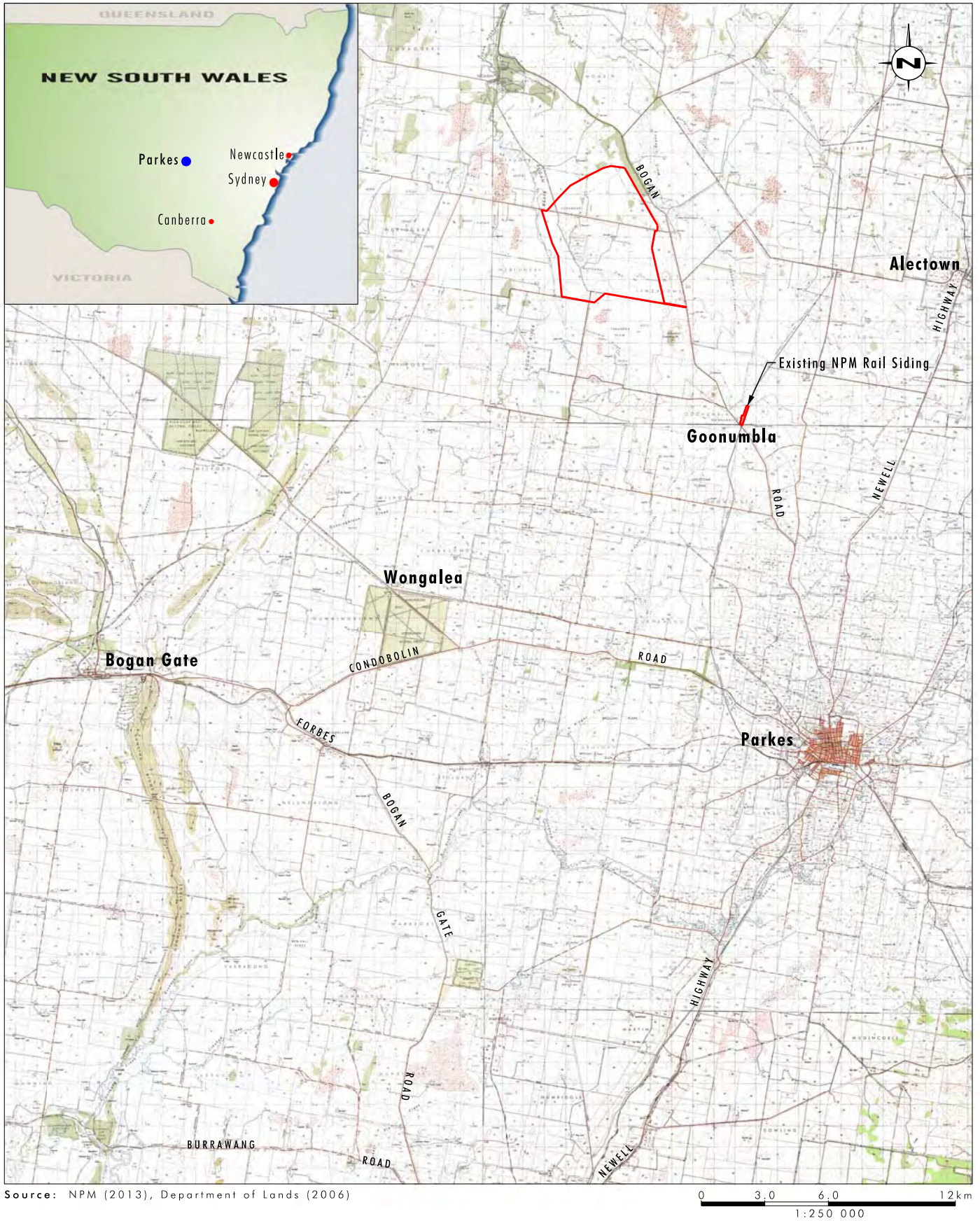
NPM currently operates under PA06_0026 issued in February 2007 by the NSW Department of Planning pursuant to Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). PA06_0026 allows for the continuation of existing operations as well as the E48 block cave extension. NPM was granted a modification to PA06_0026 in October 2009. The modification to PA06_0026 allows for the construction of an additional Tailings Storage Facility (TSF), a mine and mill upgrade to increase production to 8.5 million tonnes per annum (Mtpa) and an extension to the mine life until 2025. A second modification was carried out in 2009 to provide for the construction of a warehouse on site.

1.1 Project Overview

NPM is seeking approval for the Step Change Project (the Project) which encompasses the continuation of underground block cave mining in two existing ore bodies, the development of underground block cave mining in the E22 resource, additional campaign open cut mining located in existing mining leases and an extended mine life of 7 years until 2032.

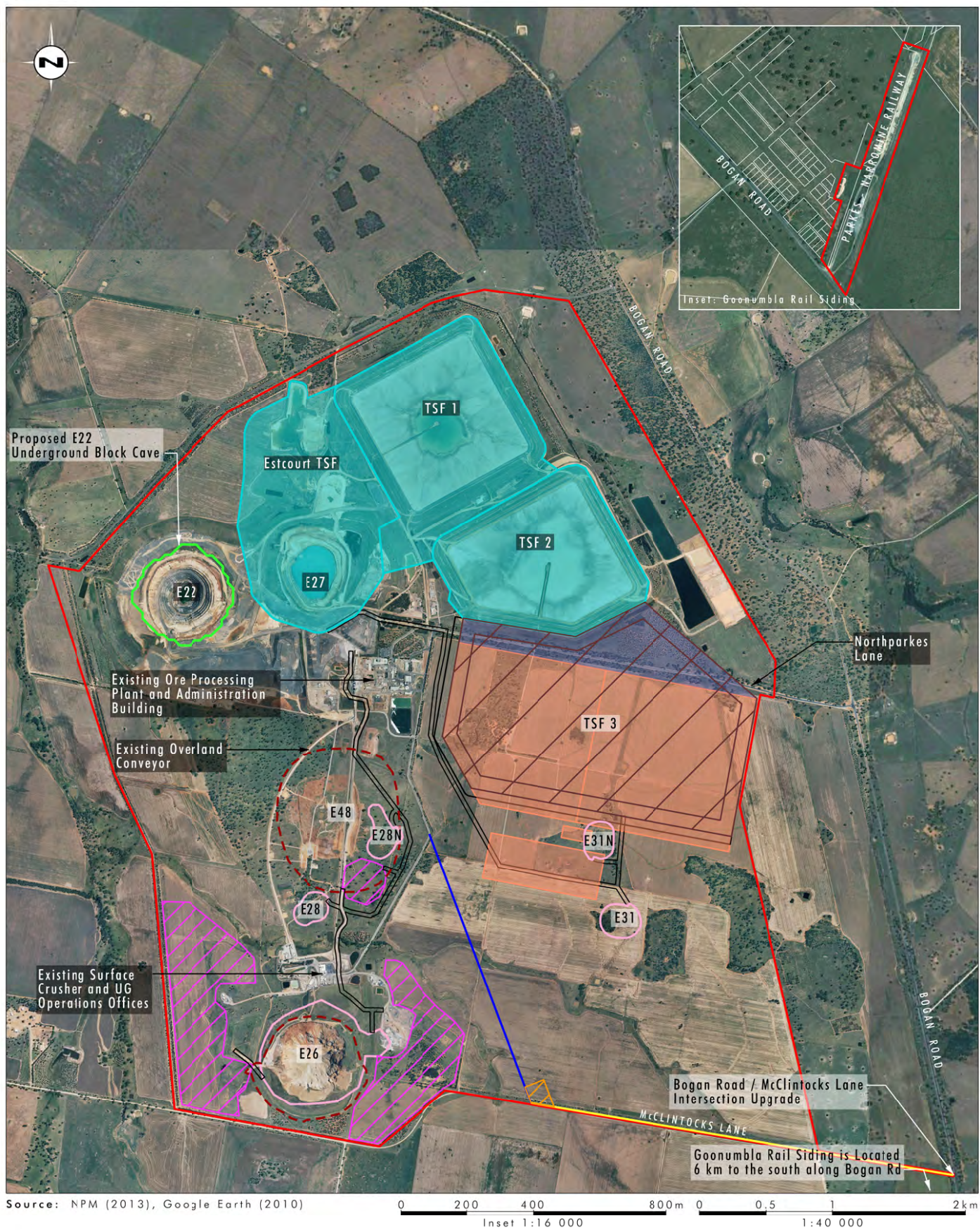
The Project Area is shown in **Figure 1.2** and consists of existing and proposed mining operations and associated infrastructure. **Figure 1.2** shows the major components of the Project which include:

- Continuation of approved underground block cave mining in the E48 and E26 ore bodies, and associated underground infrastructure.
- Development of underground block caving in the E22 resource beneath the E22 open cut void.
- Campaign open cut mining through development of five open cut resources including;
 - development of four small open cut pits E31, E31N, E28, E28N; and
 - proposed E26 open cut which is located in an area of previous underground block cave subsidence (existing vertical extent of subsidence void is approximately 200 metres).
- Amendments to the configuration of tailings storage facilities (TSFs) including:
 - continuation of tailings disposal to the existing and approved TSFs (TSF 1 and 2, infill between TSF 1 and 2, and Estcourt) to an approved height of 28 metres;



Legend
 Project Area

FIGURE 1.1
Locality Map



Legend

- Project Area
- Approved Tailings Storage Facility (Rosedale)
- Approved Subsidence Management Areas
- Existing Tailings Storage Facility
- Proposed Tailings Storage Facility Extension
- Proposed TSF3
- New Underground Block Cave Mining Area
- Proposed Open Cut Areas
- Proposed Upgrade to McClintocks Lane
- Proposed Access Control and Visitor Car Park
- Proposed Waste Dumps
- Proposed Site Access Road
- Proposed Haul Road

FIGURE 1.2

Northparkes Mines Step Change Project

- provision for additional raises on Estcourt TSF to provide for an increased height from the approved 25 metres to up to approximately 28 metres above ground surface; and
- development of a new TSF 3, which will extend to the south and from the southern embankment of TSF 2 to a height of approximately 28 metres above ground surface, which incorporates the approved Rosedale TSF.
- Development of new waste dumps for the management of E28/E28N and E26 open cut waste rock. Waste rock from E31 and E31N open cut mining areas will be utilised in the development of TSF 3.
- Continuation of approved ore processing infrastructure up to 8.5 Mtpa capacity, and road haulage of copper concentrate to the existing Goonumbra rail siding.
- Continued use of existing site infrastructure including administration buildings, workshop, internal access roads and service infrastructure.
- Continued use of surface mining infrastructure including ventilation shafts, hoisting shaft and ore conveyors.
- Continuation of existing approved water supply and management processes.
- Development of an amended access road to service all mine related traffic entering the site.
- Establishment of new visitor car parking facilities and access control to support the amended mine site access.
- Continuation of approved mining operations for an extended life of an additional 7 years until end of 2032.
- Rehabilitation and closure of the mine site will be carried out after the end of the operational life of the Project in accordance with relevant approvals.

1.1.1 The Project Area

The NPM landholdings comprise approximately 6400 hectares which encompass the existing NPM site as well as agricultural landholdings within the adjacent areas. The NPM landholdings include areas of active mining operations which cover an area of approximately 1150 hectares. The remaining NPM landholdings adjacent to the NPM site is owned and managed by NPM. NPM farms these large areas of these landholdings with cropping for wheat and canola being the most common agricultural land uses.

Initially, the scope of the Project was much larger and ecological surveys were undertaken across a broader area, referred to throughout this document as the Wider Study Area. The Project Area, which is encapsulated by the Wider Study Area, covers approximately 2644 hectares, of which approximately 2080 hectares has been disturbed previously through agricultural land uses and historical or currently approved mining activity. The proposed disturbance area relates to all land proposed to be disturbed during the Project (refer to **Figure 1.3**). The proposed disturbance area excludes the Active Operational Area, which consists of existing operational mining areas and other areas previously approved by the NSW Government for mining related purposes. The proposed disturbance area has a footprint of approximately 239 hectares. These NSW Government-approved areas are not approved by the Commonwealth Government and therefore are included within the area assessed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Referral Area) and discussed in **Section 5.2.7**.



Source: Project Area: NPM (2013), Cadastre: LPMA (2011), Aerial: Google Earth (2010)

0 1.0 2.5 5.0km
1:100 000

Legend

- Project Area
- Wider Study Area
- Existing and Approved Operations
- Project Disturbance Area
- EPBC Referral Area

FIGURE 1.3

Project Disturbance Area

The surrounding locality and region consists of mostly cleared agricultural land with patches of remnant vegetation associated with State Forests. The Limestone State Forest is located within the Project Area and is currently managed by NPM in consultation with Forests NSW in accordance with land swap and management agreements developed as part of existing approved operations.

The Project Area is located the catchments of the Bogan-Macquarie and Lachlan River Systems which are major tributaries of the Murray-Darling Basin System. The southern portion of the Project Area is located within the Lachlan River catchment area, however, there are no tributaries of the Lachlan River located within the Project Area. The Bogan River catchment forms part of the Bogan/Macquarie River catchment which flows north-west towards Nyngan. The surface water resources within and surrounding the Project Area are ephemeral and only flow after prolonged rainfall.

The Project Area is located on the edge of the inland slopes west of the Great Dividing Range. The existing NPM site is generally flat, with some low undulations, ranging in elevation from 280 mAHD to 300 mAHD. The area surrounding the NPM site is also generally flat with the most significant regional feature being Goonumbla Hill located approximately 4 kilometres south of the Project Area and which reaches a height of 386 mAHD (refer to **Figure 1.3**).

Existing mining activities have resulted in alterations to the natural topography of the NPM site. These changes consist primarily of alteration to topographical relief associated with the tailings storage facilities and waste rock stockpiles, and the creation of topographic lows by the open cut mines (E22) and by subsidence associated with E26 and E48 underground mines.

The closest townships to the Project Area are Peak Hill (approximately 25 kilometres north-east) and Parkes (approximately 27 kilometres south-east), although NPM has a more direct access to Parkes.

Land use mapping indicates that the area surrounding the NPM site consists of:

- agricultural lands (pastoral or cropping practices) which represented the majority of the area surrounding the NPM site and included land not currently mined as well as areas that support some areas of remnant vegetation; and
- rehabilitated land (revegetation works by NPM or native remnant vegetation) which occur in linear strips along roadways and fence lines as well as in blocks adjacent to remnant vegetation.

The existing land use within the Project Area has primarily supported mining activities since operational infrastructure commenced onsite in 1993. Since initial development, operations at the NPM site have expanded to include open cut and underground mining activities. Prior to the establishment of mining operations, the primary land use in the Project Area was characterised by a long history of agricultural land uses, with an emphasis on cultivation activities typical of the surrounding environment. As outlined previously, NPM currently farm the majority of the land within and surrounding the Project Area.

1.2 Objectives of Ecological Assessment

This ecological assessment has been prepared to assess the potential impact of the Project on native flora and fauna species, threatened and migratory species, endangered populations (EPs), threatened ecological communities (TECs) and their habitats occurring in the proposed disturbance area.

The objectives of the Ecological Assessment were to:

- identify the flora and fauna species previously recorded within the proposed disturbance area from existing studies undertaken for NPM, local studies and/or ecological databases;
- identify any threatened flora or fauna species, migratory fauna species, EPs, TECs, or their habitats within the proposed disturbance area, particularly those listed under the *NSW Threatened Species Conservation Act 1995* (TSC Act), *NSW Fisheries Management Act 1994* (FM Act), and the EPBC Act;
- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) in the proposed disturbance area and on lands adjoining the proposed disturbance area; and
- develop appropriate impact mitigation and management options to minimise ecological impacts associated with the proposed disturbance area.

This Ecological Assessment accompanies the broader EA prepared for the Project.

1.3 Relevant Legislation and Guidelines

The ecological assessment completed as part of this Project was prepared in accordance with the relevant Department of Planning and Infrastructure (DP&I) Director-General's Requirements (DGRs) for the Project, dated 11 March 2013, as detailed in **Table 1.1**.

Table 1.1 – Matters Specified in the Director-General's Requirements and Where they are Addressed in the Report

DGRs for Ecological Studies	Where Addressed in Report
The EA must address the following specific matters:	
Department of Planning and Infrastructure	
Key Issues	
Biodiversity – including:	
• measures taken to avoid, reduce or mitigate impacts on biodiversity;	Section 6.0
• accurate estimates of proposed vegetation clearing ;	Section 4.0
• a detailed assessment of potential impacts of the development on any: <ul style="list-style-type: none"> ▪ terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems; ▪ regionally significant remnant vegetation, or vegetation corridors; and 	Section 5.0
• if proposed, 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 7.0
Rehabilitation – including the proposed rehabilitation strategy for the site, having regard to the key principles in the Strategic Framework for Mine Closure, including:	
• rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria;	Sections 1.1.3 and 6.0
• nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and	Sections 1.1.3 and 6.0
• the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.	Section 6.0

The ecological survey and assessment completed as part of the Project was undertaken in accordance with Part 3A of the EP&A Act and the following legislation and licences, where relevant:

- TSC Act;
- FM Act;
- EPBC Act;
- National Parkes and Wildlife Service (NPWS) Scientific Research Licence;
- Animal Research Authority as provided by the NSW Department of Primary Industries; and
- NSW Department of Primary Industries Fishing Licence for Aquatic Surveys.

1.3.1 Relevant Guidelines, Frameworks and Policies

The ecological survey and assessment completed as part of the Project took into account the following guidelines, frameworks and policies:

Those specified in the Project DGRs:

- Department of Environment and Climate Change (DECC) and Department of Primary Industries (DPI) (2005). Draft Guidelines for Threatened Species Assessment (Part 3A), July 2005;
- NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002);
- Policy & Guidelines – Aquatic Habitat Management and Fish Conservation (NSW Fisheries DPI 1999); and
- Policy & Guidelines – Fish Friendly Waterway Crossings (NSW Fisheries DPI 2004).

Other relevant guidelines:

- DECC (2008a). Hygiene Protocol for the Control of Disease in Frogs;
- DECC (2008b). Principles for the Use of Biodiversity Offsets in NSW;
- Department of Environment, Climate Change and Water (DECCW) (2009a). BioBanking Assessment Methodology and Credit Calculator Operational Manual;
- NSW Office of Environment and Heritage (OEH) Interim Policy on Assessing and offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) Projects, June 2011;
- Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians (DECCW 2009b);
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft (DEC 2004);
- Threatened Species Assessment Guidelines: the Assessment of Significance (DECC 2007);

- Guidelines for Threatened Species Assessment (DoP 2005);
- Department of Environment, Water, Heritage and the Arts (DEWHA) Commonwealth EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance. October 2009;
- DPI (2008). Threatened Species Assessment Guidelines – The Assessment of Significance. February 2008;
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) EPBC Act Environmental Offsets Policy: October 2012;
- OEH (2012). Operational Manual for using the BioBanking Credit Calculator v2.0; and
- State Environmental Planning Policy No. 44 - Koala Habitat Protection.

1.4 Assessment Approach

This ecological assessment has been prepared to assess the potential impact of the Project on native flora and fauna species, threatened and migratory species, EPs, TECs and their habitats occurring in the proposed disturbance area. The process of undertaking an ecological assessment requires particular steps to identify the ecological features that require specific assessment, and to determine the level at which they are likely to be impacted. This is initially undertaken without consideration of any mitigation or offsetting measures, however the preliminary impact assessment informs Project design and, in this case, has led to the development of Project avoidance measures undertaken specifically to protect, or reduce impact on, ecological matters.

In particular, the Project design refinements resulted in a reduction of impacts on Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands EEC listed under the EPBC Act, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Grassland CEEC listed under the EPBC Act and the related TSC Act listed EEC known as, White Box Yellow Box Blakely's Red Gum Woodland (refer to **Section 5.1**).

Through the use of impact assessments under the EP&A Act and the EPBC Act, a decision was made as to whether or not species, populations or communities will be significantly impacted by the Project. The remainder of this report addresses each of these steps in detail. **Figure 1.4** provides a visual representation of this process.

During all steps the precautionary principle was applied to ensure that wherever there was uncertainty resulting from lack of data or knowledge, or uncertainty in the level or extent of impact, the most reasonable worst case was assumed. The application of the precautionary principle in the Project assessment is detailed in **Section 5.2.6**.

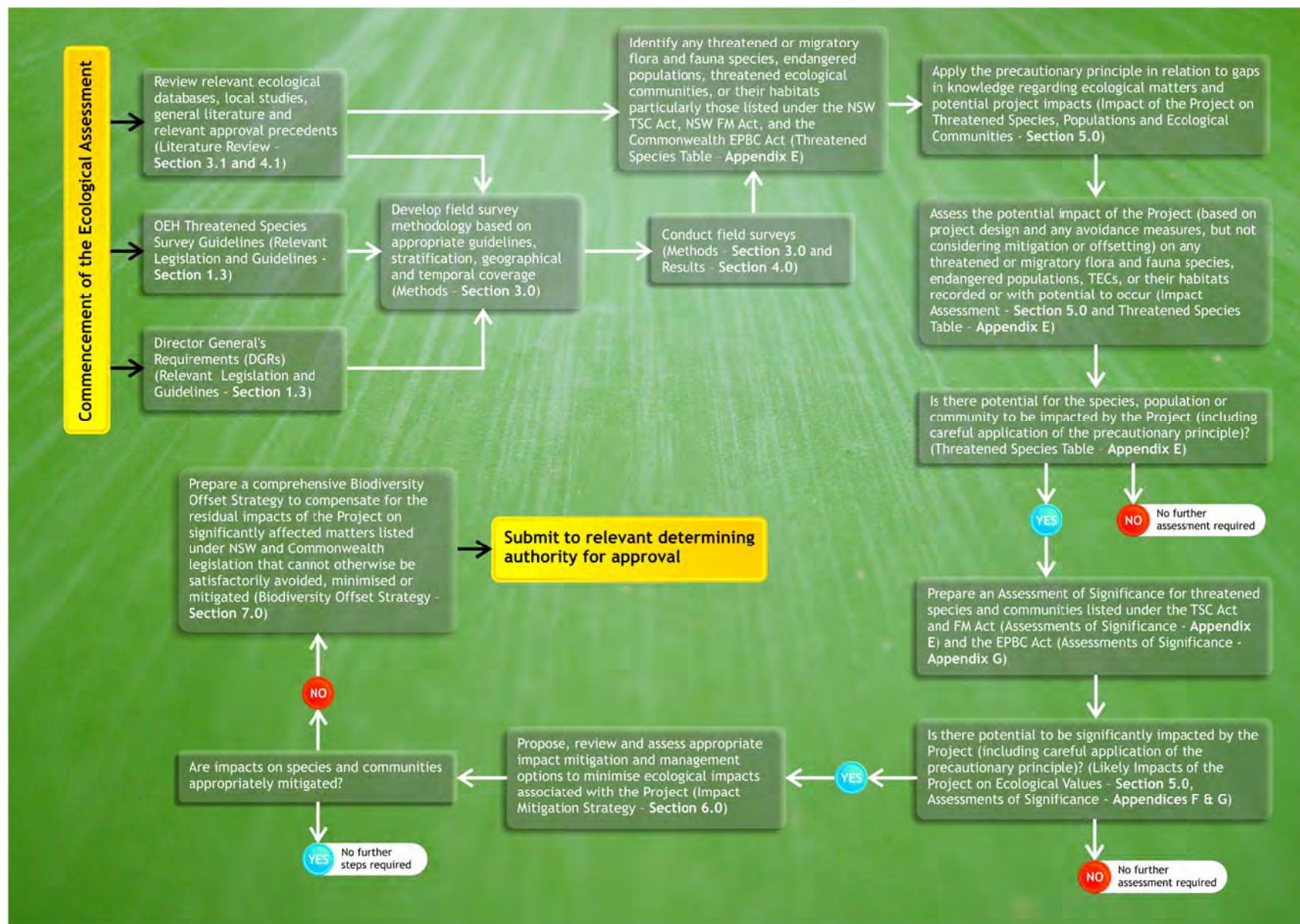


FIGURE 1.4

Approval Pathway

2.0 Regional Context

2.1 Bioregional Setting

The Project Area is located within the NSW South Western Slopes Biogeographic Region (Bioregion). Bioregions are 'relatively large areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems' (NPWS 2003). The Project Area is located in the northern part of the NSW South Western Slopes Bioregion (NPWS 2003).

The NSW South Western Slopes Bioregion comprises the lower inland slopes of the Great Dividing Range, with approximately 93 per cent (8,070,608 hectares) within NSW and the remaining 586,181 hectares within Victoria (NPWS 2003). It is characterised by a sub-humid climate, with a temperate climate occurring at higher elevations along the eastern boundary adjacent to the South Eastern Highlands Bioregion. The Project Area is within the Lower Slopes subregion which is characterised by undulating and hilly ranges and isolated peaks set in wide valleys at the apices of the Riverina alluvial flats. A diverse range of flora and fauna assemblages are likely to occur in the local area, with predominantly inland influences.

2.2 Physiography, Geology and Soils

The Project Area is located on the edge of the inland slopes to the west of the Great Dividing Range, and within the low lying flats country, between the Lachlan Valley to the south, and the Bogan Valley which flows to the north. To the west of the Project Area, the landscape rises onto the Cobar Peneplain. The Project Area is generally flat within some low undulations ranging from 280 mAHD to 300 mAHD. The Wider Study Area surrounding the Project Area is also generally flat with the most significant regional feature being Goonumbla Hill, which reaches a height of 386 mAHD, approximately 4 kilometres south of the Project Area.

Existing mining activities have resulted in alterations to the natural topography of parts of the Project. These have primarily consisted of changes in topographical relief from elevations associated with the tailings storage facilities and waste rock stockpiles, and the creation of topographic lows by the open cut mines (E22) and by subsidence associated with E26 and E48 underground mines.

2.2.1 Geology

The Project Area is situated within the Ordovician Goonumbla Volcanics of the Goonumbla Volcanic Complex (Simpson *et al.* 2000). The Goonumbla Volcanics form part of the Junee-Narromine Volcanic Belt of the Lachlan Orogen (Glen *et al.* 1998). Within the Project Area, the Goonumbla Volcanics are a folded sequence of trachyandesitic to trachytic volcanic and volcanoclastic sediments that are interpreted to have been deposited in a submarine environment.

In the region the Goonumbla Volcanics have been intruded by equigranular monzonite stocks. Quartz monzonite porphyry pipes and dykes, some of which are associated with mineralisation, have intruded both Goonumbla Volcanics and the equigranular monzonite stocks.

The NPM deposits are typical porphyry copper systems in that the mineralisation and alteration are zoned around quartz monzonite porphyries. The porphyries form narrow (typically less than 50 metres in diameter) but vertically extensive (greater than 1000 metres) pipes. Mineralisation extends from the porphyries into their host lithology. The E26 and E48 deposits range from 60 to 500 metres in diameter and extend vertically for more than 1300 metres.

2.2.2 Soils

Previous studies completed within the Project Area (Corkery 2006) have identified two dominant soil mapping units within the proposed disturbance area. Soil Mapping Unit 1 (SMU1) is associated with the crests and rocky outcrops of the Project Area and occurs to depths of over 80 centimetres with a firm to hard setting surface. The topsoil of SMU1 consists of loam, sandy clay loam or clay loam with a pH of 5 to 7. SMU1 is consistently dry and is usually hydrophobic. This soil type is less common in the proposed disturbance area than SMU2, generally occurring within areas of natural topographical elevations and where remnant vegetation is present.

Soil Mapping Unit 2 (SMU2) is associated with the lower slopes, level plains and shallow depressions in the proposed disturbance area and generally corresponds with the cultivated fields. SMU2 occurs to depths of approximately 280 centimetres with a firm to self-mulching surface which is sometimes loose, soft or hard setting. SMU2 consists of silty clay to heavy clay with a pH of 5 to 6. SMU2 is hydrophobic within some areas. SMU2 generally occurs within the areas utilised for farming practices and is the most widely distributed across the proposed disturbance area, and surrounding area.

SMU1 and SMU2 range from low to moderate erodibility. The topsoil of both soil mapping units is suitable for rehabilitation purposes. The 2009 Environmental Assessment (GHD 2009) identified that farming practices implemented by NPM such as site soil conservation works, conservation tillage practices, stubble retention and an absence of livestock grazing has helped to minimise erosion and has maintained the soils in a generally stable state across the Project Area and NPM managed lands.

2.3 Catchment Areas and Watercourses

The Project is located within the catchment of the Bogan River in the Bogan River Valley (DECCW 2010). In the vicinity of the Project Area, the headwaters of the Bogan River are ephemeral and exist as a series of pools and billabongs with variable connectivity (refer to **Figure 2.1**). Within the Project Area, the Bogan River is characterised by scattered billabongs between sections of slight grassy depressions in the landscape. Water flow is negligible unless heavy rainfall occurs.

The Bogan River begins in the Harvey Ranges between Parkes and Peak Hill and flows in a north-westerly direction to join the Darling River near Bourke. The headwaters of the Bogan River are located approximately 8 kilometres south of the Project Area boundary, where two unnamed first order streams merge to become a second order stream: the Bogan River. The southern portion of the Project Area drains into the Bogan River and Tenandra Creek which exists as a third order stream and flows from the south-eastern portion of the Project Area to join the Bogan River. Goonumbla Creek is contained within the Project Area and flows west where it joins the Bogan River, now a fourth order stream, in the south-west of the Project Area. Both Tenandra and Goonumbla creeks are ephemeral in nature and exist as a series of small pools and slight depressions within the landscape.



Source: Project Area: NPM (2013), Cadastre: LPMA (2011), Aerial: Google Earth (2010)

0 1.0 2.5 5.0km
1:100 000

Legend

- Project Area
- Wider Study Area
- Project Disturbance Area
- Drainage Line

FIGURE 2.1

Watercourses in the Wider Study Area

Cookopie Creek rises in the proximity of Goonumbra where two unnamed tributaries meet. This creek drains the land to the east of the Project Area and runs close to the eastern boundary. It is joined by a further two unnamed first and second order streams and continues north to be joined by Deception Creek and flows into the Bogan River to the north of the Project Area.

2.4 History of Land Use in the Project Area

A review of historical aerial photographs was undertaken to ascertain the historical land use of the Project Area and particularly the historical extent of native vegetation in the Project Area. Four sets of aerial photographs were obtained from the Department of Lands, with sets covering the Project Area in 1958, 1974, 1991, and 2005. These photograph sets were compared to the extent of native vegetation cover shown on the 2010 Google Earth satellite imagery of the Project Area. Overall the historic aerial photography showed that the Project Area has been dominated by farming practices since at least 1958 and that there have been only very minor changes in amount of woodland areas since 1958. Based on the known historical land use within the region, agriculture would have been a dominant land use since the mid 1800s.

The 1958 photograph (refer to **Figure 2.2**) shows that the majority of the Project Area was already being used for grazing and cropping, characteristic of current land use patterns in the Project Area. In 1958 the largest patch of woodland, approximately 70 to 80 hectares occurred to the north the Project Area and on the northern side of Adavale Lane. All other areas of woodland were highly scattered into small fragments or occurred along fence lines and/or roadsides. Some areas of scattered tree cover also occurred. During 1958 the area of woodland in the current day Limestone State Forest extended further to the north.

All of the woodland patches present within the current Project Area in 2013 were present in 1958 and indicate that such woodland patches are in excess of 55 years of age. Each of those woodland patches appear to contain large and presumable mature trees in 1958 and it is possible that the woodland patches are in excess of 75 years on age.

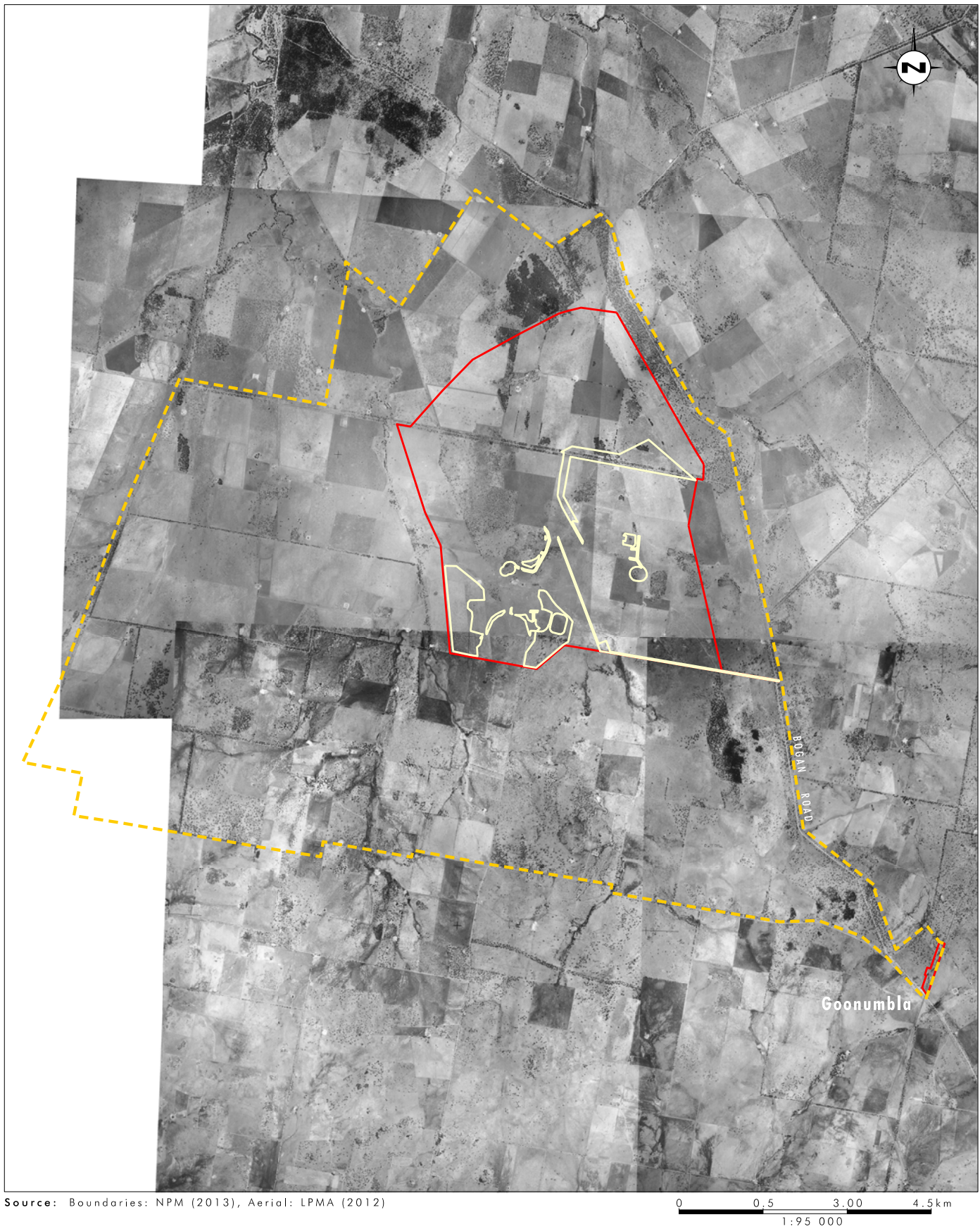
Prior to 1974 (refer to **Figure 2.3**) approximately two thirds of the 70 to 80 hectare woodland patch on the northern side of Adavale Lane had been cleared leaving a single approximately 15 hectare patch and smaller isolated patches. Otherwise there appears to be little difference in the land use patterns of the Project Area and surrounds from 1959 to 1974.

The 1991 photograph (refer to **Figure 2.4**) shows no observable difference from the 1974 photograph with land use patterns and vegetation cover appearing to remain unchanged within the Project Area.

By 2005, NPM had been in operation for 12 years resulting in considerable changes in land use in the area of the mine (refer to **Figure 2.5**). However surrounding land use patterns appear to have remained unchanged since the 1991 and earlier.

2.5 Project Area Land Use

Currently the Project Area is dominated by gold and copper mining activities and associated previous farmland areas. Non-active mining areas are managed for agriculture and are subject to dry land farming, predominately cropping.



Legend

- Project Area
- Wider Study Area
- Project Disturbance Area

FIGURE 2.2

1958 Aerial Photograph



Source: Boundaries: NPM (2013), Aerial: LPMA (2012)

0 0.5 3.00 4.5 km
1:95 000

Legend

- Project Area
- - - Wider Study Area
- Project Disturbance Area

FIGURE 2.3

1974 Aerial Photograph



Source: Boundaries: NPM (2013), Aerial: LPMA (2012)

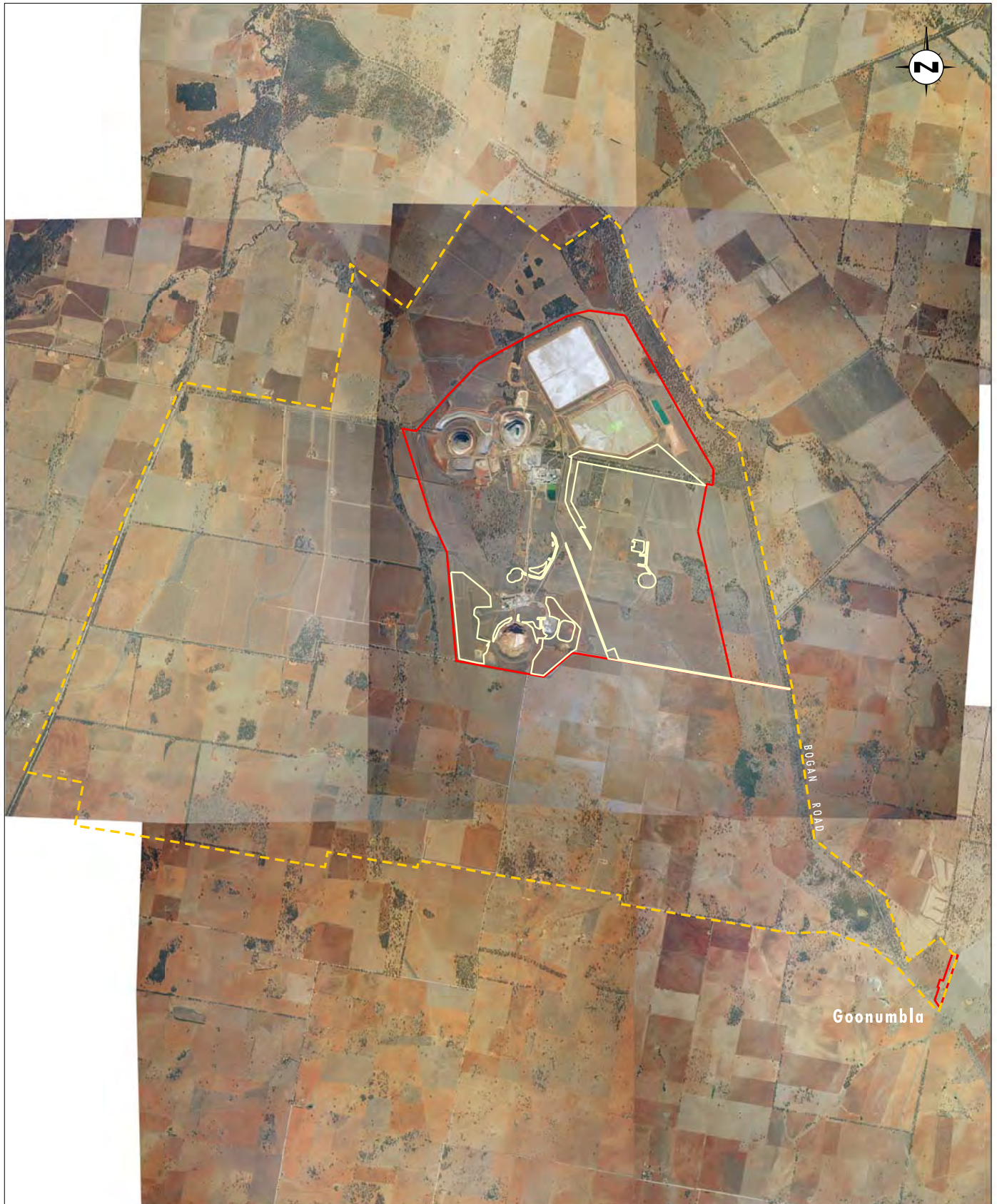
0 0.5 3.00 4.5 km
1:95 000

Legend

- Project Area
- Wider Study Area
- Project Disturbance Area

FIGURE 2.4

1990 Aerial Photograph



Source: Boundaries: NPM (2013), Aerial: LPMA (2012)

0 0.5 3.00 4.5 km
1:95 000

Legend

- Project Area
- Wider Study Area
- Project Disturbance Area

FIGURE 2.5

2005 Aerial Photograph

2.6 Surrounding Land Uses

The land use within the Wider Study Area and surrounds is dominated by agricultural cropping and broad acre grazing practices. The regional centre of Parkes is located approximately 27 kilometres to the south-east of the Project Area while the township of Peak Hill is located approximately 24 kilometres to the north-east of the Project Area, and the township of Trundle is located approximately 32 kilometres to the west.

2.7 Conservation Areas

The regional conservation areas located in the area surrounding the Project Area are shown on **Figure 2.6**. Goobang National Park occurs approximately 30 kilometres to the east of the Project Area and represents the largest area of remnant woodland and forest vegetation in the surrounding region (refer to **Figure 2.6**). This national park comprises 42,080 hectares of native vegetation and offers a wide range of habitats in undulating and hilly country (OEH 2013). While the Project Area occurs in predominately flat farmland, Goobang National Park is dominated by hilly ridgelines that extend from Manildra in the south to just west of Tomingley, approximately 62 kilometres to the north.

Other woodland reserves within the area surrounding the Project Area include Blow Clear West State Forest, which covers an area of around 1582 hectares and is located approximately 18 kilometres south-west of the Project Area (refer to **Figure 2.6**). Coradgery State Forest covers an area of around 830 hectares and is located approximately 14 kilometres north-west of the Project Area (refer to **Figure 2.6**). Wombin State Forest covers an area of around 424 hectares and is located approximately 5 kilometres north-west of the Project Area (refer to **Figure 2.6**). All of these state forests represent islands of woodland habitat within a predominantly treeless agricultural landscape.

Other reserves within a 50 kilometre radius of the centre of the Project Area include:

- Strahorn State Forest (approximately 2090 hectares);
- Trundle State Forest (approximately 430 hectares);
- East Cookeys Plains State Forest (approximately 2414 hectares);
- West Cookeys Plains State Forest (approximately 549 hectares);
- Gunningbland State Forest (approximately 1040 hectares);
- Monumea Gap State Forest (approximately 333 hectares);
- Back Yamma State Forest (approximately 4656 hectares); and
- Cookamidgera State Forest (approximately 533 hectares).

All of these state forests represent islands of woodland habitat within a predominantly treeless agricultural landscape. Back Yamma, Cookamidgera, Monumea Gap and West Cookeys Plains state forests are situated on undulating to hilly country, while Strahorn, Trundle, East Cookeys Plains and Gunningbland state forests occur on flatter country.

While not created for conservation purposes, the state forests surrounding the Project Area act as pseudo-reserves, providing a level of protection to 14,051 hectares of woodland and grassland comprising these areas (refer to **Figure 2.6**).



Source: Google Earth (2012), NPM (2011), Department of Lands (2011)

0 5 10 20 km
1:400 000

Legend

- Project Boundary
- Wider Study Area
- Project Disturbance Area
- National Parks and Nature Reserves
- State Forest
- Travelling Stock Reserves
- NPM Estcourt Existing Offset Area

FIGURE 2.6

Regional Conservation Areas

In addition to these reserves, Travelling Stock Reserves (TSRs) that occur along the roads of the region provide additional areas of tree cover and potential connectivity between remnant vegetation within the region. One TSR passes the eastern boundary of the Project Area and provides potential connectivity to the north and south of the Project Area. Other TSRs within the region provide levels of potential connectivity to the west and south-west of the Project Area (refer to **Figure 2.6**).

2.8 Regional Biodiversity Corridors

Within the South Western Slopes Bioregion, conservation tenures occupy about 184,739 hectares or 2.28 per cent of the bioregion (NPWS 2003). No formal biodiversity corridors are known to have been mapped across the Project Area or in the surrounding area. Much of the land surrounding the Project Area has undergone substantial modification since European arrival through agricultural land use and limited remnant native vegetation occurs in isolated patches throughout the region. Goobang National Park to the east of the Project Area provides the only substantial corridor system in the region and provides movement paths to the north and south. TSRs provide limited potential connectivity within the landscape (refer to **Figure 2.7**), with the TSR occurring directly to the east of the Project Area providing a potential link between habitats to the north and the south of the Project Area.

Any connection provided by TSRs in the region is likely to be important for the movement of fauna species within the landscape, providing some level of connection between large contiguous remnants required by some fauna species. In the landscape surrounding the Project Area, which has undergone extensive clearing and modification, habitat retained within some TSRs may potentially provide the only corridor link between remaining woodland remnants.

2.9 Vegetation Types and Plant Species of the Region

The areas surrounding the Project Area are predominantly composed of exotic croplands and native and exotic pastures derived from the clearing of woodlands and forests. Patches of remnant vegetation occur in isolated pockets within the landscape (DECCW 2010).

The vegetation communities mapped in the Project Area are consistent with the vegetation community descriptions described by Benson (2010) who mapped the vegetation of the NSW South-western Slopes bioregion (Benson 2010). Benson mapped the entire bioregion and identified that 80 per cent of the native vegetation had been cleared making it the most cleared and fragmented of the bioregions in NSW. Most of the remaining native vegetation within the bioregion has been extensively grazed which has negatively impacted on species diversity and vegetation community structure.

The largest native vegetation remnants occur on the low nutrient ridges and ranges and along the road verges and TSRs.

The Project Area and surrounds represent a similar situation, with road verges and TSRs containing high quality remnant native grassy woodland communities which would have once covered the nutrient rich lower slopes and plains. The steeper slopes and rocky ridges are less affected by cropping or grazing but often the vegetation communities growing in these locations are dominated by one or two canopy species (usually white cypress pine (*Callitris glaucophylla*) or mugga ironbark (*Eucalyptus sideroxylon*)) and contain relatively low species richness and structural diversity.



Source: Google Earth (2012), NPM (2011), Department of Lands (2011)

0 5 10 20 km
1:400 000

Legend

- Project Boundary
- Wider Study Area
- Project Disturbance Area
- National Parks and Nature Reserves
- State Forest
- Travelling Stock Reserves
- Likely Fauna Movement Corridor
- Possible Fauna Movement Paths

FIGURE 2.7

Potential Fauna Movement Corridors

2.10 Fauna Habitats and Species of the Region

The broad fauna habitat types of grassland, riparian, woodland and aquatic habitat found within the Project Area and Wider Study Area are representative of the broad habitat types occurring within the Lower Slopes subregion of the Central West Slopes Bioregion. The majority of habitats in the region have been extensively cleared or modified for agriculture, largely for cropping and sheep grazing. Because of the widespread clearing of habitats in the region, those remaining contain important refuges for a number of fauna species, many of which are now threatened due to habitat loss and fragmentation.

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

Alluvial woodlands within the region provide relatively larger sizes of trees than other woodland types of the area. River red gums (*Eucalyptus camaldulensis*), supported by the alluvial soils, often also provide larger-sized hollows than those found on surrounding, drier slopes and ridges. The alluvial sites also provide ephemeral standing and moving water, with small wetlands and farm dams occurring in some areas. Aquatic habitat provided by farm dams is common across the landscape surrounding the Project Area, and the Bogan River is located adjacent to the western edge of the Project Area.

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

2.11 Climate

The climate of the South-western Slopes is described as sub-humid, characterised by hot summers and no dry season. The Bureau of Meteorology (BOM) operates a meteorological station at Peak Hill Post Office (approximately 24 kilometres from the Project Area), which provides long term climatic data that is indicative of the climatic conditions in the vicinity of the Project Area (refer to **Table 2.1**). January is the warmest month, reaching an average maximum daily temperature of 33.1 degrees. July is the coolest month, with the mean maximum temperature of 15.2 degrees (BOM 2012). Rainfall is summer dominant, often occurring as short duration high intensity storms. The annual average rainfall for Peak Hill is 562.9 millimetres, occurring over an average of approximately 59 rain days each year (BOM 2012).

Table 2.1 – Monthly Average Climatic Data (from 1968 to 2012) for the Nearby Peak Hill Post Office Meteorological Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (°C)	33.1	32.4	29.3	25.0	20.0	16.2	15.2	17.0	20.5	24.6	28.1	31.2
Mean minimum temperature (°C)	19.2	19.3	16.3	12.2	8.8	6.1	4.8	5.8	7.9	11.5	14.4	17.2
Mean rainfall (mm)	58.8	51.7	49.4	42.0	44.9	42.5	44.5	43.2	38.6	48.7	47.8	50.7
Mean number of days of rain ≥ 1 mm	4.5	4.3	4.0	3.8	4.9	5.9	5.9	5.7	5.1	5.5	4.7	4.5

Mean average monthly wind speed ranges between 4.3 and 8.7 kilometres per hour at 9.00 am and between 6.1 and 9.2 kilometres per hour at 3.00 pm.

3.0 Methods

A detailed survey methodology was designed to gain a thorough understanding of the ecological features of the proposed disturbance area. As part of the Project development process, a Wider Study Area was sampled during flora and fauna surveys prior to the refinement of Project details (refer to **Figure 1.3**). Surveys of the Wider Study Area, which included the entirety of the proposed disturbance area, were undertaken during winter 2011, spring 2011, summer 2011/12 and autumn 2012. The Wider Study Area extended beyond the Project Area to provide context for threatened species, endangered populations (EPs), threatened ecological communities (TECs) and migratory species in the vicinity of the proposed disturbance area. All habitat types present within the proposed disturbance area were sampled across the wider study area and informed the understanding of the habitat types present within the proposed disturbance area. This provided a detailed understanding of the flora and fauna of the smaller proposed disturbance area.

The methods included a detailed review of relevant literature, reports and vegetation mapping, as well as searches of relevant ecological databases. Information gathered from the literature reviews and database searches was then used to design ecological surveys that were commensurate with the biology/ecology of the species or communities that were considered to have the potential to occur in the proposed disturbance area. Detailed field surveys were then undertaken within the Wider Study Area as described in **Section 3.3**.

3.1 Literature Review

The following documents were reviewed to source information on threatened species, migratory species, EPs and TECs previously recorded or likely to occur within the proposed disturbance area:

- Sinclair G, McMullen A & Peters R (1997). A case study of bird mortality and cyanide management at Northparkes.
- North Mining Limited (2006). Management Plan – Site Wide – Land use.
- R. W. Corkery & Co. Pty. Limited. (2006). Environmental Assessment: Northparkes Mine – E48 Project.
- GHD (2007). Pre Clearing Survey.
- North Mining Limited (2008). Management Plan – Site Wide – Flora and Fauna.
- GHD (2008). Anna's Island – Pre Clearing Survey.
- GHD (2009a). North Mining Limited – Northparkes Mines Section 75W Environmental Assessment.
- GHD (2009b). North Mining Limited – Northparkes Mines Section 75W Modification – Biodiversity Offset Strategy.
- GHD (2009c). Northparkes Mines Water Pipeline Removal of Two Additional Trees.
- GHD (2009d). E22 Waste Dump (W4) Extension – Pre-clearing and Clearing Survey.
- DnA Environmental (2010a). Draft 2010 Estcourt Offset Area Monitoring Report.

- DnA Environmental (2010b). Draft 2010 Rehabilitation Monitoring Report.
- GHD (2010a). Vegetation Management Plan 2010.
- GHD (2010b). Northparkes Mines Vegetation Mapping Project – Vegetation Communities, Land Use and Conservation Significance.
- Benson, J. S., Richards, P. G., Waller, S. And Allen, C. B. (2010). New South Wales Vegetation Classification and Assessment: Part 3 Plant Communities of the NSW Brigalow Belt south, Nandewar and West New England Bioregions and Update of NSW Western Plains and South-western Slopes Plant Communities, Version 3 of the NSWVCA Database.
- Eco Logical Australia (2011). Estcourt Tailings Storage Facility – Pre-clearing and Clearing Surveys.

The results of the literature review are presented in **Section 4.1**.

3.2 Ecological Database Searches

In order to identify threatened species, migratory species, EPs and TECs with the potential to occur in the proposed disturbance area relevant ecological databases were searched.

The databases searched were:

- a 20 kilometre radius search from the boundary of the Project Area on the OEH Atlas of NSW Wildlife (March 2013);
- a 20 kilometre radius search from the boundary of the Project Area of the DSEWPC Protected Matters Database (March 2013);
- a 20 kilometre radius search from the boundary of the Project Area of the BirdLife Atlas of NSW Wildlife (May 2012);
- DPI Threatened & Protected Species Records Viewer search within the Forbes, Lachlan and Parkes Local Government Areas (LGAs) (March 2013); and
- a 20 kilometre radius search from the centre of the Project Area of the PlantNET (Royal Botanic Gardens Sydney) database (March 2013).

Records from these database searches were combined with records derived through literature reviews and professional opinion to identify the range of potentially occurring threatened species, migratory species, EPs and TECs. The identification of potentially occurring threatened species, migratory species, EPs and TECs was then used to assist in the development of appropriate survey methods. The results of the database searches are presented in **Section 4.2**.

3.3 Flora Survey Methods

Vegetation survey and mapping was carried out across the Wider Study Area as well as the proposed disturbance area. In particular, vegetation surveys aimed to identify threatened species, EPs, TECs and species of local or regional significance present or potentially occurring within the proposed disturbance area. The steps involved in the vegetation survey included:

- aerial photograph interpretation (API);
- field survey site selection using stratification;
- field survey and associated plant identification; and
- vegetation community description and delineation.

The following sections provide details on each step in the methodology.

3.3.1 Aerial Photograph Interpretation

Aerial photographs of the proposed disturbance area and Wider Study Area were viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment and vegetation community mapping in the proposed disturbance area. Aerial photography of the proposed disturbance area and Wider Study Area was sourced from NPM and dated 2012. Other areas within the Wider Study Area which were not covered by the NPM supplied aerial photograph were viewed using Google Earth dated 2010.

The Manifold System 8.0 Enterprise Edition geographic information system (GIS) was used to view these aerial photos on-screen, using a 32 bit mode. Use of GIS allowed zooming to a relatively large scale. Using this method, mapping was carried out at a scale of approximately 1:10,000, since at higher magnification than this the gain in scale was outweighed by the loss of resolution.

3.3.2 Field Survey Site Selection and Stratification of the Project Area

Systematic survey sites were selected by considering a range of bio-physical attributes that were likely to influence or determine the type of vegetation communities present. Reference was made to the relevant OEH flora survey guidelines (DEC 2004) when designing the field survey, with appropriate survey methods selected that maximised the opportunities of identifying the full suite of flora species (and vegetation communities) that could occur within the proposed disturbance area. This stratification was done intuitively, but also based on existing topographic, soil, vegetation and geological mapping. Other factors considered included the spatial coverage of sites across the overall proposed disturbance area and Wider Study Area, as well as topographic position and aspect.

3.3.3 Flora Field Survey

Flora field surveys were carried out within the proposed disturbance area and Wider Study Area in winter and spring 2011, and in summer and autumn 2012. Survey methods included:

- Standard plot (quadrat) sampling: semi-quantitative sampling in 400 m² sites (20 x 20 metres) within distinctive vegetation units. Additional plot sampling in 1000 m² sites (20 x 50 metres) was undertaken in certain vegetation units to ascertain if they conformed to EPBC Act TEC determinations.
- BioBanking plots/transects: additional biometric data were collected at each standard flora plot.
- Semi-quantitative rapid assessment points in approximately 10 x 10 metre sites.
- Qualitative rapid assessment points.
- Meandering transects comprising non-quantitative sampling along transects through vegetation units.
- Field reconnaissance comprising the identification of spatial arrangement of the vegetation across the proposed disturbance area and Wider Study Area.

The above methods are described in the following sections.

3.3.3.1 Quadrat Sampling

Quadrat sampling of flora was undertaken using methods that are relatively standard in most NSW government vegetation management agencies and elsewhere. This ensured that data collected by other relevant surveys could be compared to the current survey results, and that the data from the Project could be analysed in an equivalent way to that collected by other recognised studies.

Systematic 0.04 hectare plots were used to undertake semi-quantitative sampling of vegetation. The typical dimensions of the plots were 20 metres by 20 metres.

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

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

Plot-based sampling was carried out systematically to provide representative sampling of a range of attributes that occur in the proposed disturbance area and Wider Study Area, and that influence or determine the presence of different flora species and vegetation associations.

The location of each plot was recorded using hand held geographic positioning systems (GPS). The location of vegetation plots completed within the proposed disturbance area and Wider Study Area is provided on **Figure 3.1** and **Figure 3.1A**.



Source: Project Area: NPM (2013), Cadastre: LPMA (2011), Aerial: Google Earth (2010)

Note: Some rapid assessment points are out of view at the scale of this image.

Quadrats not labelled on this figure are labelled on Figure 3.1A

0 1.0 2.5 5.0km
1:100 000

Legend

- Project Area
- Wider Study Area
- Project Disturbance Area
- Autumn 2012 Walking Transects
- - Autumn 2012 Driving Transects
- Spring 2011 Walking Transects and Targeted *Diuris tricolor* Survey
- - Spring 2011 Driving Transects
- Summer 2011-2012 Walking Transects
- - Summer 2011-2012 Driving Transects
- Autumn 2012 Floristic Quadrats
- Spring 2011 Floristic Quadrats
- Summer 2011-2012 Floristic Quadrats
- Winter 2011 Rapid Assessment Points (Qualitative)
- Spring 2011 Rapid Assessment Points (Qualitative)
- Summer 2011-2012 Rapid Assessment Points (Quantitative)

FIGURE 3.1

2011/12 Flora Survey Effort



Legend

- Project Area
- Wider Study Area
- Project Disturbance Area
- Autumn 2012 Walking Transects
- Autumn 2012 Driving Transects
- Spring 2011 Walking Transects and Targeted *Diuris tricolor* Survey
- Spring 2011 Driving Transects
- Summer 2011-2012 Walking Transects
- Summer 2011-2012 Driving Transects
- Autumn 2012 Quadrat
- Spring 2011 Quadrat
- Summer 2011-2012 Quadrat
- Spring 2011 Rapid Assessment (Qualitative)
- Winter 2011 Rapid Assessment (Qualitative)
- Summer 2011-2012 Rapid Assessment Points (Quantitative)

FIGURE 3.1A

2011/12 Flora Survey Effort

At each plot, about 45 to 60 minutes were spent searching for all vascular flora species present within the 0.04 hectare quadrat area. These were recorded on a standard proforma with a cover-abundance value to reflect their percentage cover in the plot. A modified Braun-Blanquet 6-point scale was used to estimate cover-abundances of all plant species within each plot (Braun-Blanquet 1927), with selected modifications sourced from Poore (1955) and Austin *et al.* (2000). **Table 3.1** shows the cover-abundance categories used. Additional searches (meandering transects) were also carried out to identify additional species located outside of the plot and within the vegetation unit being sampled. These were recorded without a cover-abundance value.

Table 3.1 – Modified Braun-Blanquet Crown Cover-abundance Scale

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

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

Additional details were also recorded in each plot, including soil texture, drainage and depth; site disturbances; slope and aspect; physiography (position in the landscape); and vegetation structure (strata percentage covers, heights and dominant species). Photographic records were also taken at each site.

Vegetation communities identified were compared to TECs listed under the TSC Act and EPBC Act. The following approach was employed to determine if any vegetation communities conformed to any TEC determinations:

- assessment using quadrat sizes required by EPBC Act Policy Statements, EPBC Act Listing Advice, EPBC Act Conservation Advice; as well as TSC Act Final Determinations and Community Profiles (see **Section 3.3.7.1**);
- comparison with published species lists, including lists of 'important species', for listed TECs (see **Section 3.3.7.1**);
- comparison with published native understorey plant densities for listed TECs (see **Section 3.3.7.1**);
- comparison with habitat descriptions and distributions for listed TECs;
- assessment of relevant guidelines published by the Commonwealth DSEWPC and NSW OEH;

- comparison with other assessments of TECs in the region; and
- comparison against determinations, guidelines, listing advice, recovery plans and conservation advice provided for each TEC, particularly those from the NSW Scientific Committee and the Commonwealth Threatened Species Scientific Committee.

3.3.3.2 Rapid Assessments Points

Two types of rapid assessments were undertaken. Semi-quantitative rapid assessments points of approximately 10 x 10 metres were carried out to maximise information about the vegetation in the proposed disturbance area and Wider Study Area within the limitations of time and resources available. Approximately 10 to 15 minutes was spent searching for vascular plants occurring at each rapid assessment point. Each species was given one of four abundance ratings and included:

- Abundance rating 1 = one/few individuals.
- Abundance rating 2 = uncommon.
- Abundance rating 3 = common.
- Abundance rating 4 = abundant.

Details on vegetation structure were also recorded and included for each stratum height, per cent foliage cover and dominant species.

The second type of rapid assessment undertaken was qualitative rapid assessment points. At each of these the dominant overstorey species were recorded as well as notes on the dominant understorey species present. Generally 5 minutes or less was spent at each point, allowing large areas to be covered.

Both types of rapid assessment points were used as ways of accurately documenting the vegetation characteristics of large areas, which were later transferred into a GIS to aid vegetation community mapping and description.

3.3.3.3 Meandering Transects

Meandering transects were walked through vegetation units across much of the proposed disturbance area and Wider Study Area (refer to **Figure 3.1**). Additional sampling of vegetation was undertaken along these transects, particularly searches for threatened and otherwise significant species, EPs and TECs. Meandering transects enable floristic sampling across a much larger area than systematic plots, especially where the number of plots is limited. Records along transects supplemented floristic sampling carried out in plots, however, the data is collected in the form of presence records, rather than semi-quantitative cover abundance scores.

Meandering transects targeted specific vegetation units and provided information on spatial patterns of vegetation that fed into vegetation community mapping for the proposed disturbance area.

3.3.3.4 Field Reconnaissance

Field reconnaissance was carried out during all field surveys and while travelling throughout the proposed disturbance area and Wider Study Area. Field reconnaissance contributed to the ground-truthing of vegetation community boundaries, refinement of community descriptions, and providing a more comprehensive understanding of the floristic features across the proposed disturbance area and Wider Study Area.

3.3.3.5 Field Survey Effort and Timing

The vegetation of the proposed disturbance area and Wider Study Area was surveyed across all four seasons, winter, spring, summer and autumn.

Table 3.2 provides details on the timing of flora survey completed in the proposed disturbance area and Wider Study Area. All surveys were completed by two ecologists.

Table 3.2 – Flora Survey Timing

Season	Survey Methods	Survey Area	Dates	Person Days of Survey
Winter	Rapid vegetation surveys.	Proposed Disturbance Area and Wider Study Area	27 and 28 July 2011	4
Spring	Rapid vegetation surveys, systematic plot-based surveys and targeted threatened flora searches.	Proposed Disturbance Area and Wider Study Area	26 to 30 September 2011	10
Summer	Rapid vegetation surveys, systematic plot-based surveys and targeted threatened flora searches.	Wider Study Area	30 January to 3 February 2012	10
Autumn	Rapid vegetation surveys, systematic plot-based surveys and targeted threatened flora searches.	Proposed Disturbance Area and Wider Study Area	15 to 19 May 2012	10
Total				34

In total, 34 person-days were undertaken by Umwelt to sample the vegetation communities and flora species of the proposed disturbance area and Wider Study Area (refer to **Figure 3.1**). A summary of all botanical surveys (winter 2011 to autumn 2012) is shown in **Table 3.3** below.

Table 3.3 – Flora Survey Effort Summary

Flora Survey Technique	Wider Study Area	Project Area	Proposed Disturbance Area	Total
Floristic quadrats	34	19	3	56
Semi quantitative rapid assessment points	60	18	1	79
Qualitative rapid assessment points	365	76	12	453
Meandering transects and field reconnaissance	151 kilometres of walking and 526 kilometres of driving			

3.3.4 Targeted Threatened Flora Searches

Targeted threatened flora searches were completed throughout the Wider Study Area (refer to **Figure 3.1**) for potential threatened flora species as identified in **Appendix D**. In particular, extensive surveys for the pine donkey orchid (*Diuris tricolor*) were undertaken across areas of suitable habitat within the Wider Study Area (refer to **Figure 3.1**). Targeted seasonal surveys for the pine donkey orchid (*Diuris tricolor*) were conducted over only a small portion of the proposed disturbance area (refer to **Figure 3.1**). Some suitable habitat areas of the current proposed disturbance area were not part of the proposed Project Area during targeted surveys in Spring 2011. Prior to conducting these searches, the flowering status of this species was verified using a known population at Dubbo as a reference site. It was confirmed the week prior to the spring 2011 surveys that this species was in full flower (Garry Germon – Senior Threatened Species Officer, OEH pers. comm.).

A second known population in the nearby Blow Clear West Nature Reserve was also used as a reference. A site inspection of this population by NSW National Parkes staff failed to locate any individuals at the Blow Clear West Nature Reserve site (Silvana Keating – NSW National Parkes Ranger pers. comm.). The failure to detect the pine donkey orchid flowering at the site in Blow Clear West Nature Reserve (last recorded in 2008) means that the known population had not yet started to flower or the species did not flower in 2011 at the site or the species no longer occurs at the site within Blow Clear West Nature Reserve.

The targeted threatened flora searches were variable in length and location, and were tailored to suit the environment in which they occurred to gain maximum coverage of likely habitat for potential threatened flora species. A meandering technique was selected over the plot-based method since the amount of replicate plots that could have been sampled within each vegetation unit was limited by a restricted survey time. The meandering technique within each search area increased the amount of data that could be collected within the available survey time, thereby maximising the quality and coverage of vegetation description and mapping. Targeted threatened flora searches are useful for detecting threatened flora species across large areas, as they enable the surveyor to cover large proportions of the area under investigation, unlike plot-based surveys.

3.3.5 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within plots and on meandering transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2013), the on-line plant name database maintained by the National Herbarium of New South Wales. PlantNET was accessed regularly but most recently for a full taxonomic check in February 2013.

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

3.3.6 Vegetation Community Description and Mapping

Vegetation communities were identified through examination of field survey results, including plot and transect data, their relationship to vegetation patterns evident on aerial photography and to landform elements of the proposed disturbance area. Communities were defined as 'an assemblage of species populations that occur together in space and time and can be defined at any scale within a hierarchy of habitats' (Begon *et al.* 2006).

Colour API was used to map the spatial extent of vegetation communities in the proposed disturbance area, using manual interpretation of photos through differentiation of communities based on colour and textural properties. The digital aerial photograph was taken in 2012, and the resolution of the ortho-rectified image was 0.5 metre per pixel.

Mapping was informed by the results of field survey, and field reconnaissance facilitated its ground-truthing (refer to **Section 3.3.3.4**). Vegetation communities were mapped on-screen over recent aerial photography of the proposed disturbance area (see **Section 3.3.2**). Mapping was undertaken using the Manifold System 8.0 Enterprise Edition geographical information system in a 32 bit mode.

Each mapped vegetation unit was assigned a map unit according to the NSW Vegetation Classification and Assessment Project (Benson *et. al.* 2010). This was undertaken by reading vegetation map unit descriptions and comparing these to the results of the standard floristics plot data collected on the proposed disturbance area and Wider Study Area. In addition, each mapped vegetation community was assigned a biometric vegetation type for the Lachlan CMA area from the Biometric Vegetation Types Database (OEH 2012).

3.3.7 Targeted Threatened Ecological Community Investigations

Potential for a number of TECs to occur in the proposed disturbance area was identified through a review of previous surveys of the proposed disturbance area and Wider Study Area, expert knowledge and database searches. The following TECs were either known to occur in the proposed disturbance area or Wider Study Area, or were considered to have high potential to occur and were specifically targeted during surveys:

- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (EEC – TSC Act).
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EEC – EPBC Act).
- White Box Yellow Box Blakely's Red Gum Woodland (EEC – TSC Act).
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC – EPBC Act).

Where potential habitat for these communities was identified during surveys within the proposed disturbance area or Wider Study Area, a quantitative sampling method using 0.04 hectare quadrats (refer to **Section 3.3.4.1**), was used to collect the information necessary to determine whether the community present was consistent with the listed TEC, such as floristic species composition, structure, soil type and topographic position. However, two of the above mentioned TECs require specific survey methodology to make the determination of their presence or absence. These are discussed below in **Section 3.3.7.1**.

3.3.7.1 TEC Specific Survey Methods

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC - EPBC Act)

The same floristic quadrat methodology described in **Section 3.3.3.1** was employed in potential areas of this TEC. The additional survey methods listed in **Table 3.4** were undertaken to meet the requirements of the Listing Advice (Threatened Species Scientific Committee 2006) and Policy Statement (Department of Environment and Heritage 2006a) for the community.

Table 3.4 – White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland CEEC Specific Survey Methods

Measurement Taken	Threshold for Identification of TEC
Identification of the most common overstorey species	Either white box (<i>Eucalyptus albens</i>), yellow box (<i>E. melliodora</i>) or Blakely’s red gum (<i>E. blakelyi</i>), or a combination of two or three of these species.
Percentage of native perennial vegetation cover	At least 50 per cent.
Number of native understorey species present, excluding grasses AND the number of important species as listed in the species list of the EPBC Act Policy Statement for the community (DSEWPC 2006b)	At least 12 native understorey species, including one important species as listed in the species list of the EPBC Act Policy Statement for the community (DSEWPC 2006b).
The number of mature trees of at least 125 centimetres circumference at 1.3 metres above the ground	At least 20 mature trees per hectare, or natural regeneration of the dominant overstorey eucalypts.

Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EEC – EPBC Act)

The same floristic quadrat methodology described in **Section 3.3.3.1** was employed in potential areas of this TEC. The additional survey methods listed in **Table 3.5** were undertaken to meet the requirements of the Listing Advice (Threatened Species Scientific Committee 2010) for the community.

Table 3.5 – Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC Specific Survey Methods

Category	Measurement Taken	Threshold for Identification of TEC
General Criteria	1b. Identification of the dominant or co-dominant tree species	western grey box (<i>Eucalyptus microcarpa</i>)
	1c. Percentage of non-grass weed species in the ground layer.	Vegetative cover of less than 30 per cent.
Larger Woodland Criteria (2 hectares or more in size)	3a. Number of trees per hectare that are hollow bearing or have a DBH of at least 60 centimetres.	At least 8 trees per hectare.
	3b. Percent of perennial native grasses within the vegetative ground cover.	At least 10 per cent.
	OR	
	4a. Number of trees per hectare that have a DBH of at least 12 centimetres.	At least 20 trees per hectare.
	4b. Percent of perennial native species within the vegetative ground cover.	At least 50 per cent.

Table 3.5 – Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC Specific Survey Methods (cont.)

Category	Measurement Taken	Threshold for Identification of TEC
Derived Grassland Criteria (where the canopy is less developed or absent)	5a. Presence of western grey box (<i>Eucalyptus microcarpa</i>) in surrounding woodland.	Clear evidence that western grey box (<i>Eucalyptus microcarpa</i>) dominated or co-dominated the grassland.
	5b. Percent of perennial native species within the vegetative ground cover.	At least 50 per cent.
	5c. Number of native species present in the ground layer.	At least 12 species.

The Listing Advice for this TEC applies the information collected through the above sampling methods to a variety of criteria depending on the either the size of the woodland patch or if it is a derived grassland (Threatened Species Scientific Committee 2010).

The survey criteria required to determine the presence or absence of the two EPBC Act listed TECs is more detailed than the similar TSC Act listed TECs. Therefore potential vegetation was assessed to the survey standard required by the EPBC Act listed variation of the community.

3.3.8 Determination of Threatened Ecological Communities

Vegetation communities identified in the Project Area were compared to TECs listed under the TSC Act and the EPBC Act.

The assessment of similarity to TECs was made using the following approach:

- comparison with published species lists, including lists of ‘important species’, for the TSC Act and EPBC Act listed TECs (as identified in **Section 3.3.7.1**);
- comparison with habitat descriptions and distributions for the TSC Act and EPBC Act listed TECs (as identified in **Section 3.3.7.1**);
- recent guidelines for interpreting listing criteria for species, populations and ecological communities under the NSW TSC Act (NSW Scientific Committee 2012) were followed. Those relevant to ecological communities included two core matters and additional ‘supplementary descriptors’ (Preston and Adam 2004), which are described below:
 - The assemblage of species: Is a core matter to be considered in the identification of ecological communities. It is a measurable matter based on the results of field surveys. Descriptions of ecological communities include a list of characteristic flora species, identifying those that occurred frequently, those that were dominant and important species that assist in the delineation of different communities. Where necessary and/or applicable rare or threatened flora species were also mentioned.
 - Describing the particular area: Is a non-interpretive matter that can be accurately described. Threatened ecological communities have location boundaries and limits where they are restricted to; therefore it is important the location of the Project Area be identified.

- Supplementary descriptors: As identified by Preston and Adam (2004), these can facilitate the interpretation, and allow stronger descriptions of ecological communities. These may be structural features including the community's strata, or other descriptors including physiographic position, relationships with abiotic factors, biotic features and dynamic features (NSW Scientific Committee 2012). The physiography (position in the landscape), soil texture, drainage and depth; site disturbances; slope and aspect; and vegetation structure (strata percentage covers, heights and dominant species) were described for ecological communities.

3.3.9 Summary and Adequacy of Flora Field Survey Effort

Table 3.6 summarises the suggested minimum effort required to undertake adequate surveys of flora species in accordance with Draft Threatened Species Survey and Assessment: Guidelines for Developments and Activities (DEC 2004), including threatened species and mapping and describing vegetation communities.

Table 3.6 – Recommended Flora Survey Effort According to the Draft OEH Guidelines*

Survey Technique	Suggested Minimum Effort
Transects	<ul style="list-style-type: none"> • 1x100 m traverse per stratification unit <2 hectares. • 2x100 m traverses per 2 to 50 hectares of stratification unit. • 3x100 m traverses per 51 to 250 hectares of stratification unit. • 5x100 m traverses per 251 to 500 hectares of stratification unit. • 10x100 m traverses per 501 to 1000 hectares of stratification unit, plus one additional 100 m traverse for each extra 100 hectares thereof.
Quadrat	<p>At least:</p> <ul style="list-style-type: none"> • 1 quadrat per stratification unit <2 hectares. • 2 quadrats per 2 to 50 hectares of stratification unit. • 3 quadrats per 51 to 250 hectares of stratification unit. • 5 quadrats per 251 to 500 hectares of stratification unit. • 10 quadrats per 501 to 1000 hectares of stratification unit. • plus one additional quadrat for each extra 100 hectares thereof.

* Number of plots recommended in accordance with the Draft Threatened Species Survey and Assessment: Guidelines for Developments and Activities (DEC 2004).

Table 3.7 identifies the adequacy of the plot and transect-based survey with respect to OEH (2004) draft guidelines. While only 3 of the required 12 plots were completed in the proposed disturbance area, 20 plots completed in the surrounding Wider Study Area (including the proposed disturbance area) prior to the identification of the proposed disturbance area were used to provide a understanding of the vegetation communities that occurred in the proposed disturbance area and surrounds. The 20 plots completed across the Wider Study Area included plots in each of the native vegetation communities that occur in the proposed disturbance area and the individual number of plots in each of those communities exceeded the required number of plots for the proposed disturbance area.

Table 3.7 – Adequacy of Vegetation Survey

Vegetation Community (Stratification Unit)	Area (ha) in Proposed Disturbance Area ¹	Flora Plots			Rapid Assessments	
		No. Required ² .	Proposed Disturbance Area	Wider Study Area	Proposed Disturbance Area	Wider Study Area
Bimble Box – White Cypress Pine Woodland	12	2	0	4	1	22
Bimble Box – White Cypress Pine Woodland – Exotic Understorey	1.7	1	1	2	1	3
Cultivated Land	112	0	0	0	0	6
Disturbed Land	11	0	0	0	0	0
Exotic Grassland	39	2	2	3	0	9
Grey Box Grassy Woodland (EEC – TSC Act/EEC – EPBC Act)	23	2	0	4	3	96
Grey Box Grassy Woodland – DNG (EEC – TSC Act/EEC – EPBC Act)	15	2	0	4	3	40
Plantation	25	2	0	0	0	7
White Cypress Pine – Yellow Box – Grey Box – Bimble Box Woodland (EEC – TSC Act/CEEC – EPBC Act)	0.28	1	0	3	0	22
Un-mapped areas ³	0	0	0	0	5	268
Total	239	12	3	20	13	473

Notes:

- 1 Rounding of totals applied (numbers less than 1 – 2 decimal places, numbers between 1 and 10 – 1 decimal place, and greater than 10 no decimal places).
- 2 Number of plots and transects (100 metre traverses) recommended in accordance with DEC (2004) – see **Table 3.5**.
- 3 While rapid assessments were undertaken across the majority of accessible areas within the Wider Study Area, quadrat sampling was only undertaken in areas of the Wider Study Area that contained vegetation communities that occurred within the proposed disturbance area or earlier possible disturbance areas.

Quadrats were not completed in the Disturbed Land community as it did not support a naturally occurring vegetation community.

3.4 Terrestrial Fauna Survey

3.4.1 Previous Fauna Surveys

Fauna surveys were carried out within the Wider Study Area and the proposed disturbance area to identify the fauna species and their habitats occurring, or considered to have the potential to occur, including threatened species, migratory species, endangered populations, and species of local or regional significance.

3.4.1.1 Fauna Field Survey

Fauna surveys across the Wider Study Area were undertaken during winter 2011, spring 2011, summer 2011/12 and autumn 2012. Fauna surveys in autumn 2012 also included the proposed disturbance area.

During winter 2011 targeted regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*) surveys were undertaken across the Wider Study Area. Winter bird surveys were undertaken on 27 and 28 July 2011 and targeted areas of flowering eucalypt trees.

During spring 2011, fauna surveys were undertaken from 27 to 30 September across the Wider Study Area. Three fauna trapping sites (trapping sites 1, 2 and 3) were established during spring 2011. Fauna trapping sites sampled the largest patches of remnant forest/woodland communities within Wider Study Area (refer to **Figure 3.2**). Area search methods were undertaken in conjunction with the trapping surveys and sampled additional areas across the Wider Study Area.

The summer 2011/12 surveys were undertaken from 30 January to 3 February 2012 and replicated the survey effort of the spring surveys, resampling the same three trapping sites (trapping sites 1, 2 and 3). Additional area searches were also undertaken across other areas of the Wider Study Area, including in the proposed disturbance area.

The autumn 2012 surveys were undertaken from 7 to 11 May 2012. The autumn survey was undertaken within the Wider Study Area and proposed disturbance area. A single trapping site (trapping site 4) was established within the Wider Study Area and approximately 1 kilometre to the east of the closest part of the proposed disturbance area to sample previously un-sampled habitat areas (refer to **Figure 3.2**).

Fauna survey effort was designed in consideration of the following survey guidelines:

- Department of Environment and Conservation NSW (DEC) (2004). Threatened Species Survey and Assessment: Guidelines for development and activities (working draft).
- Department of Environment and Climate Change NSW (DECC) (2009b). Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians.
- DECC (2007). Threatened Species Assessment Guidelines: the Assessment of Significance.
- Department of Planning (DoP) (2005). Guidelines for Threatened Species Assessment.
- Department of Environment, Water, Heritage and the Arts (DEWHA) (2010a). Survey Guidelines for Australia's Threatened Birds.
- DEWHA (2010b). Survey Guidelines for Australia's Threatened Frogs.



Source: Project Area: NPM (2013), Cadastre: LPMA (2011), Aerial: Google Earth (2010)

Note: Survey effort at trapping sites is shown on Figures 3.3 and 3.4

0 1.0 2.5 5km
Scale 1:100 000

Legend

- Project Area
- Wider Study Area
- Project Disturbance Area
- Opportunistic Amphibian Driving Survey
- Anabat Echolocation Recorder
- Call Playback
- Habitat Assessment
- Diurnal Bird and Reptile Search
- Koala SAT and Habitat Tree Assessment
- ▲ Diurnal Bird Search
- ▲ Diurnal Reptile Search
- Targeted Winter Bird Survey

FIGURE 3.2

2011/12 Fauna Survey
Effort Outside of
Trapping Sites

- DEWHA (2010c). Survey Guidelines for Australia's Threatened Bats.
- DEWHA (2011a). Survey Guidelines for Australia's Threatened Reptiles.
- DEWHA (2011b). Survey Guidelines for Australia's Threatened Mammals.

3.4.2 Trapping Surveys

A variety of different types of traps, targeting a wide range of species, were used during the trapping surveys and are detailed below.

3.4.2.1 Terrestrial Elliott Traps

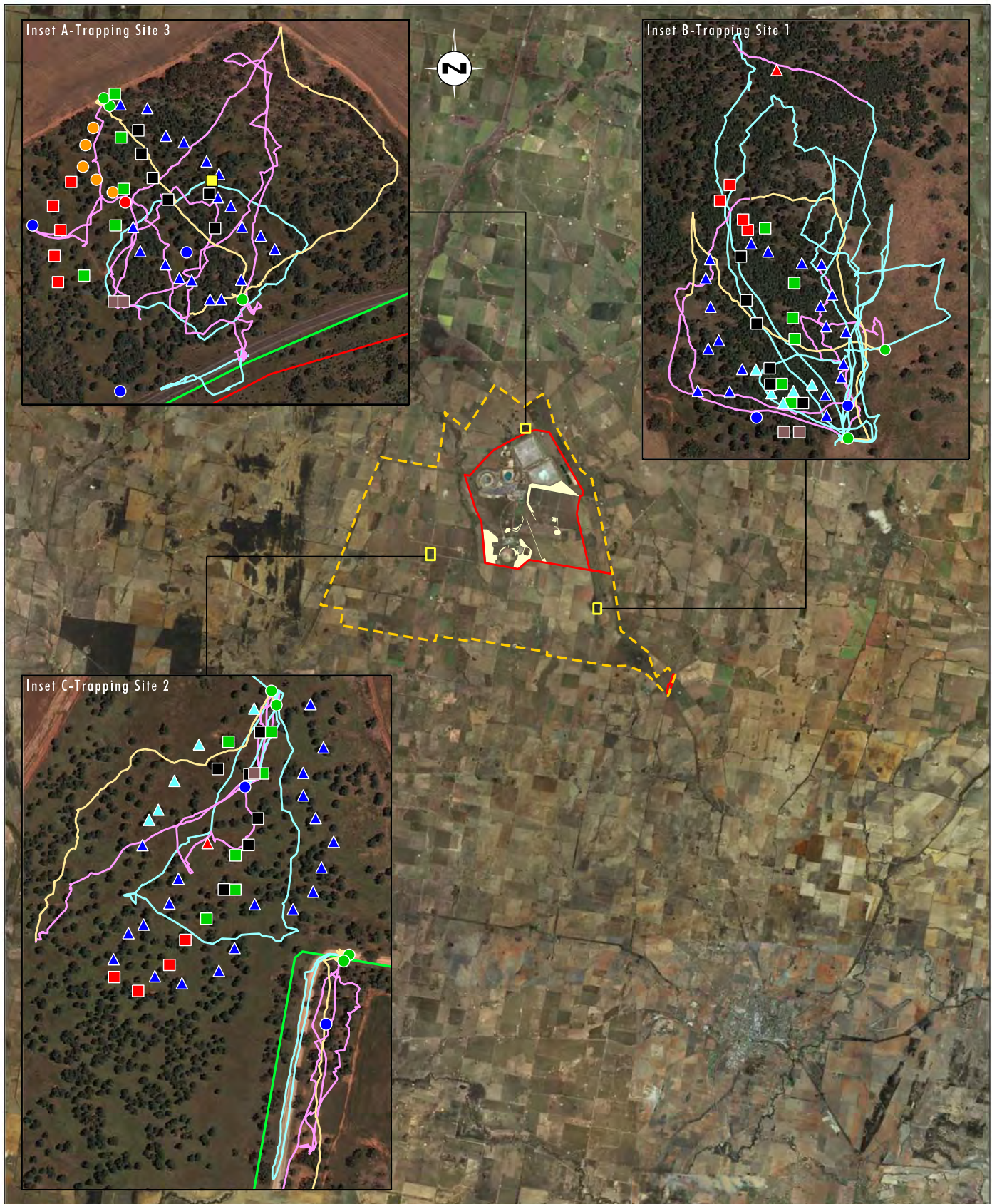
Terrestrial Elliott A and Elliott B traps were set in pairs approximately 20 metres apart on the ground and baited with a mixture of rolled oats and peanut butter. All traps were positioned where possible amongst habitat features such as logs, fallen bark, rocks and ground cover. All Elliott traps were covered with a plastic bag to prevent rain entering and were lined with woollen wadding to provide insulation for captured animals. All terrestrial Elliott traps were positioned to avoid overheating in early morning sunlight, and were tilted towards the front to prevent rain from entering the plastic bag covering the trap. Terrestrial Elliott trapping was undertaken during the spring 2011 (refer to **Figure 3.3**), summer 2011/12 and autumn 2012 survey periods (refer to **Figure 3.4**).

During spring 2011, 25 terrestrial Elliott A and 25 terrestrial Elliott B traps were set at trapping sites 1 and 2, with 25 terrestrial Elliott A and 19 terrestrial Elliott B traps set at trapping site 3 (see **Figure 3.3**). In summer 2012, 25 terrestrial Elliott A and 25 terrestrial Elliott B traps were set at each of the three trapping locations. During autumn 2012, 25 terrestrial Elliott A and 25 terrestrial Elliott B were set at trapping site 4 (see **Figure 3.4**). A total of 1376 terrestrial Elliott trap nights were completed across the Wider Study Area (refer to **Table 3.9**), comprising 700 terrestrial Elliott A trap nights and 676 terrestrial Elliott B trap nights.

3.4.2.2 Arboreal Elliott B Traps

Arboreal Elliott B traps were set approximately 10 to 40 metres apart on tree trunks (depending on the provision of suitable trees in the trapping area), and were baited with a mixture of rolled oats, peanut butter and honey. Traps were positioned on platforms attached to the trunks of large trees, three to four metres above the ground. Where possible, large trees with hollows were selected as trap sites. The trunk of the tree and entrance to the trap were sprayed with a honey and water mixture to attract arboreal mammals. All Elliott traps were covered with a plastic bag to prevent rain entering and were lined with woollen wadding to provide insulation for captured animals. All traps were positioned to avoid exposure to morning sunlight, and were tilted towards the tree to prevent rain from entering the plastic bag covering the trap.

During spring 2011 and summer 2012 a total of six arboreal Elliott B traps were set at trapping sites 1, 2 and 3 (refer to **Figure 3.3**). During autumn 2012, six arboreal Elliott B traps were set at trapping site 4 (refer to **Figure 3.4**). A total of 168 arboreal Elliott B trap nights were completed across the Wider Study Area (refer to **Table 3.9**).



Source: Project Area: NPM (2013), Cadastre: LPMA (2011), Aerial: Google Earth (2010)

Note: Insets A,B and C show survey locations for Spring 2011. Summer 2011/12 survey location at trapping sites is shown on Figure 3.4. All other survey effort (away from trap sites) is shown on Figure 3.2

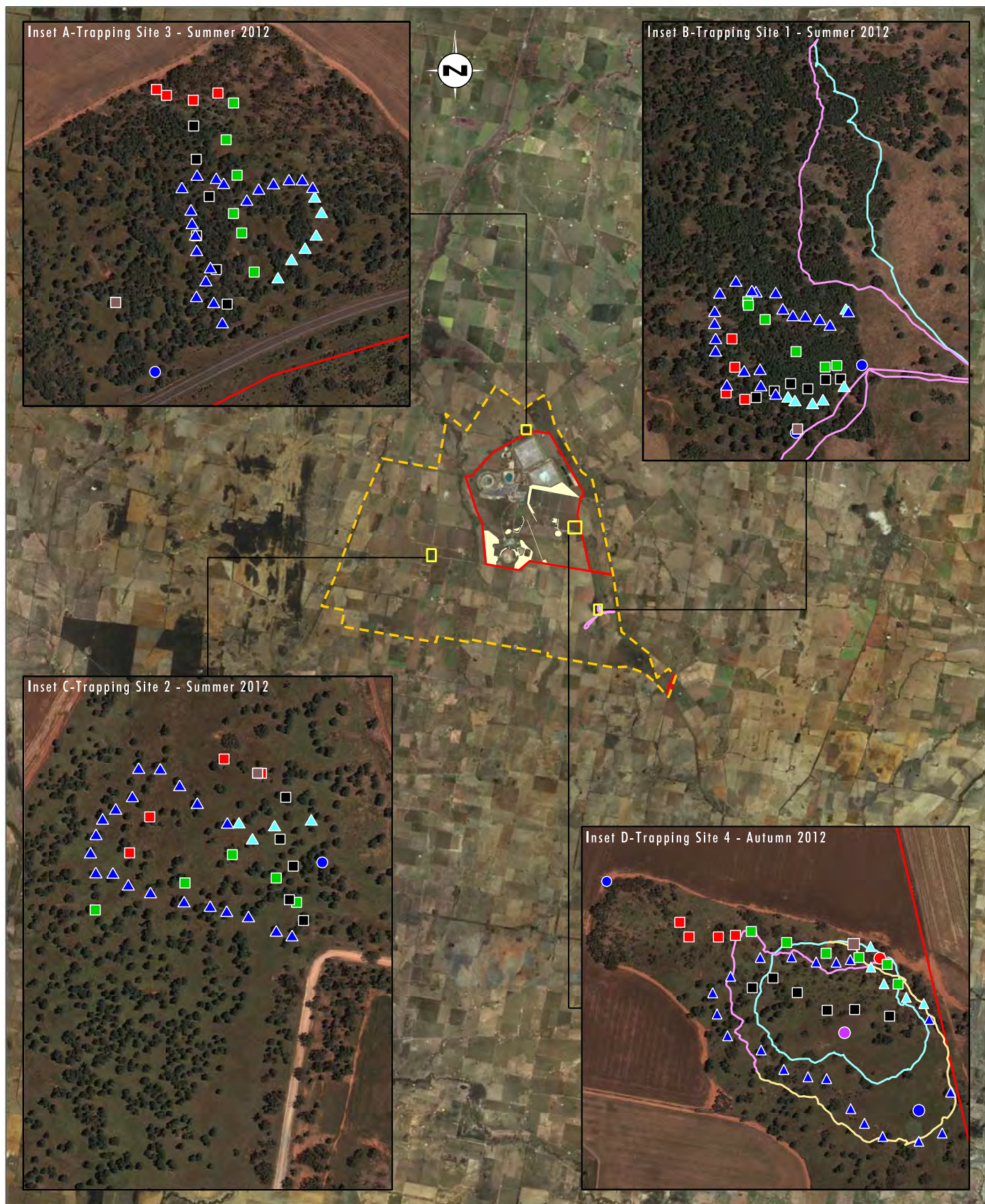
0 5 10 12.5 km
1:250 000

Legend

- | | | |
|---|---|--|
| Project Area | ● Anabat Echolocation Recorder | ▲ Terrestrial Elliott A Trap and Elliott B Trap and Hair Funnel Trap |
| Wider Study Area | ■ Arboreal Elliott B Trap and Hair Funnel Trap | ● Call Playback |
| Project Disturbance Area | ■ Arboreal Hair Funnel Trap | ● Habitat Assessment |
| — Bird Survey Transect | ■ Cage Trap | ▲ Diurnal Bird Search |
| — Reptile and Amphibian Survey Transect | ■ Harp Trap | ■ Targeted Winter Bird Survey |
| — Opportunistic Amphibian Driving Survey | ● Terrestrial Elliott A Trap | |
| — Spotlight Survey Transect | ▲ Terrestrial Elliott A Trap and Elliott B Trap | |

FIGURE 3.3

Spring 2011
Trapping Sites



Source: Project Area: NPM (2013), Cadastre: LPMA (2011), Aerial: Google Earth (2010)
Note: Spring trapping survey effort is shown on Figure 3.3. All other survey effort (away from trap sites) is shown on Figure 3.2

0 5 10 12.5 km
1:250 000

Legend

- Project Area
- - - Wider Study Area
- Project Disturbance Area
- Bird Survey Transect
- Reptile and Amphibian Survey Transect
- Spotlight Survey Transect
- Anabat Echolocation Recorder
- Arboreal Elliott B Trap and Hair Funnel Trap
- Arboreal Hair Funnel Trap
- Cage Trap
- Harp Trap
- ▲ Terrestrial Elliott A Trap and Elliott B Trap and Hair Funnel Trap
- Habitat Assessment
- Diurnal Bird and Reptile Search

FIGURE 3.4

Summer and Autumn
2012 Trapping Sites

3.4.2.3 Terrestrial Cage Traps

Single ended cage traps (600 millimetres (L) by 300 millimetres (H) by 300 millimetres (W)) were baited with raw chicken necks. Half of the length of each trap was covered with a plastic bag and shade cloth to provide shelter for captured animals from the elements (rain, wind and sun). All cage traps were positioned to avoid exposure to early morning sunlight. Traps were positioned on level ground or amongst vegetation where the trap was unable to roll away if a captured animal struggled within the trap. Cage trapping was undertaken during the spring, summer and autumn survey period.

During spring 2011 and summer 2012, six cage traps were set at trapping sites 1, 2 and 3 for four nights each (refer to **Figure 3.3**). During autumn 2012, six cage traps were set at trapping site 4 (refer to **Figure 3.4**). A total of 168 terrestrial cage trap nights were completed across the Wider Study Area (refer to **Table 3.9**).

3.4.2.4 Terrestrial Hair Funnels

Terrestrial Faunatech hair funnels were baited with either meat (raw chicken necks) or a rolled oats and peanut butter mixture. All terrestrial hair funnels were positioned amongst habitat features such as logs, fallen bark, rocks and ground cover. All hair funnels were left in position for between 4 and 86 nights and all hair samples collected were identified by Barbara Triggs (a recognised expert in the field of hair and scat identification).

During spring 2011 and summer 2012 a total of 20 terrestrial hair funnels were set at trapping sites 1, 2 and 3 (refer to **Figure 3.3**). During autumn 2012, a total of 20 terrestrial hair funnels were set at trapping site 4 (refer to **Figure 3.4**). A total of 4980 terrestrial hair funnel nights were completed across the Wider Study Area (refer to **Table 3.9**).

3.4.2.5 Arboreal Hair Funnels

Large Faunatech style hair funnels were baited with a rolled oats, peanut butter and honey mixture. Arboreal hair funnels were positioned 1.5 to 2.0 metres above the ground on tree trunks or branches. The entrance to the hair funnel and the tree trunk were sprayed with a honey and water emulsion as an attractant. All collected hair samples were identified by Barbara Triggs.

During spring 2011 and summer 2012 a total of 10 arboreal hair tubes were set at trapping sites 1, 2 and 3 (refer to **Figure 3.3**). In autumn, a total of 10 arboreal hair tubes were set at trapping site 4 (refer to **Figure 3.4**). A total of 2490 arboreal hair funnel sampling nights were completed across the Wider Study Area (refer to **Table 3.9**).

3.4.2.6 Harp Trapping

Faunatech two-bank harp traps were used during the fauna survey to catch micro-bats. The harp traps were placed in the middle of distinct tracks through vegetation which bats are considered to use as flyways.

During spring 2011 and summer 2012 a total of two harp traps were set up for two nights at trapping sites 1, 2 and 3 (refer to **Figure 3.3**). In autumn, two harp traps were set up at trapping site 4 (refer to **Figure 3.4**). A total of 32 nights of harp trapping was completed across the Wider Study Area (refer to **Table 3.9**).

3.4.3 Area Searches

A variety of area searches of differing duration and purpose were undertaken as part of the fauna survey. The area searches employed across the Wider Study Area and the proposed disturbance area are detailed below, and **Figure 3.2** displays the locations of all area searches.

3.4.3.1 Spotlighting Searches

Spotlighting searches were undertaken both on foot and from a moving vehicle. Walking spotlighting searches were undertaken by two observers for a period of at least 30 minutes (total of one person hour) on each occasion. Vehicle spotlighting searches were undertaken by the passenger(s) from a slow moving vehicle along vehicle tracks between trapping sites. Walking and vehicle spotlighting searches were undertaken using 30 watt Lightforce spotlights.

At all locations (refer to **Figures 3.2, 3.3 and 3.4**) spotlighting was undertaken by two people for a period of 30 minutes. A total of 10 walking person hours and approximately eight hours of driving spotlighting searches were completed across the Wider Study Area during surveys.

3.4.3.2 Reptile and Amphibian Searches

Diurnal searches targeting reptiles and amphibians were undertaken during the warmest parts of the day. Diurnal searches were undertaken by two people for between half a person hour and one person hour on two separate days. Nocturnal searches targeted amphibians and nocturnal reptiles. All reptile and amphibian searches were undertaken by two ecologists for a period of at least 30 minutes. Nocturnal reptile and amphibian searches were undertaken using LED headlamps and/or 30 watt Lightforce spotlights.

Habitat features investigated during reptile and amphibian searches included water bodies, emergent vegetation, wet soak areas, logs, rocks, loose bark on tree trunks, exposed bedrock, leaf litter and open grassland areas. Amphibians not identifiable from their calls were captured for visual identification. All amphibians were handled according to the hygiene protocol for the control of disease in frogs (Wellington and Haering 2001). Non-venomous snake species and small lizards were captured for identification where necessary.

During the spring, summer and autumn survey periods a total of 21 person hours of diurnal, and 10 person hours of nocturnal reptile and amphibian searches were undertaken across the Wider Study Area (refer to **Figures 3.2, 3.3 and 3.4**). In addition to this, targeted amphibian searches were undertaken within the Wider Study Area following a period of heavy and prolonged rainfall during the summer survey. These searches consisted of driving along the roads in the Wider Study Area and stopping at regular intervals or where amphibian activity was high.

3.4.3.3 Bird Searches

Bird searches were undertaken across the Wider Study Area and the proposed disturbance area at various times of the day, primarily in early to mid morning and mid to late afternoon. Bird searches were undertaken for one person hour (by one or two observers). Opportunistic observations were recorded during all other aspects of the field survey, particularly while checking traps and when travelling between survey sites. Bird species were identified from characteristic calls and by observation using a 15 - 45 by 50 spotting scope or 10 by 42 binoculars.

A total of 33.5 person hours of bird surveys were completed across the Wider Study Area during the winter, spring and summer survey periods, and across the Wider Study Area and the proposed disturbance area during the autumn survey period. The locations of bird surveys are shown on **Figures 3.2, 3.3 and 3.4**.

3.4.3.4 Regent Honeyeater and Swift Parrot Surveys

Surveys targeting the regent honeyeater and swift parrot were undertaken during July 2011. Surveys targeted areas of flowering eucalypts and areas of honeyeater activity. At each survey site a minimum 20 person minutes of survey were completed.

A total of 2.3 person hours of regent honeyeater and swift parrot targeted surveys were completed during July 2011. The locations of regent honeyeater and swift parrot targeted surveys are shown on **Figure 3.2**.

3.4.3.5 Koala Searches

Searches for signs of presence of koala's were undertaken across the Wider Study Area and the proposed disturbance area in accordance with the Spot Assessment Technique (SAT). At each koala SAT location, searches were undertaken on and around the base of between 10 and 30 of the largest trees. These searches focused on signs of occupancy including scats left at the base of trees or characteristic scratches on the trunk. A total of 15 koala SAT surveys were undertaken across the Wider Study Area and the proposed disturbance area (refer to **Figure 3.2**).

3.4.3.6 Micro-bat Echolocation Recordings

Echolocation calls were detected using an Anabat II Bat Detector. Echolocation calls were recorded using an Anabat CF storage ZCAIM or an Anabat SD2 unit. The combination of detector and recording device is hereafter collectively referred to as the 'Anabat echolocation recorder'. The Anabat echolocation recorders were positioned at an approximate 30 degree angle approximately 1 metre off the ground in a purpose built PVC pipe that protects the detector from rain. While micro-bat activity is likely to be reduced during rain, calls were still able to be collected during dry parts of the night (particularly nights with brief thunderstorms).

Anabat echolocation recorders were positioned within the vicinity of potential micro-bat flyways. The recorders were automated and programmed to start recording one hour before dusk and to stop recording one hour after sunrise the following morning. Recordings were collected over two to four nights at any single Anabat echolocation recording location.

Anabat echolocation recorders were set for between two and four nights at each trapping site. A total of 32 nights of Anabat survey were completed across the Wider Study Area.

All recorded calls were analysed by Glenn Hoyer of Fly by Night Surveys Pty Limited (a recognised expert in the identification of micro-bat calls). The echolocation calls of species were identified to one of three levels of confidence:

- confident;
- probable; and
- possible.

For the purposes of this assessment, all three levels of confidence were treated as positive identifications. The location of Anabat surveys are shown on **Figure 3.2**.

3.4.3.7 Nocturnal Call Playback

Nocturnal call playback sessions were undertaken within the first four hours after dusk. Calls were broadcast using a 10 watt directional loud hailer. Call playback sessions commenced and ended with a quiet listening period of approximately two minutes. Each species' call was played for a minimum of four minutes followed by a listening period of two minutes before the beginning of the next species' call. Mammal calls were played before bird calls to prevent the calls of predators (such as owls) decreasing the likelihood of prey species (such as gliders) responding to call playback. Call playback sessions included the calls of the:

- bush stone-curlew (*Burhinus grallarius*);
- squirrel glider (*Petaurus norfolcensis*);
- koala (*Phascolarctos cinereus*);
- masked owl (*Tyto novaehollandiae*);
- barking owl (*Ninox connivens*); and
- powerful owl (*Ninox strenua*).

A total of 12 nocturnal call playback sessions were undertaken during the spring, summer and autumn surveys (refer to **Figure 3.2**).

During the autumn survey, targeted call playback surveys were also undertaken targeting likely habitat areas for the bush stone-curlew and Sloanes froglet (*Crinia sloanei*). Eight targeted call playback sessions were undertaken during autumn 2012 across the Wider Study Area and the proposed disturbance area.

3.4.3.8 Signs of Presence Searches

Searches for indirect evidence of animal presence were conducted opportunistically during all survey activities, particularly during habitat searches and reptile and amphibian searches. Due to the opportunistic nature of signs of presence surveys the level of survey effort was not recorded. Evidence of presence included scats, feathers, nests, burrows, bones, tufts of hair and scratch marks on trees. All hair, scat and bone samples were identified by Barbara Triggs (a recognised expert in the field of hair and scat identification).

3.4.4 Habitat Assessments and Hollow Bearing Tree Surveys

Thirteen habitat assessments were undertaken across the range of habitat types present across the Wider Study Area (refer to **Figure 3.2**). The assessment targeted potential habitat and resources for fauna species, particularly threatened fauna species. Records of a number of habitat features were made at each site, including:

- evidence of disturbance such as fire, weeds, feral animals, dumping, erosion and logging;
- presence of fallen timber/logs;
- presence of stumps and stags;
- presence of groundcover features such as rock, litter, grasses, logs, boulder, soil and lichen;
- presence of dieback and/or insect attack;

- mistletoe presence;
- presence of perch sites, fallen and loose bark;
- vegetation strata and composition;
- tree size class (trunk diameter), and age (old growth, mature, regenerating, saplings);
- presence of other specific feed tree species (such as for cockatoos and honeyeaters); and
- collection of detailed hollow data, including tree species and height, hollow size, orientation, position and height.

In addition to these general habitat features, searches for specific habitat requirements for threatened fauna species with potential to occur in the area were also made including the presence of winter-flowering eucalypt species for the regent honeyeater (*Anthochaera phrygia*) and the swift parrot (*Lathamus discolor*).

Habitat features such as tree hollows and fallen logs were inspected for any evidence of fauna occupation such as roost sites, scratches on the trunks of trees, chewed entrances to hollows, scratchings or diggings near logs and scats at the base of trees or near logs.

In addition, specific surveys were undertaken to ascertain the abundance of hollow-bearing trees within the proposed disturbance area. A total of 22 hollow-bearing tree surveys were undertaken in conjunction with habitat assessments and flora plots across the Wider Study Area. Each survey was undertaken within a 20 metre by 50 metre plot and information was collected on the number and size of any hollows and the number of trees containing the hollows. Hollow sizes were divided into the following classes:

- Very small (less than 25 millimetres diameter entrance);
- Small (26 – 50 millimetres diameter entrance);
- Medium (51 – 100 millimetres diameter entrance);
- Large (100 – 300 millimetres diameter entrance); and
- Very large (greater than 300 millimetre entrance).

The approximate abundance of hollows per hectare within each of the timbered vegetation communities was also calculated. This was achieved by dividing the total hollows recorded by the sum of the areas of the plots. This calculation was also done for each of the size classes of hollows and the total number of hollow bearing trees within each community.

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

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

The species listed in Schedule 2 of the policy are listed in **Table 3.8**.

Table 3.8 – Species of Eucalypt listed in Schedule 2 of SEPP 44

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

An assessment of the presence of koala feed tree species (as listed on **Table 3.8**) was made throughout the Wider Study Area. Where koala feed tree species were present in the Wider Study Area, an assessment of the proportion of feed species (compared to non-feed species) within the canopy was undertaken. Assessment of the proportion of Schedule 2 feed tree species was undertaken during habitat assessments and flora quadrats.

3.4.6 Fauna Survey Effort Summary

Table 3.9 summarises the trapping survey effort undertaken across the Wider Study Area between spring 2011 and autumn 2012.

Table 3.9 – Summary of Fauna Survey Trapping Effort

Trapping Method	Number of Trap Nights			
	Spring 2011	Summer 2011/12	Autumn 2012	Total Effort
Terrestrial Elliott A	300	300	100	700
Terrestrial Elliott B	276	300	100	676
Terrestrial cage	72	72	24	168
Arboreal Elliott B	72	72	24	168
Harp Trap	12	12	8	32
Terrestrial hair funnel	3540	1260	180	4980
Arboreal hair funnel	1770	630	90	2490

Note: One trap night equals one trap set for one night.

Table 3.10 summarises the area search effort undertaken across within the Wider Study Area between during 2011 and 2012.

Table 3.10 – Summary of Fauna Area Search Effort

Survey Method	Winter 2011	Spring 2011	Summer 2012	Autumn 2012	Total Effort
Bird surveys (person hours)	7	6.5	9	11	33.5
Diurnal reptile and amphibian surveys (person hours)	N/A	3	7	11	21
Nocturnal reptile and amphibian surveys (person hours)	N/A	6	2	2	10
Additional nocturnal amphibian searches following heavy rain (person hours)	N/A	N/A	10.5	N/A	10.5
Walking spotlight surveys (person hours)	N/A	6	2	2	10
Driving spotlight surveys (km)	N/A	Undertaken opportunistic-ally distance not recorded	10.63 km	8.95 km	19.58 km
Nocturnal call playback (sessions)	N/A	6	3	2	11
Targeted bush stone-curlew and Sloanes froglet call playback (sessions)	N/A	0 – undertaken as part of nocturnal reptile and amphibian surveys	1	8	9
Koala SAT (no.)	N/A	N/A	N/A	15	15
Anabat echolocation (entire nights)	N/A	12	12	8	32

Table 1 of **Appendix A** summarises the fauna survey effort undertaken and how it compares with the recommended but not mandatory OEH (DEC 2004) guidelines.

The survey effort undertaken for the Project was considered adequate to sample the threatened and non-threatened fauna species that may occur within the proposed disturbance area. Where threatened species were not recorded but suitable habitat and recent nearby records occur, the threatened species was considered likely to be present using a precautionary approach.

4.0 Results

4.1 Literature Review

Relevant literature (refer to **Section 3.1**) is discussed in **Appendix B**, focusing on threatened species, migratory species, EPs and TECs previously recorded or likely to occur within the proposed disturbance area. The literature review aimed to develop a list of threatened and migratory species, EPs and TECs previously recorded within or in the vicinity of the proposed disturbance area either previously recorded or with potential to occur.

4.2 Database Searches

The threatened species, migratory species, EPs and TECs likely to occur within the proposed disturbance area were identified by a systematic approach comprising, appropriate database searches, a review of relevant literature, and targeted field surveys.

4.2.1 Protected Matters Database Search

A 20 kilometre radius search from the boundary of the Project Area was completed using the EPBC Protected Matters Search Tool database (the search undertaken on 4 March 2013) to identify threatened species and threatened ecological communities (TECs) with the potential to occur within, or adjacent to, the proposed disturbance area (refer to **Table 4.1**).

Table 4.1 – Protected Matters Database Search Results

Threatened Ecological Communities (TECs)			
TECs	Name		Status
	Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia		E
	Weeping Myall Woodland		E
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		CE
Threatened Species			
Flora	Scientific Name	Common Name	Status
	Species or Species Habitat Likely to Occur		
	<i>Austrostipa metatoris</i>		V
	<i>Austrostipa wakoolica</i>		E
	<i>Swainsona murrayana</i>	Slender Darling-pea, slender swainson, Murray swainson-pea	V
	Species or Species Habitat May Occur		
	<i>Tylophora linearis</i>		E

Table 4.1 – Protected Matters Database Search Results (cont.)

Threatened Species			
Fauna	Species or Species Habitat Known to Occur		
	<i>Botaurus poiciloptilus</i>	Australasian bittern	E
	<i>Leipoa ocellata</i>	Malleefowl	V
	<i>Phascolarctos cinereus</i> (combined populations of QLD, NSW and the ACT)	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	V
	Species or Species Habitat May Occur		
	<i>Anthochaera phrygia</i>	Regent honeyeater	E
	<i>Pseudomys novaehollandiae</i>	New Holland mouse	V
	<i>Dasyurus maculatus maculatus</i>	Spotted-tail quoll	E
	<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V
	<i>Maccullochella peelii</i>	Murray cod	V
	<i>Macquaria australasica</i>	Macquarie perch	E
	Species or Species Habitat Likely to Occur		
	<i>Aprasia parapulchella</i>	Pink-tailed legless lizard	V
	<i>Lathamus discolor</i>	Swift parrot	E
	<i>Rostratula australis</i>	Australian painted snipe	V
	<i>Polytelis swainsonii</i>	Superb parrot	V
	<i>Petrogale penicillata</i>	Brush-tailed rock-wallaby	V
Migratory Species	Species or Species Habitat Known to Occur		
	<i>Leipoa ocellata</i>	Malleefowl	V
	Species or Species Habitat May Occur		
	<i>Apus pacificus</i>	Fork-tailed swift	
	<i>Ardea alba</i>	Great white egret, white egret	
	<i>Ardea ibis</i>	Cattle egret	
	<i>Gallinago hardwickii</i>	Latham's snipe, Japanese snipe	
	<i>Hirundapus caudacutus</i>	White-throated needletail	
	<i>Merops ornatus</i>	Rainbow bee-eater	
	<i>Rhipidura rufifrons</i>	Rufous fantail	
	<i>Anthochaera phrygia</i>	Regent honeyeater	E
	Species or Species Habitat Likely to Occur		
	<i>Rostratula benghalensis s. lat.</i>	Painted snipe	V
	<i>Tringa stagnatilis</i>	Marsh sandpiper	
	<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	

Status (EPBC Act):
CE Critically Endangered
E Endangered
V Vulnerable

The 20 kilometre radius search from the boundary of the Project Area using the EPBC Protected Matters Search Tool database identified three TEC's), four threatened flora species, 14 threatened fauna species, and 12 migratory fauna species as occurring, or having the potential to occur, within the proposed disturbance area.

4.2.1.1 Atlas of NSW Wildlife Database Search

A 20 kilometre radius search from the boundary of the Project Area was completed using the Atlas of NSW Wildlife Database records (the search undertaken on 4 March 2013) to identify threatened species with the potential to occur within, or adjacent to, the proposed disturbance area (refer to **Table 4.2**).

Table 4.2 – Atlas of NSW Wildlife Database Search for Threatened Fauna and Flora Species Records within 20 Kilometres of the Project Area

Common Name	Scientific Name	Status TSC Act	Status EPBC Act	Number of records (20 km Radius)	Number of records (all mapsheets ¹)
Amphibians					
Sloanes froglet	<i>Crinia sloanei</i>	V		0	1
Birds					
Malleefowl	<i>Leipoa ocellata</i>	E	V & MIG	1	2
Magpie goose	<i>Anseranas semipalmata</i>	V		0	3
Freckled duck	<i>Stictonetta naevosa</i>	V		0	13
Blue-billed duck	<i>Oxyura australis</i>	V		0	11
Speckled warbler	<i>Chthonicola sagittata</i>	V		5	197
Spotted harrier	<i>Circus assimilis</i>	V		5	17
Little eagle	<i>Hieraaetus morphnoides</i>	V		5	27
Square-tailed kite	<i>Lophoictinia isura</i>	V		0	2
Australasian bittern	<i>Botaurus poiciloptilus</i>	E	E	0	1
Bush stone-curlew	<i>Burhinus grallarius</i>	E		0	10
Glossy black-cockatoo	<i>Calyptorhynchus lathami</i>	V		0	35
Major Mitchell's cockatoo	<i>Lophochroa leadbeateri</i>	V		0	3
Brown treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V		15	271
Diamond firetail	<i>Stagonopleura guttata</i>	V		6	83
Grey falcon	<i>Falco hypoleucos</i>	E		0	49
Black falcon	<i>Falco subniger</i>	PV		0	19
Brolga	<i>Grus rubicunda</i>	V		0	3
Painted honeyeater	<i>Grantiella picta</i>	V		1	2
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V		1	27
Regent honeyeater	<i>Anthochaera phrygia</i>	CE	E & MIG	0	6
Pied honeyeater	<i>Certhionyx variegatus</i>	V		0	1
White-fronted chat	<i>Epthianura albifrons</i>	V		0	6
Varied sittella	<i>Daphoenositta chrysoptera</i>	V		4	22
Gilberts whistler	<i>Pachycephala inornata</i>	V		0	20
Hooded robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V		4	35
Scarlet robin	<i>Petroica boodang</i>	V		0	3
Flame robin	<i>Petroica phoenicea</i>	V		0	7

Table 4.2 – Atlas of NSW Wildlife Database Search for Threatened Fauna and Flora Species Records within 20 Kilometres of the Project Area (cont.)

Common Name	Scientific Name	Status TSC Act	Status EPBC Act	Number of records (20 km Radius)	Number of records (all mapsheets ¹)
Grey-crowned babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V		19	101
Little lorikeet	<i>Glossopsitta pusilla</i>	V		0	50
Turquoise parrot	<i>Neophema pulchella</i>	V		0	55
Superb parrot	<i>Polytelis swainsonii</i>	V	V	17	146
Swift parrot	<i>Lathamus discolor</i>	E	E	0	11
Australian painted snipe	<i>Rostratula australis</i>	E	V & MIG	0	2
Curlew sandpiper	<i>Calidris ferruginea</i>	E	MIG	0	2
Black-tailed godwit	<i>Limosa limosa</i>	V	V & MIG	0	2
Barking owl	<i>Ninox connivens</i>	V		4	16
Mammals					
Eastern pygmy-possum	<i>Cercartetus nanus</i>	V		0	1
Spotted-tailed quoll	<i>Dasyurus maculatus</i>	V	V	0	5
Yellow-bellied sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V		6	12
Squirrel glider	<i>Petaurus norfolcensis</i>	V		0	8
Koala	<i>Phascolarctos cinereus</i>		V	2	14
Boodie, burrowing bettong (mainland)	<i>Bettongia lesueur graii</i>	Extinct	Extinct	0	1
Grey-headed flying-fox	<i>Pteropus poliocephalus</i>	V	V	0	1
Corben's long-eared bat	<i>Nyctophilus corbeni</i>	V		0	7
Little pied bat	<i>Chalinolobus picatus</i>	V	V	10	20
Reptiles					
Pink-tailed legless lizard	<i>Aprasia parapulchella</i>	V	V	0	1
Flora					
	<i>Tylophora linearis</i>	V	E	0	25
Silky swainson-pea	<i>Swainsona sericea</i>	V		1	1
Pine donkey orchid	<i>Diuris tricolor</i>	V		2	4
	<i>Austrostipa wakoolica</i>	E		4	12
Scant pomaderris	<i>Pomaderris queenslandica</i>	E		0	3

1 = mapsheets included Alectown (8532), Parkes (8531), Bogan Gate (8431), Peak Hill (8532), Trundle (8432), Tullamore (8432), Forbes (8531) and Jemalong (8431)

Status (TSC Act):

E Endangered Species
CE Critically Endangered Species
V Vulnerable Species
PV Proposed Vulnerable Species

Status (EPBC Act):

E Endangered
V Vulnerable
MIG Migratory Species

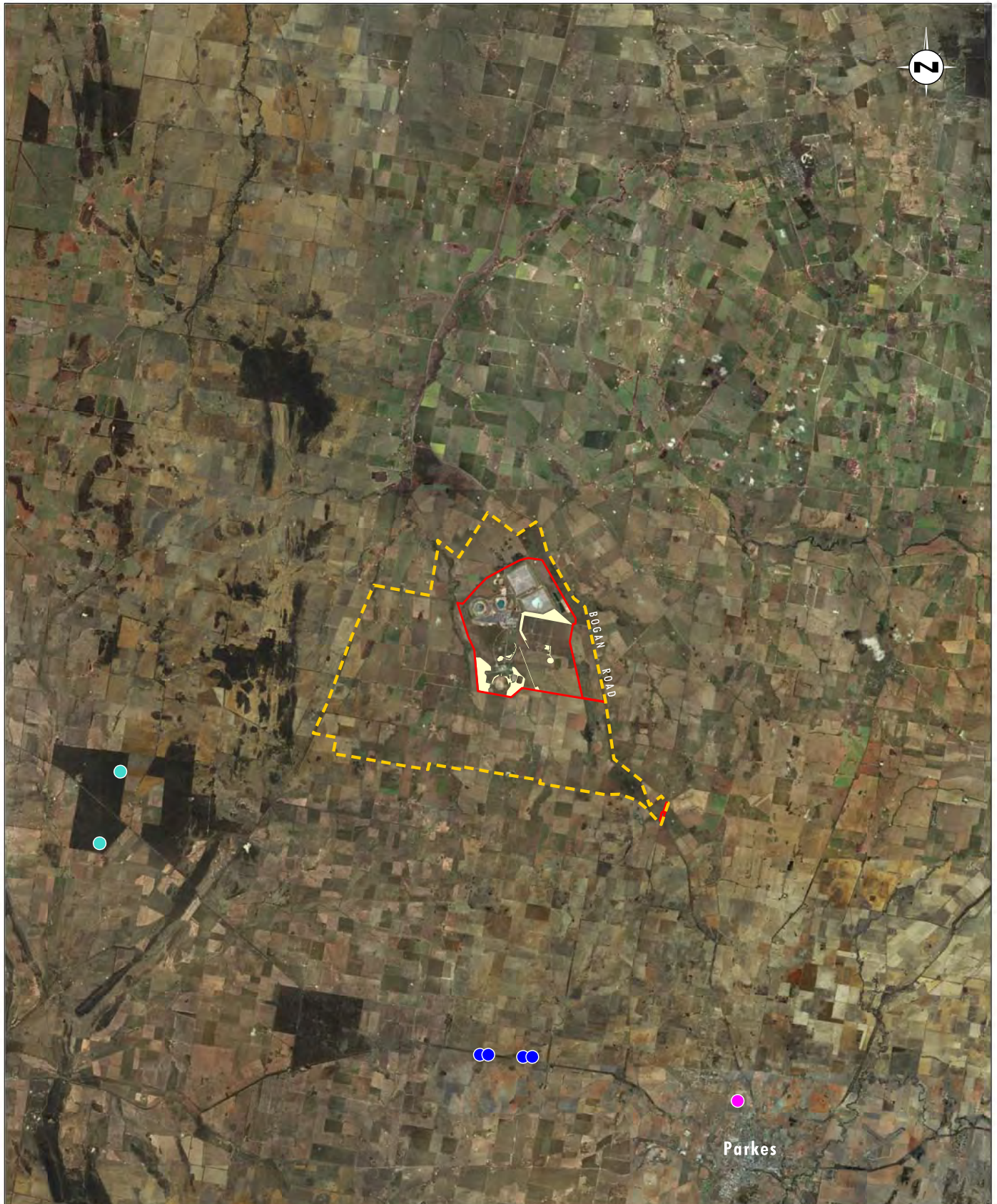
A 20 kilometre radius search from the boundary of the Project Area completed using the Atlas of NSW Wildlife Database records identified three threatened flora species (refer to **Figure 4.1**), 13 threatened bird species and three threatened mammal species (refer to **Figure 4.2**) as occurring within 20 kilometres of the Project Area. These consisted of 12 vulnerable and one endangered bird species; three vulnerable mammal species and two vulnerable and one endangered flora species.

4.2.1.2 BirdLife Atlas Database Search

A 20 kilometre radius search from the boundary of the Project Area was completed using the BirdLife Australia Atlas Database (the search undertaken on 29 May 2012) to identify threatened bird species with the potential to occur in, or adjacent to, the proposed disturbance area (refer to **Table 4.3**).

Table 4.3 – BirdLife Australia Atlas Search for Threatened Bird Species Records within 20 Kilometres of the Project Area

Common Name	Scientific Name	TSC Act	EPBC Act	First date	Last date	Number of records
Birds						
Magpie goose	<i>Anseranas semipalmata</i>	V		1998	2011	4
Freckled duck	<i>Stictonetta naevosa</i>	V		1999	2011	37
Blue-billed duck	<i>Oxyura australis</i>	V		1998	2012	82
Australasian bittern	<i>Botaurus poiciloptilus</i>	E1		1999	1999	1
Black-breasted buzzard	<i>Hamirostra melanosternon</i>	V		1999	1999	1
Spotted harrier	<i>Circus assimilis</i>	V		1998	2010	28
Little eagle	<i>Hieraaetus morphnoides</i>	V		1999	2012	33
Grey falcon	<i>Falco hypoleucos</i>	E1		1999	2000	2
Black falcon	<i>Falco subniger</i>	PrV		1999	2000	4
Bush stone-curlew	<i>Burhinus grallarius</i>	E1		2000	2000	1
Australian painted snipe	<i>Rostratula australis</i>	E1	V & MIG	2000	2000	1
Glossy black-cockatoo	<i>Calyptorhynchus lathami</i>	V		2000	2011	4
Major Mitchells cockatoo	<i>Lophochroa leadbeateri</i>	V		1999	2009	9
Little lorikeet	<i>Glossopsitta pusilla</i>	V		1998	2011	15
Superb parrot	<i>Polytelis swainsonii</i>	V	V	1998	2011	49
Swift parrot	<i>Lathamus discolor</i>	E1	E	2000	2009	3
Turquoise parrot	<i>Neophema pulchella</i>	V		1998	2009	20
Barking owl	<i>Ninox connivens</i>	V		2000	2000	1
Brown treecreeper	<i>Climacteris picumnus</i> subsp. <i>victoriae</i>	V		1998	2012	240
Speckled warbler	<i>Chthonicola sagittata</i>	V		1998	2012	104
White-fronted chat	<i>Epthianura albifrons</i>	V		1999	2008	5
Black-chinned honeyeater	<i>Melithreptus gularis gularis</i>	V		1998	2010	12
Painted honeyeater	<i>Grantiella picta</i>	V		1999	2011	2



Source: Boundaries: NPM (2013), Aerial: Google Earth (2010)

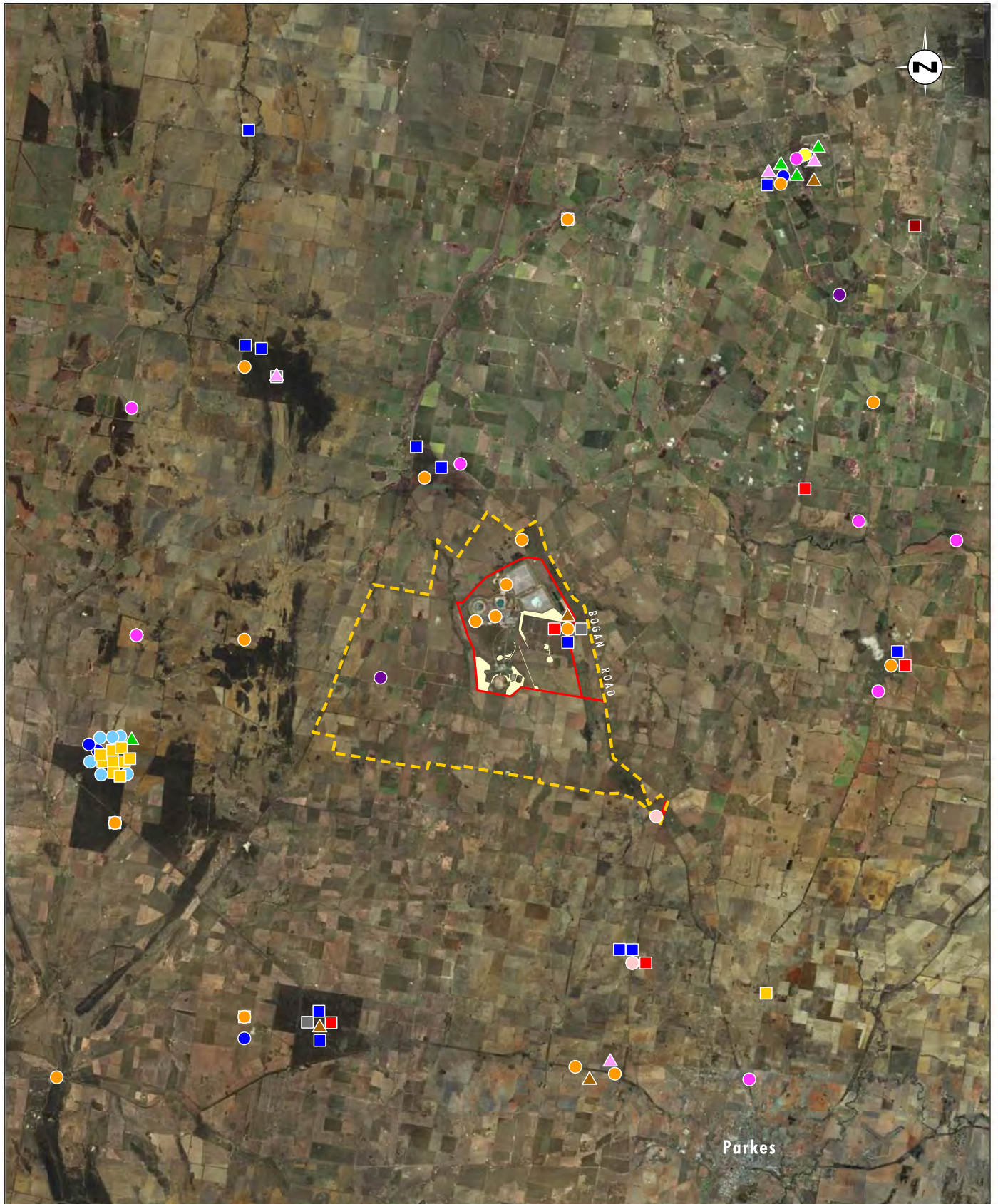
0 5.0 10.0 12.5 km
1:250 000

Legend

- Project Area
- Wider Study Area
- Project Disturbance Area
- *Austrostipa wakaolica*
- *Diuris tricolor*
- *Swainsona sericea*

FIGURE 4.1

NSW Atlas of Wildlife Threatened
Flora Species within 20 Kilometres
of the Project Area



Source: Boundaries: NPM (2013), Aerial: Google Earth (2010)

0 5.0 10.0 12.5 km
1:250 000

Legend

- | | | | |
|---|--|--|--|
| Project Area | ■ Diamond firetail | ■ Malleefowl | ● Yellow-bellied sheath-tail-bat |
| Wider Study Area | ● Grey-crowned babbler | ● Painted honeyeater | |
| Project Disturbance Area | ■ Hooded robin | ▲ Speckled warbler | |
| ▲ Barking owl | ● Koala | ● Spotted harrier | |
| ● Black-chinned honeyeater | ● Little eagle | ● Superb parrot | |
| ■ Brown tree creeper | ■ Little pied bat | ▲ Varied sittella | |

FIGURE 4.2

NSW Atlas of Wildlife Threatened
Fauna Species within 20 Kilometres
of the Project Area

Table 4.3 – BirdLife Australia Atlas Search for Threatened Bird Species Records within 20 Kilometres of the Project Area (cont.)

Common Name	Scientific Name	TSC Act	EPBC Act	First Date	Last Date	Number of records
Grey-crowned babbler	<i>Pomatostomus temporalis</i> subsp. <i>temporalis</i>	V		1997	2012	280
Varied sittella	<i>Daphoenositta chrysoptera</i>	V		1998	2011	43
Gilbert's whistler	<i>Pachycephala inornata</i>	V		1999	2010	10
Scarlet robin	<i>Petroica boodang</i>	V		2003	2003	1
Flame robin	<i>Petroica phoenicea</i>	V		1998	2003	11
Hooded robin	<i>Melanodryas cucullata</i> subsp. <i>cucullata</i>	V		1998	2009	20
Diamond firetail	<i>Stagonopleura guttata</i>	V		1998	2012	44
Migratory Species						
White-throated needletail	<i>Hirundapus caudacutus</i>		MIG	1999	2003	3
Fork-tailed swift	<i>Apus pacificus</i>		MIG	1999	1999	1
Eastern great egret	<i>Ardea modesta</i>		MIG	1998	2012	41
Cattle egret	<i>Ardea ibis</i>		MIG	2000	2006	6
Glossy ibis	<i>Plegadis falcinellus</i>		MIG	1995	2008	23
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>		MIG	1998	2012	71
Latham's snipe	<i>Gallinago hardwickii</i>		MIG	2000	2008	6
Common greenshank	<i>Tringa nebularia</i>		MIG	1999	2001	4
Marsh sandpiper	<i>Tringa stagnatilis</i>		MIG	1999	2006	7
Sharp-tailed sandpiper	<i>Calidris acuminata</i>		MIG	1998	2007	14
White-winged black tern	<i>Chlidonias leucopterus</i>		MIG	1999	2001	3
Swift parrot	<i>Lathamus discolor</i>	E1	E	2000	2009	3

Status (TSC Act):

E1 Schedule 1, Part 1: Endangered Species
PrV Schedule 2: Preliminary Listing Vulnerable Species
V Schedule 2: Vulnerable Species

Status (EPBC Act):

E Endangered
V Vulnerable
MIG Migratory species

The 20 kilometre radius search from the boundary of the Project Area completed using the BirdLife Australia Atlas Database records identified 29 threatened and 13 migratory bird species with the potential to occur in, or adjacent to, the proposed disturbance area (refer to **Table 4.3**). This included 24 species listed as vulnerable and five species listed as endangered under the TSC Act and; two species listed as vulnerable and one species listed as endangered under the EPBC Act.

4.2.1.3 Department of Primary Industries Database Search

A search of the Forbes, Lachlan and Parkes Local Government Areas (LGAs) was completed using the Primary Industries Fishing and Aquaculture Records Viewer (DPI 2012) (the search undertaken on 4 March 2013) to identify endangered aquatic ecological communities and threatened fish species with the potential to occur within, or adjacent to, the proposed disturbance area. The search identified three endangered ecological communities and three threatened fish species with the potential to occur within, or adjacent to, the proposed disturbance area (refer to **Table 4.4**).

Table 4.4 – Department of Primary Industries Database Search for Threatened Fish Species Records within Forbes, Lachlan and Parkes LGAs

Ecological Community		EPBC Act	FM Act	Forbes LGA	Lachlan LGA	Parkes LGA
Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River			EEC	No	No	Yes
Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River			EEC	Yes	Yes	Yes
Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment			EEC	No	No	No
Common Name	Scientific Name	EPBC Act	FM Act	Forbes LGA	Lachlan LGA	Parkes LGA
				Number of Known Records		
Silver perch	<i>Bidyanus bidyanus</i>		V	3	1	0
Murray cod	<i>Maccullochella peelii</i>	V		8	7	0
Freshwater catfish	<i>Tandanus tandanus</i>		EP	1	3	0

V Vulnerable
EP Endangered population
EEC Endangered ecological community

4.3 Flora Survey Results

As a result of flora surveys and vegetation community mapping, a diverse range of plant species and vegetation communities (including EECs), were recorded in the proposed disturbance area. The following sections detail these results.

4.3.1 Flora Species

A total of 277 plant species were identified by Umwelt within the Wider Study Area from surveys during 2011 and 2012. Plants were recorded from three major vascular plant classes, the conifers, ferns and flowering plants (refer to **Table 4.5**) and included trees, shrubs, forbs, grasses, sedges, rushes, reeds, ferns, mistletoes, vines and twiners. **Appendix C** provides a full list of the flora species recorded in each quadrat (with a cover abundance score) or rapid assessment and also shows those species recorded opportunistically.

Table 4.5 – Composition of Plant Classes and Families Recorded across the Wider Study Area

Plant Class	Sub-class	Number of Families	Number of Species
Coniferopsida		1	1
Filicopsida		3	4
Magnoliopsida	Liliidae	8	87
Magnoliopsida	Magnoliidae	48	185
Totals (all plants)		60	277

A total of 58 plant families were recorded within the Wider Study Area (refer to **Table 4.5**). Poaceae (grasses) was the most speciose family with 61 species recorded, followed by Asteraceae (daisies) with 45 species recorded, Chenopodiaceae (saltbushes) with 20 species recorded, and Fabaceae (all sub families) (peas and wattles) with 17 species recorded.

Of the 277 species recorded within the Wider Study Area, 63 (23 per cent) were introduced species. Introduced species that were commonly recorded include spear thistle (*Cirsium vulgare*), *Lepidium africanum*, greater beggars ticks (*Bidens subalternans*) and flaxleaf fleabane (*Conyza bonariensis*). Two of the species recorded (less than 1 per cent of the flora of the Wider Study Area) are declared noxious weeds in the Parkes LGA under the *Noxious Weed Act 1993*. African boxthorn (*Lycium ferocissimum*) is also listed at a Weed of National Significance (Department of Primary Industries 2009). The declared noxious weeds recorded in the Wider Study Area are listed in **Table 4.6**.

Table 4.6 – Noxious Weeds Recorded in the Wider Study Area

Family	Botanical Name	Common Name	Noxious weed control objective ¹
Asteraceae	* <i>Xanthium spinosum</i>	Bathurst burr	4
Solanaceae	* <i>Lycium ferocissimum</i>	African boxthorn	4

Notes:

* Denotes introduced – not native to Australia.

¹ Department of Primary Industries, 2009 Control objectives.

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

4.3.2 Vegetation Communities

Surveys of the proposed disturbance area identified five vegetation communities and three types of disturbed or non-vegetated areas (refer to **Figure 4.3**). Vegetation communities were also sampled across the Wider Study Area to inform the identification and mapping of the vegetation communities within the proposed disturbance area. The vegetation communities identified within the proposed disturbance area are listed in **Table 4.7**.

Vegetation communities were aligned, where possible, with vegetation map units as described in the *New South Wales Vegetation Classification and Assessment* (Benson *et. al* 2010). **Table 4.7** shows the area of each vegetation community within the proposed disturbance area, and the following sections provide brief descriptions of each community.



Source: Boundaries: NPM (2013), Aerial: Google Earth (2010)

0 0.5 1 1.5 km
1:35 000

Legend

- Project Area
- Wider Study Area
- Project Disturbance Area
- Bimble Box-White Cypress Pine Woodland
- Bimble Box-White Cypress Pine Woodland-Exotic Understorey
- Disturbed Land
- Exotic Grassland

- Grey Box Grassy Woodland (EEC - TSC Act/EEC - EPBC Act)
- Grey Box Grassy Woodland-DNG (EEC - TSC Act/EEC - EPBC Act)
- Plantation
- White Box-Yellow Box-Blakely's Red Gum Woodland (EEC - TSC Act/CEEC - EPBC Act)
- Cultivated Agricultural Land

FIGURE 4.3

Vegetation Communities of the Project Disturbance Area

Table 4.7 – Vegetation Communities Identified Within the Proposed Disturbance Area

Vegetation Community	Legal Status		Proposed Disturbance Area (ha ¹)
	TSC	EPBC	
Bimble Box – White Cypress Pine Woodland	-	-	12
Bimble Box – White Cypress Pine Woodland – Exotic Understorey	-	-	1.7
Grey Box Grassy Woodland	EEC	EEC	23
Grey Box Grassy Woodland – DNG	EEC	EEC	15
White Box – Yellow Box – Blakely's Red Gum Woodland	EEC	CEEC	0.28
Sub-total			52
Disturbed and Non-vegetated Areas			
Cultivated Land	-	-	112
Disturbed Land	-	-	11
Exotic Grassland	-	-	39
Plantation	-	-	25
Sub-total			187
Total			239

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

4.3.2.1 Grey Box Grassy Woodland

Benson *et. al* (2010) community: ID76 – Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.

Biometric Vegetation Type: LA154 - Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (Benson 76).

Conservation Status

Grey Box Grassy Woodland is consistent with:

- EPBC Act: Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grassland of South-eastern Australia Endangered Ecological Community.
- TSC Act: Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Nandewar and Brigalow Belt South Bioregions Endangered Ecological Community.

This community will hereafter be referred to as 'Grey Box Grassy Woodland'. Approximately 23 hectares of Grey Box Grassy Woodland was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

Grey Box Grassy Woodland occurred along the entrance road to NPM (old Northparkes Lane), in the proposed E28 open cut area, and as a narrow strip along parts of McClintocks Lane (refer to **Figure 4.1**).

Grey Box Grassy Woodland was typically tall woodland with a canopy generally dominated by western grey box (*Eucalyptus microcarpa*), White cypress pine (*Callitris glaucophylla*) also occasionally occurred in the canopy. A sparse sub-canopy dominated by bullock (*Allocasuarina luehmannii*) may also occur.

Shrubs were generally sparse to absent and may include hakea wattle (*Acacia hakeoides*), galvanized burr (*Sclerolaena birchii*) and western rosewood (*Alectryon oleifolius*).

A dense ground cover dominated by grasses was typical, including *Austrostipa scabra* subsp. *falcata*, hairy panic (*Panicum effusum*), *Austrostipa bigeniculata*, windmill grass (*Chloris truncata*), *Enteropogon acicularis*, Browns lovegrass (*Eragrostis brownii*), *Austrodanthonia bipartita* and ringed wallaby grass (*Austrodanthonia caespitosa*), with occurrences of plains grass (*Austrostipa aristiglumis*) where the ground was wetter. Other common ground cover species were kidney weed (*Dichondra repens*), *Sida corrugata*, woolly New Holland daisy (*Vittadinia gracilis*), *Glycine tabacina*, quena (*Solanum esuriale*), creeping saltbush (*Atriplex semibaccata*), lesser joyweed (*Alternanthera denticulata*), whiteroot (*Pratia purpurascens*), *Oxalis perennans*, knob sedge (*Carex inversa*), *Vittadinia gracilis* and *Einadia nutans* subsp. *nutans*.

The disturbed nature of surrounding vegetation and the broader landscapes meant that introduced flora species were also common. Dominant species included greater beggars ticks (*Bidens subalternans*), spear thistle (*Cirsium vulgare*), common sowthistle (*Sonchus oleraceus*), flaxleaf fleabane (*Conyza bonariensis*) and *Lepidium africanum*.

In summary this community complies with the final determination (NSW Scientific Committee 2007) and listing advice (Threatened Species Scientific Committee 2010) with regard to the following criteria.

General Condition Thresholds (1a, 1b and 1c):

- the minimum patch size was at least 0.5 hectare;
- the canopy layer contained western grey box (*Eucalyptus microcarpa*); and
- the vegetative cover of non-grass weed species in the ground layer was less than 30 per cent.

Condition Thresholds (4a and 4b):

- the woodlands were greater than 2 hectares in size;
- all four quadrats surveyed comprised at least 20 trees per hectare with a DBH of at least 12 centimetres; and
- all four quadrats surveyed had at least 50 per cent of the vegetative cover in the ground layer comprised by perennial native species.

Table 4.8 identifies how the Grey Box Grassy Woodlands meets the TEC requirements under thresholds 4a and 4b in all four quadrats. Additionally, 75 per cent of the quadrats surveyed (three of the four) met the TEC requirements under thresholds 3a and 3b.

**Table 4.8 – Application of Condition Thresholds to Grey Box Grassy Woodland
Quadrats Surveyed within the Wider Project Area**

Quadrat	Size Category (ha)	Condition thresholds 3a and 3b ¹		Condition thresholds 4a and 4b ¹	
		No. trees/ha hollow bearing or have a DBH of at least 60 cm	Percentage of the vegetative ground cover comprised by perennial native grasses. ²	No. trees/ha with a DBH of at least 12 cm	Percentage of the vegetative ground cover comprised by perennial native species. ²
8A	>2	0	40	475	60
8C	>2	25	60	200	90
8D	>2	25	80	50	90
SQ2	>2	25	50	350	90

1 = Based on the scoring system used within the modified Braun-Blanquet 6-point scale (Braun-Blanquet, 1927; Poore, 1955; Austin et al., 2000) percentage totals were rounded to the nearest multiple of 10.

2 = Threatened Species Scientific Committee (2010).

4.3.2.2 Grey Box Grassy Woodland – Derived Native Grassland

Corresponding Benson *et. al* (2010) community: ID76 – Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.

Biometric Vegetation Type: LA154 - Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (Benson 76).

Conservation Status

Grey Box Grassy Woodland – DNG is consistent with:

- EPBC Act: Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grassland of South-eastern Australia Endangered Ecological Community.
- TSC Act: Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobarr Penepine, Nandewar and Brigalow Belt South Bioregions Endangered Ecological Community.

This community will be referred to as 'Grey Box Grassy Woodland – DNG' hereafter. Approximately 15 hectares of Grey Box Grassy Woodland – DNG was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

Grey Box Grassy Woodland – DNG occurred on the relatively fertile soils in northern and southern regions of the proposed disturbance area. Specifically the community occurred north and south of the entrance road to NPM (old Northparkes Lane), in the proposed E28 open cut area, in the proposed south-western waste dump area and along McClintocks Lane (refer to **Figure 4.1**). These areas were likely to have previously been dominated by an open grey box (*Eucalyptus microcarpa*) woodland based on the stands of remnant woodland that occurred in vicinity to the areas of grasslands.

Apart from the occasional western grey box (*Eucalyptus microcarpa*) scattered tree, this community was largely devoid of trees and sub-shrubs. The ground cover was composed of native and introduced grasses and forbs. Commonly recorded native species included windmill grass (*Chloris truncata*), weeping lovegrass (*Eragrostis parviflora*), *Enteropogon acicularis*, hairy panic (*Panicum effusum*), wallaby grass (*Rytidosperma bipartitum*) and galvanized burr (*Sclerolaena birchii*). The cover of introduced plant species was dominated by saffron thistle (*Carthamus lanatus*), burr medic (*Medicago polymorpha*), lucerne (*Medicago sativa*) and skeleton weed (*Chondrilla juncea*).

Grey Box Grassy Woodland – DNG is closely related to Grey Box Grassy Woodland, as it is likely to have once been part of this community prior to clearing.

This community in its DNG form conforms to the NSW TSC Act listed Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions EEC as well as the Commonwealth EPBC Act listed Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC.

In summary this community complies with the Final Determination (NSW Scientific Committee 2007) and Listing Advice (Threatened Species Scientific Committee 2010) with regard to the following criteria.

General Condition Thresholds (1a, 1b and 1c):

- the minimum patch size was at least 0.5 hectare;
- the canopy layer contained western grey box (*Eucalyptus microcarpa*) (previously); and
- the vegetative cover of non-grass weed species in the ground layer was less than 30 per cent.

Condition Thresholds (5a, 5b and 5c):

- the dominance of western grey box (*Eucalyptus microcarpa*) in woodlands surrounding the grasslands was clear evidence that it would have once been the dominant tree canopy species;
- all four quadrats surveyed in the Grey Box Grassy Woodland – DNG had at least 50 per cent of the vegetative cover in the ground layer of perennial native species; and
- at least 12 native species were recorded within the ground layer in 75 per cent of the quadrats surveyed (three of the four).

Table 4.9 identifies how the Grey Box Grassy Woodland – DNG conforms with the TEC requirements under thresholds 5b and 5c in 75 per cent of the quadrats surveyed (three of the four).

Table 4.9 – Application of Condition Thresholds on Grey Box Grassy Woodland – DNG Quadrats Surveyed within the Wider Project Area

Quadrat	Condition threshold 5b ¹	Condition threshold 5c ¹
	Percentage of vegetative cover in the ground layer comprised of perennial native species. ²	Number of native species present in the ground layer.
9A	80	9
Q07	90	23
Q09	75	19
Q14	95	19

¹ Threatened Species Scientific Committee (2010).

² Based on the scoring system used within the modified Braun-Blanquet 6-point scale (Braun-Blanquet, 1927; Poore, 1955; Austin et al., 2000) percentage totals were rounded to the nearest multiple of 10.

4.3.2.3 White Box – Yellow Box – Blakely’s Red Gum Woodland

Benson *et. al* (2010) community: ID75 – Yellow Box - White Cypress Pine grassy woodland on deep sandy-loam alluvial soils of the eastern Riverina and western South-western Slopes Bioregions.

Biometric Vegetation Type: LA217 – White Box - Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 282).

Conservation Status

White Box – Yellow Box – Blakely’s Red Gum Woodland is consistent with:

- EPBC Act: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community (CEEC).
- TSC Act: White box Yellow Box Blakely's Red Gum Woodland (EEC).

This community will be referred to as ‘White Box – Yellow Box – Blakely’s Red Gum Woodland’ hereafter. Approximately 0.28 hectare of White Box – Yellow Box – Blakely’s Red Gum Woodland was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

This vegetation community was restricted to a small area in the central western portion of the proposed disturbance area associated with a proposed haul road (refer to **Figure 4.3 Inset**).

White Box – Yellow Box – Blakely’s Red Gum Woodland in the proposed disturbance area comprised a tall sparse to open yellow box (*Eucalyptus melliodora*) and white cypress pine (*Callitris glaucophylla*) canopy as the dominant stratum. Old cut stumps were recorded in some stands of this community suggesting logging activities have previously taken place. Yellow box (*Eucalyptus melliodora*) trees in the community were predominantly middle aged, but old growth trees were scattered throughout.

The community typically lacked a mid stratum, but kurrajong (*Brachychiton populneus* subsp. *populneus*) and velvet mock olive (*Notelaea microcarpa* var. *microcarpa*) shrubs were recorded in very low numbers.

The understorey of this community was characterised by a medium sparse *Austrostipa scabra* subsp. *falcata*, woolly New Holland daisy (*Vittadinia gracilis*) and *Sida corrugata*, forb and grass ground stratum. A number of other indigenous forbs and grasses were recorded but were not necessarily characteristic of the community. Some of these species included *Einadia polygonoides*, windmill grass (*Chloris truncata*), quena (*Solanum esuriale*), *Einadia nutans* subsp. *linifolia*, tussock grass (*Poa labillardierei* var. *labillardierei*) and golden everlasting (*Xerochrysum bracteatum*).

Introduced flora species were relatively common in the ground stratum with horehound (*Marrubium vulgare*), greater beggars ticks (*Bidens subalternans*), flaxleaf fleabane (*Conyza bonariensis*) and *Lepidium africanum* being the more dominant species.

In summary this community complies with the NSW Final Determination (NSW Scientific Committee 2011), Commonwealth Listing Advice (Threatened Species Scientific Committee 2006) and policy statement (DSEWPC 2006a) with regard to the following criteria.

- Yellow box (*Eucalyptus melliodora*) was recorded as the most common overstorey species;
- all five quadrats surveyed in the Wider Study Area had a predominantly native understorey;
- patches were at least 0.1 hectare in size;
- at least 12 native understorey species (excluding grasses) were recorded in all of the five quadrats surveyed; and
- at least one important species was recorded in all five quadrats surveyed.

As all five quadrats met the understorey condition classification requirements of the TEC, there was no need to apply the additional woodland classification. These are only required where the understorey criteria are not met.

Table 4.10 – Application of Condition Thresholds on White Box – Yellow Box – Blakely's Red Gum Woodland Quadrats Surveyed within the Wider Project Area

Quadrat	Is the patch at least 0.1 ha in size?	Understorey Condition Thresholds			Additional Woodland Thresholds ¹	
		Percentage of perennial vegetation cover in the ground layer made up of native species.	Number of native understorey species present (excluding grasses).	Is there at least one important species present?	Is the patch at least 2 hectares in size?	Number of mature trees per hectare.
MelA	Yes	80	18	Yes	N/A	N/A
12A	Yes	80	17	Yes	N/A	N/A
Q06	Yes	80	24	Yes	N/A	N/A
Q12	Yes	80	18	Yes	N/A	N/A
Q13	Yes	90	20	Yes	N/A	N/A

¹ = Additional woodland thresholds only required if there is less than 12 native understorey species present (excluding grasses).

4.3.2.4 Bimble Box – White Cypress Pine Woodland

Benson *et. al* (2010) community: ID82 – Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion.

Biometric Vegetation Type: LA152 – Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Benson 82) [although this does not occur in the same Bioregion as the proposed disturbance area there is no appropriate biometric vegetation type listed for the South Western Slopes Bioregion].

Conservation Status

- EPBC Act: Not listed.
- TSC Act: Not listed.

Approximately 12 hectares of Bimble Box – White Cypress Pine Woodland was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

Bimble Box – White Cypress Pine Woodland was recorded throughout parts of the central and southern sections of the proposed disturbance area (refer to **Figure 4.1**). It is one of the more dominant vegetation communities in the Wider Study Area, forming relatively large woodland patches in comparison to the vegetation within the proposed disturbance area.

This community comprised an open woodland of moderate height (12 to 20 metres high) dominated by bimble box (*Eucalyptus populnea* subsp. *bimbil*). White cypress pine (*Callitris glaucophylla*) also occurred occasionally as a canopy tree but more frequently as a sub-canopy tree. The canopy was recruiting in this community with 2 to 4 metre high bimble box (*Eucalyptus populnea* subsp. *bimbil*) saplings observed.

Western grey box (*Eucalyptus microcarpa*) trees were occasionally present in this vegetation community and at low densities. It is therefore not considered to be consistent with any western grey box dominated TECs.

Sub-shrubs were relatively uncommon in the Bimble Box – White Cypress Pine Woodland understorey. The community was characterised by a dense grassy understorey (60 to 75 per cent cover) dominated by the following native grasses; tussock grass (*Poa labillardierei* var. *labillardierei*), *Austrostipa scabra* subsp. *falcata*, hairy panic (*Panicum effusum*), *Austrostipa bigeniculata* and Coolibah grass (*Panicum queenslandicum* var. *queenslandicum*).

A number of small forbs and shrubs were also present in the ground layer in relatively low abundances (5 to 15 per cent cover). Dominant species included kidney weed (*Dichondra repens*), *Einadia nutans* subsp. *linifolia*, *Einadia polygonoides*, *Glycine tabacina*, *Salsola kali* var. *kali*, woolly New Holland daisy (*Vittadinia gracilis*) and yellow burr-daisy (*Calotis lappulacea*). Some less common species that also occurred included hairy tails (*Ptilotus erubescens*), winter apple (*Eremophila debilis*), nodding chocolate lily (*Dichopogon fimbriatus*) and quena (*Solanum esuriale*).

Introduced plant species density was high at times, but generally was moderate (approximately 5 per cent cover). The most prevalent species included horehound (*Marrubium vulgare*), wild aster (*Aster subulatus*), greater beggars ticks (*Bidens subalternans*) and flaxleaf fleabane (*Conyza bonariensis*).

4.3.2.5 Bimble Box – White Cypress Pine Woodland – Exotic Understorey

Benson *et. al* (2010) community: ID82 – Western Grey Box – Poplar Box – White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion.

Biometric Vegetation Type: LA152 – Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Benson 82) [although this does not occur in the same Bioregion as the proposed disturbance area there is no appropriate biometric vegetation type listed for the South Western Slopes Bioregion].

Conservation Status

- EPBC Act: Not listed.
- TSC Act: Not listed.

Approximately 1.7 hectares of Bimble Box – White Cypress Pine Woodland – Exotic Understorey was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

Bimble Box – White Cypress Pine Woodland – Exotic Understorey generally occurred as isolated remnants within open and intensively cropped paddocks within the Wider Study Area (refer to **Figure 4.1**). Within the proposed disturbance area, Bimble Box – White Cypress Pine Woodland – Exotic Understorey occurred in the proposed E31 open cut area. Surrounding farming practices have significantly modified the understorey of this community, with a suite of introduced flora species now dominating.

Remnant woodland patches comprised an open to mid-dense woodland dominated by bimble box (*Eucalyptus populnea* subsp. *bimbil*) and white cypress pine (*Callitris glaucophylla*) of moderate height (12 to 18 metres high). The canopy density of this community appeared to vary based on the relative size of the patches, with smaller stands comprising mid-dense canopies (60 per cent cover) and open canopies (30 per cent cover) in the larger stands.

Sub-shrubs were virtually absent from the community, with the exception of bimble box (*Eucalyptus populnea* subsp. *bimbil*) recruits. Some native grasses and forbs were recorded in the understorey and ground layer, albeit in low cover. The more common native species included *Austrostipa bigeniculata*, wallaby grass (*Rytidosperma bipartitum*) and *Austrostipa scabra* subsp. *falcata*, kidney weed (*Dichondra repens*), spiny-fruit saltbush (*Atriplex spinibractea*), corrugated sida (*Sida corrugata*) and climbing saltbush (*Einadia nutans* subsp. *nutans*).

As previously mentioned, a number of introduced flora species were common in the understorey. Dominant introduced species included greater beggars ticks (*Bidens subalternans*), horehound (*Marrubium vulgare*), London rocket (*Sisymbrium irio*), vervain (*Salvia verbenaca*) and flaxleaf fleabane (*Conyza bonariensis*). The combined cover of introduced flora species was typically around 20 per cent.

4.3.2.6 Exotic Grassland

Benson *et. al* (2010) community: Not listed.

Biometric Vegetation Type: Not listed.

Conservation Status

- EPBC Act: Not listed.
- TSC Act: Not listed.

Approximately 39 hectares of Exotic Grassland was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

Exotic Grasslands occurred throughout the proposed disturbance area and occupied parts of the landscape that had been disturbed in the past but still contain some native flora species. Specifically, Exotic Grasslands were recorded on drainage lines, old cropped paddocks and previously cleared land surrounding the Active Operational Areas. Exotic Grasslands do not include cultivated agricultural cropping land dominated by exotic pasture or crop species.

Exotic Grasslands usually supported a variety of introduced flora species. A small number of opportunistic indigenous grasses were typically present in areas soon after disturbance. These were generally small areas, but across the community these native species were outcompeted by introduced flora species. However, the foliage cover was typically co-dominated by introduced forbs and indigenous grasses. These areas were not identified as a form of Derived Native Grassland due to their long history of disturbance and high likelihood of continued modification.

The most common introduced flora species included greater beggars ticks (*Bidens subalternans*), flaxleaf fleabane (*Conyza bonariensis*), curled dock (*Rumex crispus*), spear thistle (*Cirsium vulgare*), wild aster (*Aster subulatus*) and common verbena (*Verbena officinalis*). Fewer indigenous flora species were present, but those dominant were coolibah grass (*Panicum queenslandicum* var. *queenslandicum*), spear grass (*Austrostipa bigeniculata*) and tussock grass (*Poa labillardierei* var. *labillardierei*).

4.3.2.7 Disturbed Land

Benson *et. al* (2010) community: Not listed.

Biometric Vegetation Type: Not listed.

Conservation Status

- EPBC Act: Not listed.
- TSC Act: Not listed.

Approximately 112 hectares of Disturbed Land was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

Disturbed Land refers to cleared areas (generally less than 10 per cent plant ground cover) within the proposed disturbance area, most often associated with existing mining areas. It also includes farm dams, storage areas and material stockpiles.

These areas have been exposed to a history of modifications by the operations of NPM. Consequently, other than the occasional scattered western grey box (*Eucalyptus microcarpa*) no remnant vegetation remains in these areas. Disturbed Lands were largely made up of introduced flora species, with pasture grasses and weeds dominating.

Due to the heavily modified nature of this community, no formal vegetation assessments were conducted. Plant species documented within this description have been made based on opportunistic sampling.

4.3.2.8 Plantation

Benson *et. al* (2010) community: Not listed.

Biometric Vegetation Type: Not listed.

Conservation Status

- EPBC Act: Not listed.
- TSC Act: Not listed.

Approximately 25 hectares of Plantation was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

Plantation vegetation occurred in numerous locations across the proposed disturbance area with the largest area located north of the existing mine access road (refer to **Figure 4.1**). This community occurred in previously cleared areas of land that have been revegetated with a number of native tree and shrub species.

Trees and shrubs were planted in single species lines in the Plantation community, species included a mix on native canopy species that were not local to the area as well as a small proportion of western grey box (*Eucalyptus microcarpa*). Plantation areas were highly modified from previous clearing activities with an understorey dominated by introduced flora species, namely cobbler's pegs (*Bidens pilosa*) and flaxleaf fleabane (*Conyza bonariensis*). However, indigenous forbs were lightly scattered throughout in the ground layer, of which the dominant species was kidney weed (*Dichondra repens*).

4.3.2.9 Cultivated Agricultural Land

Benson *et. al* (2010) community: Not listed.

Biometric Vegetation Type: Not listed.

Conservation Status

- EPBC Act: Not listed.
- TSC Act: Not listed.

Approximately 112 hectares of Cultivated Agricultural Land was recorded within the proposed disturbance area.

Floristic and Structural Character in the Wider Study Area and Proposed Disturbance Area

Cultivated Agricultural Land refers to cleared areas, typically paddocks, that are entirely utilised for agricultural purposes. The land is predominantly used for growing stock feed crops and therefore ploughing occurs frequently. The paddocks supported a mixture of introduced flora species, with pasture grasses and weeds dominating.

Due to the heavily modified nature of this community, no formal vegetation assessments were conducted. Plant species documented within this description have been made based on opportunistic sampling.

4.3.3 Threatened Ecological Communities

Two Threatened Ecological Communities (TECs) listed under the EPBC Act and TSC Act were recorded in the proposed disturbance area during surveys.

4.3.3.1 Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grassland of South-eastern Australia (EEC – EPBC Act)/Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (EEC – TSC Act)

As previously discussed (refer to **Section 4.3.2**) two vegetation communities identified within the proposed disturbance area conform to the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grassland of South-eastern Australia EEC of the EPBC Act and also conform to the Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions EEC of the TSC Act. The two communities and their extent within the proposed disturbance area are:

- Grey Box Grassy Woodland: 23 hectares; and
- Grey Box Grassy Woodland – DNG: 15 hectares.

4.3.3.2 White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC – EPBC Act)/White Box Yellow Box Blakely's Red Gum Woodland (EEC – TSC Act)

The vegetation community White Box – Yellow Box – Blakely's Red Gum Woodland identified within the proposed disturbance area conforms to the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC of the EPBC Act, and also conforms to the White Box - Yellow Box - Blakely's Red Gum Woodland EEC of the TSC Act. A total of 0.28 hectare of this community has been mapped in the proposed disturbance area.

4.3.4 Endangered Flora Populations

No endangered populations listed under the TSC Act were recorded in the proposed disturbance area and none were identified as potentially occurring during the literature review and database searches (see **Sections 4.1** and **4.2**).

4.3.5 Threatened Flora Species

No threatened flora species were recorded in the proposed disturbance area during field surveys. Suitably timed and targeted surveys were undertaken across the Wider Study Area for species previously identified as having the potential to occur within the proposed disturbance area.

One species, pine donkey orchid (*Diuris tricolor*), was recorded within the Wider Study Area during targeted surveys to the north of the proposed disturbance area (refer to **Figure 4.4**). Seasonal targeted surveys for pine donkey orchid (*Diuris tricolor*) were only conducted over a small portion of the proposed disturbance area (refer to **Figure 3.1**).

The population of pine donkey orchid (*Diuris tricolor*) was recorded within a patch of White Cypress Pine Woodland along the northern boundary of the Project Area (approximately 2.5 kilometres north of the Proposed Disturbance Area). The population extended north, across the realigned section of Adavale Lane, into a larger patch of White Cypress Pine Woodland within the Wider Project Area. A total of 234 plants were recorded within the two areas, a majority of which occur outside of the Project Area (refer to **Figure 4.2**).

No patches of White Cypress Pine Woodland occur within the Proposed Disturbance Area, however suitable habitat for the species remains present. Particularly in open areas of the Grey Box Woodland where white cypress pine (*Callitris glaucophylla*) is locally dominant. Habitat also occurs, albeit in small areas, within the Adavale Lane and McClintocks Lane road reserves. Additional areas include the woodland north of the E26 existing subsidence area. Combined these only comprise a small portion of the proposed disturbance area, but the potential presence and potential impacts to this species within the proposed disturbance area cannot be discounted.

Suitable habitat is considered to occur in the proposed disturbance area for four other threatened species, *Tylophora linearis*, silky Swainson-pea (*Swainsona sericea*), *Austrostipa wakoolica* and *Austrostipa metatoris*. None of these species were recorded during any of the surveys undertaken across the Wider Study Area and the proposed disturbance area. As each of these species may be detected in any season, the potential for these species to occur within the proposed disturbance area is considered to be low.

4.3.6 Rare or Threatened Australian Plants and Regionally Significant Flora Species

No rare, threatened or regionally significant flora species were recorded within the Wider Study Area or the proposed disturbance area.

4.3.7 Groundwater Dependent Ecosystems (GDEs)

There are no identified high priority Groundwater Dependent Ecosystems (GDEs), including the listed Threatened Ecological Communities, within or surrounding the proposed disturbance area. The closest identified high priority GDE is located approximately 50 kilometres to south-east of the proposed disturbance area.

4.4 Terrestrial Fauna Survey Results

A total of 18 species have been recorded in the proposed disturbance area, comprising 1 reptile, 14 birds and 3 mammals (refer to **Appendix D**). A total of 141 fauna species have been recorded within the Wider Study Area (which includes the proposed disturbance area), comprising 12 frog species, 13 reptiles, 91 birds and 25 mammals (refer to **Appendix D**).



Source: Boundaries: NPM (2013), Aerial: Google Earth (2010)

'Identified during Ecological Survey of the Wider Study Area by Umwelt and others since 2009, excluding Atlas 1:100 000 of NSW Wildlife Records

0 1.0 2.5 5.0 km
0 125 300 625 m
Inset 1:12 500

Legend

- Project Area
- - - Wider Study Area
- Project Disturbance Area
- *Diuris tricolor*

FIGURE 4.4

Threatened Flora Locations'

4.4.1 Terrestrial Fauna Habitat in the Proposed Disturbance Area

Four general fauna habitat types occurred within the proposed disturbance area. Each of the four general habitat types has a range of characteristics which influence the habitat value, and the range of fauna species which are likely to be identified within each habitat type. The broad habitat types recorded within the proposed disturbance area comprised woodland habitat, grasslands, farm dams and disturbed habitats.

4.4.1.1 Woodland Habitats

The vegetation of the woodland areas generally comprised an open, low woodland overstorey and a scattered low understorey habitat area. Canopies were dominated by middle aged (200 - 400 millimetres DBH) trees reaching 5 to 22 metres in height. Mature (400 to 600 millimetres DBH) trees also occurred but at lower frequencies within the canopy. Old growth trees (600+ millimetres DBH) were scarce. Saplings (less than 100 millimetres diameter stems) were scarce to moderately common ranging between 1 and 10 metres in height. Stags (dead standing trees) were scarce. The dominant canopy species were western grey box (*Eucalyptus microcarpa*), bimble box (*Eucalyptus populnea*), yellow box (*Eucalyptus melliodora*) and white cypress (*Callitris glaucophylla*).

Tree hollows were recorded in middle-aged, mature and old growth trees. Very small (less than 25 millimetres), small (26 to 50 millimetres), medium (51 to 100 millimetres) and large (101 to 300 millimetres) tree hollows were common and extra large (greater than 300 millimetres) tree hollows occurred at low density. Hollows were generally a mixture of alive and dead hollows.

An open shrub layer was common and ranged between 0.5 metre and 1.5 metres in height. The shrub layer often contained a poor to moderate level of species and structural diversity. The ground cover was predominately a mix of native and exotic grass species reaching an average height of 0.1 to 0.8 metre with areas of soil, litter and herb/forbs also occurring. Log cover (fallen trees and branches) was scattered to moderate and dominated by small (<100 millimetres diameter), medium (101 – 300 millimetres diameter) and large (>300 millimetres diameter) logs. Log cover predominately comprised solid (with and without bark) and hollow logs however some rotten logs were also recorded.

Species specific habitat areas of loose tree bark were recorded. No areas of rock on rock, rock overhangs, caves, litter at the base of trees, terrestrial termite mounds or arboreal termite mounds were recorded. One of the 10 koala food tree species listed on Schedule Two of NSW State Environmental Planning Policy No. 44 (Koala Habitat Protection) (SEPP 44, refer to **Section 5.5**), bimble box (*Eucalyptus populnea*), was common throughout much of the woodland habitat of the proposed disturbance area.

Connectivity between woodland remnants within the proposed disturbance area was poor.

4.4.1.2 Grassland Habitats

Canopy layer and shrub layers were generally absent from this community, although isolated paddock trees and areas of regenerating eucalypts and shrubs occurred. Most woody vegetation had previously been cleared for agricultural purposes.

The ground layer was dominated by native and introduced grasses and forbs. Commonly recorded native species included windmill grass (*Chloris truncata*), weeping lovegrass (*Eragrostis parviflora*), *Enteropogon acicularis*, hairy panic (*Panicum effusum*), wallaby grass (*Rytidosperma bipartitum*) and galvanized burr (*Sclerolaena birchii*).

Introduced species were commonly recorded within the grassland habitats including saffron thistle (*Carthamus lanatus*), burr medic (*Medicago polymorpha*), lucerne (*Medicago sativa*), skeleton weed (*Chondrilla juncea*) and *Lepidium africanum*.

Grassland habitat areas provide little habitat value for most fauna species other than small terrestrial grassland species, macropods or granivorous birds.

4.4.1.3 Farm Dam Habitats

Six moderate sized farm dams occurred scattered throughout the proposed disturbance area, most commonly occurring within grassland and disturbed habitat areas. Farm dam quality was variable ranging from low quality dams with no emergent or bank side vegetation to high quality dams with large areas of emergent and bank side vegetation. As a result of this variability in quality, their suitability as habitat for a range of fauna varies. The high quality farm dams provide suitable seasonal breeding and foraging habitat for a range of frogs whereas the poor quality dams may only provide a semi-permanent drinking resource for common disturbed area species such as macropods.

4.4.1.4 Disturbed Habitats

Disturbed habitat areas include cropped paddocks, roads and mining operations including subsidence areas, tailings dams and surface infrastructure areas. Disturbed habitat areas provide limited habitat value only to disturbance adaptable species which typically rely on natural habitats for most of their daily requirements.

4.4.2 Hollow Bearing Tree Abundance

Hollow bearing tree abundance varied across the Wider Study Area but overall, within the timbered vegetation, hollow abundance was relatively high. **Table 4.11** below summarises the results of the hollow-bearing tree surveys.

Table 4.11 – Hollow Bearing Tree and Tree Hollow Abundance

Vegetation Community	Trees with Hollows per Hectare	Very Small Hollows per Hectare	Small Hollows per Hectare	Medium Hollows per Hectare	Large Hollows per Hectare	Very Large Hollows per Hectare	All Hollows per Hectare
Grey Box Grassy Woodland	63	36	40	44	24	11	155
Bimble Box White Cypress Pine Woodland	29	16	16	13	3	0	49
White Box Yellow Box Blakely's Red Gum Woodland	25	60	45	5	5	0	115

The hollow densities and hollow sizes varied across the vegetation communities. Grey Box Grassy Woodland contained the highest density of hollows of all three communities and was the only vegetation community found to contain very large hollows. Bimble Box White Cypress Pine Woodland was found to contain the lowest density of hollows overall.

White Box Yellow Box Blakely's Red Gum Woodland contained the highest density of very small hollows per hectare of the all three communities and also contained the highest number of hollows per hollow-bearing tree of the three communities with an average of 4.6 hollows per hollow bearing tree, with Grey Box Grassy Woodland second with an average of 2.8, and Bimble Box White Cypress Pine containing the least with an average of 1.6 hollows per hollow-bearing tree.

Table 4.12 below shows the potential loss of tree hollows as a result of the Project based on the densities shown in **Table 4.11**. The numbers presented within **Table 4.12** are estimates based on the extrapolation of the abundance data collected at each sampling location (as summarised in **Table 4.11**).

Table 4.12 – Potential Tree Hollow Loss as a Result of the Project

Vegetation Community	Area to be Removed by the Project (hectares)	Trees with Hollows to be Removed	Very Small Hollows to be Removed	Small Hollows to be Removed	Medium Hollows to be Removed	Large Hollows to be Removed	Very Large Hollows to be Removed
Grey Box Grassy Woodland	23	1449	828	920	1012	552	253
Bimble Box White Cypress Pine Woodland	12	348	192	192	156	36	0
White Box Yellow Box Blakely's Red Gum Woodland	0.28	7	17	45	13	1	0
Total		1804	1037	1057	1181	589	253

An estimated 1804 trees containing hollows are expected to be removed as a result of the Project.

4.4.3 Terrestrial Fauna Species Recorded in the Wider Study Area

Only records made during ecological surveys undertaken since 2008 (in the past five years) have been included in the following list of threatened fauna species as suggested by OEH in the DGRs.

Records of fauna species should be interpreted carefully as they are usually subject to survey effort and observer bias. Additionally, many species are highly mobile (particularly many birds) thus these species can readily occur in areas other than where they were recorded. For this reason, fauna records obtained from surveys throughout the Wider Study Area (including areas that will not be impacted by the current proposal) are considered to represent the species likely to occur in the proposed disturbance area (in appropriate habitat).

The aim of field surveys was not to determine population sizes, rather to assess the presence or potential presence of species.

The following sections provide details of the fauna species recorded during surveys of Wider Study Area.

4.4.3.1 Threatened Fauna Species

Records made during ecological surveys undertaken since 2008 (in the past five years) have been included in the following list of threatened fauna species as recommended by OEH in the Project's DGRs. The grey falcon and the brolga, included in the list below, were the only threatened species not recorded by Umwelt during the surveys for the Project and were recorded by Eco Logical during surveys within the Wider Study Area for a different project (Eco Logical 2011).

A total of 15 threatened fauna species were recorded within the Wider Study Area and comprised one amphibian, 12 birds and two micro-bat species. Two threatened fauna species were recorded within the proposed disturbance area, the superb parrot (*Polytelis swainsonii*) and grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*). The superb parrot is listed as vulnerable under the TSC Act and the EPBC Act and the grey-crowned babbler (eastern subspecies) is listed as vulnerable under the TSC Act.

One species, the black falcon (*Falco subniger*) is currently listed as a proposed vulnerable species in a Preliminary Determination under TSC Act (dated 17 August 2012). This means that the NSW Scientific Committee has made a Preliminary Determination to support a proposal to list the black falcon as a vulnerable species under the TSC Act. For the purposes of this ecological assessment, the black falcon was assessed as a vulnerable species.

Each of the threatened species records are described below.

Sloanes froglet (*Crinia sloanei*)

Sloanes froglet was recorded during February 2012 during opportunistic surveys of the Wider Study Area following a heavy rainfall event (refer to **Figure 4.3**). More than 10 individuals were recorded by call from inundated paddocks and road verges while conducting driving spotlight and walking spotlight surveys along McClintocks Lane, and a single individual was captured at the Bogan River crossing on McClintocks Lane.

Sloanes froglet is a cryptic, irruptive species that is only detectable following periods of heavy rainfall, when it emerges to breed in temporarily flooded landscapes. The species was recorded to the south-west of the proposed disturbance area during suitable survey conditions; however due to Project timing most of the proposed disturbance area was not part of the field survey area during the survey that occurred during suitable conditions for the species potential detection. Due to the presence of potential habitat, if Sloanes froglet occurs it may be a resident species within the proposed disturbance area. Sloanes froglet is listed as Vulnerable under the TSC Act.

Grey Falcon (*Falco hypoleucos*)

The grey falcon has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on one occasion (Eco Logical 2011) in a paddock adjacent to the current tailings dam in the north of the Active Operational Area in 2010 (refer to **Figure 4.3**). No other records of the grey falcon within the Wider Study Area are known.

The grey falcon is likely a rare or occasional visitor to the proposed disturbance area, which contains suitable forging habitat for the species. The grey falcon is listed as Endangered under the TSC Act.

Black Falcon (*Falco subniger*)

The black falcon has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on one occasion in autumn 2012 (refer to **Figure 4.3**). One individual was observed on that occasion flying west above McClintocks Lane. No other records of the black falcon within the Wider Study Area are known.

The black falcon is likely a rare or occasional visitor to the proposed disturbance area, which contains suitable foraging habitat for the species. The Scientific Committee, established by the TSC Act, has made a Preliminary Determination to list the black falcon as Vulnerable under the TSC Act.

Spotted Harrier (*Circus assimilis*)

The spotted harrier was not recorded within the proposed disturbance area, however it was recorded within the Wider Study Area on six occasions during surveys undertaken in spring 2011, summer 2012 and autumn 2012 (refer to **Figure 4.3**).

The spotted harrier is likely a regular visitor to the Wider Study Area and proposed disturbance area, as it is a wide-ranging species that inhabits open woodland, grassland and modified habitats in western NSW. Foraging habitat is available for the spotted harrier throughout the proposed disturbance area and its surrounds. The spotted harrier is listed as Vulnerable under the TSC Act.

Little Eagle (*Heiraaetus morphnoides*)

The little eagle has not been recorded in the proposed disturbance area, however it has been recorded within the Wider Study Area on one occasion, where a single individual was recorded in January 2012. The little eagle was perched on a fencepost in an area of revegetated woodland bounding Adavale Lane (refer to **Figure 4.3**). No other records of the little eagle within the proposed disturbance area are known.

The little eagle is likely an occasional or rare visitor to the proposed disturbance area which contains suitable foraging habitat throughout woodland, grassland and modified areas. The little eagle is listed as Vulnerable under the TSC Act.

Brolga (*Grus rubicunda*)

The brolga has been not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on one occasion (Eco Logical 2010) in a paddock adjacent to the current tailings dam in the north of the Active Operational Area in 2010 (refer to **Figure 4.3**). No other records of the brolga within the Wider Study Area are known.

The brolga is likely a rare visitor to the proposed disturbance area, which may provide suitable foraging habitat during times of heavy rainfall and flooding. The brolga is listed as Vulnerable under the TSC Act.

Bush Stone-curlew (*Burhinus grallarius*)

The bush stone-curlew has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on four occasions during September 2011 and February 2012. The bush stone-curlew responded to call playback in areas to the north-west and south-west of the proposed disturbance area. Two individuals were recorded in a woodland remnant on a private property to the south-west of the proposed disturbance area (refer to **Figure 4.3**).

The bush stone-curlew is likely a resident species within woodland remnants in the Wider Study Area and similar woodland habitat occurs within the proposed disturbance area. It is likely that the species may utilise suitable habitat throughout the proposed disturbance area and the proposed disturbance area may form part of one or more bush stone-curlew home range areas. The bush stone-curlew is listed as Endangered under the TSC Act.

Superb Parrot (*Polytelis swainsonii*)

The superb parrot has been recorded in the proposed disturbance area on one occasion and within the Wider Study Area on a further 17 occasions during surveys conducted in May and October 2009, October 2010, July and September 2011, and January, February and May 2012 (refer to **Figure 4.3**). More than 157 individuals have been recorded within the Wider Study Area across all survey periods.

The superb parrot is a regular visitor to many of the woodland habitats within and adjacent to the Wider Study Area. Foraging habitat for the species is provided within these habitats occurring within the proposed disturbance area. Potential breeding habitat is located in box woodland and in river red gums (*Eucalyptus camaldulensis*) which occur at low density along the Bogan River (within the Wider Study Area). The superb parrot is listed as Vulnerable under the TSC Act, and Vulnerable on the EPBC Act.

Swift Parrot (*Lathamus discolor*)

The swift parrot has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on two occasions. This species was recorded within the Active Operational Area in 2010 (Eco Logical 2010), and two individuals were recorded on a private property to the south-west of the proposed disturbance area in May 2012 (refer to **Figure 4.3**).

The swift parrot is likely an occasional seasonal visitor to the Wider Study Area and may also use similar habitats occurring in the proposed disturbance area, occurring during periods of winter flowering by mature eucalypt tree species. The swift parrot is listed as Endangered under the TSC Act, and as Endangered under the EPBC Act.

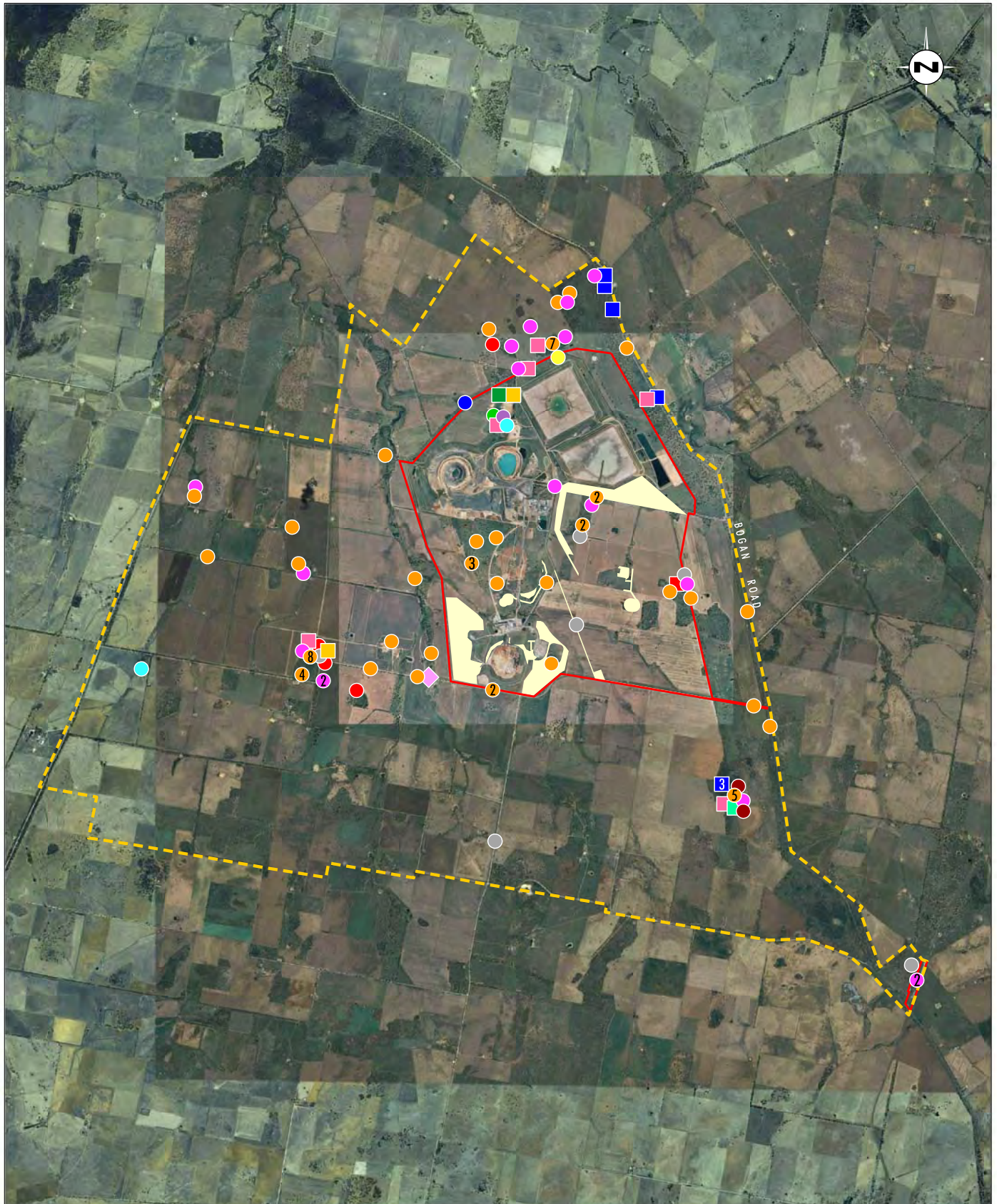
Masked Owl (*Tyto novaehollandiae*)

The masked owl has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on one occasion in September 2011, when a single individual was recorded to the south of the proposed disturbance area (refer to **Figure 4.5**). The individual was heard calling, and then found perched in a tree. No other records of the masked owl within the Wider Study Area are known.

The masked owl is likely an occasional visitor to the proposed disturbance area which contains some areas of suitable habitat for the species. The masked owl is listed as Vulnerable under the TSC Act.

Brown Treecreeper (*Climacteris picumnus victoriae*)

The brown treecreeper has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on seven occasions (refer to **Figure 4.3**). The brown treecreeper was recorded during July, September and October 2011, and May 2012 surveys.



Source: Boundaries: NPM (2013), Aerial: Google Earth (2010)

Note: Number inside symbol indicates the number of times that species was recoded at that location.

* Identified during Ecological Survey of the Wider Study Area by Umwelt and others since 2009, excluding Atlas of NSW Wildlife Records

0 1.0 2.5 5.0km
1:100 000

Legend

 Project Area	■ Brown treecreeper	■ Little pied bat	● Superb parrot
 Wider Study Area	● Bush stone-curlew	■ Masked owl	● Swift parrot
 Project Disturbance Area	■ Eastern bentwing-bat	● Painted honeyeater	● Rainbow bee-eater
Threatened Species	● Grey-crowned babbler	◆ Sloane's froglet	
■ Black falcon	● Grey falcon	● Spotted harrier	
● Brolga	● Little eagle	■ Squirrel glider	

FIGURE 4.5

Threatened and Migratory
Fauna Locations'

The brown treecreeper is likely a resident species within the woodland remnants in which it has been recorded. No other locations of the brown treecreeper are known throughout the Wider Study Area. The brown treecreeper is listed as Vulnerable under the TSC Act.

Painted Honeyeater (*Grantiella picta*)

The painted honeyeater has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on one occasion. A single individual was heard calling from regenerating roadside vegetation along Adavale Lane in summer 2012 (refer to **Figure 4.3**). No other records of the painted honeyeater within the Wider Study Area are known.

The painted honeyeater is likely an occasional visitor to the proposed disturbance area during periods of mistletoe flowering. The painted honeyeater is listed as Vulnerable under the TSC Act.

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

The grey-crowned babbler has been recorded in the proposed disturbance area on two occasions and 54 times within the Wider Study Area (refers to **Figure 4.3**). The grey-crowned babbler was recorded during all fauna surveys conducted from 2009 until 2012.

The grey-crowned babbler is a resident species of many of the woodland remnants within and immediately adjacent to the proposed disturbance area. It is likely that parts of one or more grey-crowned babbler group home range areas occur within the proposed disturbance area. Due to the scattered nature of the woodland vegetation within the proposed disturbance area it is unlikely that the proposed disturbance area contains the entire home range area of any grey-crowned babbler group. Grey-crowned babbler nests (for roosting and/or nesting) of varying quality (ranging from actively used to deteriorating un-used nests) can be found within many woodland remnants within the Wider Study Area. The grey-crowned babbler is listed as Vulnerable under the TSC Act.

Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)

The eastern bentwing-bat has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on six occasions during the September 2011 field surveys and twice during the 2010 surveys (Eco Logical 2010) (refer to **Figure 4.3**).

The eastern bentwing-bat is likely a regular visitor to the proposed disturbance area and most likely roosting within caves beyond the Wider Study Area (such as in Goobang National Park). There is the small possibility that roost sites may occur in road culverts and buildings within the Wider Study Area and even within the Active Operational Area. The eastern bentwing-bat is listed as Vulnerable under the TSC Act.

Little pied bat (*Chalinolobus picatus*)

The little pied bat has not been recorded within the proposed disturbance area, however it has been recorded within the Wider Study Area on two occasions, once in September 2011 and once in 2010 (Eco Logical 2010) refer to **Figure 4.3**).

The little pied bat is may be a regular or occasional visitor of the Wider Study Area, foraging throughout the proposed disturbance area. The species is listed as Vulnerable under the TSC Act.

4.4.3.2 Migratory Fauna Species

No migratory fauna species were recorded within the proposed disturbance area, however one species, the rainbow bee-eater (*Merops ornatus*), was recorded on two occasions within the Wider Study Area (refer to **Figure 4.3**). Both of these records were from spring 2011 when this species typically migrates southward.

4.4.3.3 Non-threatened Fauna Species

A total of 126 non-threatened fauna species have been recorded within the Wider Study Area, comprising 11 frog species, 13 reptiles, 81 birds and 21 mammals (see **Appendix D**).

Amphibians

Eleven frog species were recorded in the Wider Study Area comprising seven ground frog species of the family Myobatrachidae and four tree frogs from the family Hylidae. Frog species commonly recorded were the spotted marsh frog (*Limnodynastes tasmaniensis*), wrinkled toadlet (*Ueperoleia rugosa*) and green tree frog (*Litoria caerulea*). **Appendix D** contains a list of the all amphibian species recorded across the Wider Study Area.

Reptiles

Thirteen reptile species were recorded across the Wider Study Area. The most commonly recorded species included the lace monitor (*Varanus varius*), wall lizard (*Cryptoblepharus virgatus*), Boulenger's skink (*Morethia boulengeri*) and eastern bearded dragon (*Pogona barbata*). No threatened reptile species were recorded. **Appendix D** contains a list of the all reptile species recorded across the Wider Study Area.

Birds

A total of 81 bird species have been recorded in the Wider Study Area. A total of 39 families were represented, with the largest number of species recorded in the families of Acanthizidae (eight gerygones and thornbills), Meliphagidae (six honeyeaters), Psittacidae (six lorikeets and parrots) and Accipitridae (five eagles, hawks and kites).

Some of the more frequently observed bird species recorded in the Wider Study Area included the eastern rosella (*Platycercus eximius*), weebill (*Smicrornis brevirostris*), spotted pardalote (*Pardalotus punctatus*), striated pardalote (*Pardalotus striatus*), yellow-faced honeyeater (*Lichenostomus chrysops*), noisy miner (*Manorina melanocephala*), grey shrike thrush (*Colluricincla harmonica*), pied butcherbird (*Cracticus nigrogularis*), Australian magpie (*Gymnorhina tibicen*), grey fantail (*Rhipidura albiscapa*), willie wagtail (*Rhipidura leucophrys*), Australia raven (*Corvus coroniodes*) and white-winged chough (*Corcorax melanorhamphos*). **Appendix D** contains a list of the all bird species recorded within the Wider Study Area.

Mammals

Twenty-seven mammal species were recorded within the Wider Study Area with the most common family (Vespertilionidae – micro-bats) recording 12 species.

Commonly recorded terrestrial mammals were the eastern grey kangaroo (*Macropus giganteus*) and yellow-footed antechinus (*Antechinus flavipes*).

Only a single arboreal mammal species, the common brushtail possum, has been recorded in the Wider Study Area.

A total of 16 micro-bat species were recorded in the Wider Study Area. The most commonly recorded micro-bats included little forest bat (*Vespadelus vulturnus*), little broad-nosed bat (*Scotorepens greyii*), Goulds wattled bat (*Chalinolobus gouldii*) and chocolate wattled bat (*Chalinolobus morio*). **Appendix D** contains a list of all mammal species recorded within the Wider Study Area.

Introduced Fauna Species

Seven introduced fauna species (5 per cent of all fauna recorded) were recorded and comprised the common myna (*Acridotheres tristis*), common starling (*Sturnus vulgaris*), house mouse (*Mus musculus*), black rat (*Rattus rattus*), red fox (*Vulpes vulpes*), rabbit (*Oryctolagus cuniculus*) and hare (*Lepus capensis*).

4.4.3.4 Endangered Fauna Populations

No endangered fauna populations (as listed under the TSC Act) were recorded within the proposed disturbance area and none are expected to occur.

4.4.3.5 Koala SAT Searches and SEPP 44 Assessment

A total of 15 locations were assessed for the presence and percentage composition of SEPP 44 Schedule 2 tree species within the Wider Study Area including two locations within the proposed disturbance area.

Two SEPP 44 Schedule 2 tree species were recorded within the proposed disturbance area being bumble box (*Eucalyptus populneus*) and white box (*Eucalyptus albens*). A combined total of 450 trees were searched throughout the Wider Study Area including 60 within the proposed disturbance area. In addition to this, 11 call-playback sessions and 10 person hours of walking spotlighting surveys were undertaken within the Wider Study Area (**Figure 3.3**). No koalas were identified during walking or driving spotlight searches; no koalas responded to call playback sessions; no koala scats were recorded during targeted surveys; and no koalas were recorded during any other aspect of field surveys. No core koala habitat was identified as defined by SEPP 44 within the proposed disturbance area or Wider Study Area.

4.5 Assessment of Likelihood of Occurrence for Threatened Species, Endangered Populations, TECs and Migratory Species

This section identifies the threatened species, migratory species, EPs and TECs that are considered likely or known to occur within the proposed disturbance area.

Sections 4.1 to 4.4 identified a number of threatened species, migratory species, EPs or TECs that have been recorded within the proposed disturbance area (records from field surveys and a literature review), have been recorded within a 20 kilometre radius of the Project Area (database searches) or are predicted to possibly occur within the proposed disturbance area (Protected Matters Database Search).

An assessment of the likelihood of each threatened species, migratory species, EP or TEC to occur within the proposed disturbance area has been undertaken in **Appendix E**. The assessment of likelihood to occur compared the habitat requirements of the species with the habitat types present in the proposed disturbance area and considered the number and frequency of records of the threatened species, migratory species, EP or TEC within a 20 kilometre radius of the Project Area.

The following sections identify the threatened species, migratory species, EPs and TECs that were considered in **Appendix E** to have potential to occur (at varied levels) within the proposed disturbance area.

4.5.1 Flora

4.5.1.1 Threatened Ecological Communities

Table 4.13 lists the two TECs that occur within the proposed disturbance area. No other TECs listed under either the TSC Act or the EPBC Act are considered likely to occur in the proposed disturbance area.

Table 4.13 – TECs Assessed as Likely to Occur within the Proposed Disturbance Area

TEC ¹	Legal Status		Likelihood of Occurrence ²
	TSC Act	EPBC Act	
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	EEC	EEC ³	Known
White Box Yellow Box Blakely's Red Gum Woodland	EEC	CEEC-	Known

Notes:

- 1 TSC Act nomenclature is used for the TECs
 2 Likelihood of occurrence as determined in Appendix D of this report
 EEC Endangered ecological community
 CEEC Critically endangered ecological community
 EPBC Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
 TEC Threatened Ecological Community
 TSC NSW *Threatened Species Conservation Act 1995*

4.5.1.2 Threatened Flora Species

Table 4.14 lists the six threatened flora species identified in **Appendix E** as known to occur, considered likely to occur or have potential to occur within the proposed disturbance area.

Table 4.14 Threatened Flora Species Known, Likely or with Potential to Occur within the Proposed Disturbance Area

Common Name	Botanical Name	Status		Likelihood of Occurrence ¹
		TSC Act	EPBC Act	
	<i>Austrostipa metatoris</i>	V	V	Potential
	<i>Austrostipa wakoolica</i>	E	E	Potential
Pine donkey orchid	<i>Diuris tricolor</i>	V	-	Potential
Slender Darling-pea	<i>Swainsona murrayana</i>	V	V	Potential
Silky Swainson-pea	<i>Swainsona sericea</i>	V	-	Potential
	<i>Tylophora linearis</i>	V	E	Potential

Notes:

- 1 Likelihood of occurrence as determined in Appendix E of this report
 V Vulnerable species
 E Endangered species
 EPBC Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
 TSC NSW *Threatened Species Conservation Act 1995*

4.5.1.3 ROTAP Species

Table 4.15 lists the five ROTAP species that are known to occur or have potential to occur within the proposed disturbance area. The five ROTAP species are the same five threatened flora species identified above in the **Table 4.14**. No additional ROTAP species are known or have potential to occur within the proposed disturbance area. There is no legal requirement to assess the potential impact on ROTAP species, and no further assessment of ROTAP species will be undertaken however, their potential to occur has been assessed due to their regional significance.

Table 4.15 – Threatened Flora Species Assessed as Known, Likely or with Potential to Occur within the Proposed Disturbance Area

Common Name	Botanical Name	Status			Likelihood of Occurrence ¹
		ROTAP Code	TSC Act	EPBC Act	
	<i>Austrostipa metatoris</i>	3V	V	V	Potential
	<i>Austrostipa wakoolica</i>	2E	E	E	Potential
Pine donkey orchid	<i>Diuris tricolor</i>	3K	V	-	Potential
Slender Darling-pea	<i>Swainsona murrayana</i>	3VCi	V	V	Potential
	<i>Tylophora linearis</i>	3E	V	E	Potential

¹ Likelihood of occurrence as determined in Appendix E of this report

ROTAP Codes:

C	In a conservation reserve
i	Inadequately reserved
K	Poorly known
V	Vulnerable
E	Endangered
2	Found over < 100 kilometres range
3	Found over > 100 kilometres range

4.5.2 Fauna

4.5.2.1 Threatened Species

Table 4.16 lists the 22 threatened fauna species identified in **Appendix E** as that are known to occur, considered likely to occur or have potential to occur within the proposed disturbance area.

Table 4.16 – Threatened Fauna Species Assessed as Known, Likely or with Potential to Occur within the Proposed Disturbance Area

Common Name	Scientific Name	Legal Status		Likelihood of Occurrence ¹
		TSC Act	EPBC Act	
Frogs				
Sloanes froglet	<i>Crinia sloanei</i>	V	-	Likely
Birds				
Grey falcon	<i>Falco hypoleucos</i>	E	-	Potential
Square-tailed kite	<i>Lophoictinia isura</i>	V	-	Potential
Black-breasted buzzard	<i>Hamirostra melanosternon</i>	V	-	Potential
Barking owl	<i>Ninox connivens</i>	V	-	Potential
Speckled warbler	<i>Chthonicola sagittata</i>	V	-	Potential
Varied sittella	<i>Daphoenositta chrysoptera</i>	V	-	Potential

Table 4.16 – Threatened Fauna Species Assessed as Known, Likely or with Potential to Occur within the Proposed Disturbance Area (cont.)

Common Name	Scientific Name	Legal Status		Likelihood of Occurrence ¹
		TSC Act	EPBC Act	
Hooded robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	-	Potential
Diamond firetail	<i>Stagonopleura guttata</i>	V	-	Potential
Black falcon	<i>Falco subniger</i>	PV	-	Likely
Spotted harrier	<i>Circus assimilis</i>	V	-	Likely
Little eagle	<i>Hieraaetus morphnoides</i>	V	-	Likely
Brolga	<i>Grus rubicunda</i>	V	-	Likely
Bush stone-curlew	<i>Burhinus grallarius</i>	E	-	Likely
Swift parrot	<i>Lathamus discolor</i>	E	E	Likely
Masked owl	<i>Tyto novaehollandiae</i>	V	-	Likely
Brown treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	-	Likely
Painted honeyeater	<i>Grantiella picta</i>	V	-	Likely
Superb parrot	<i>Polytelis swainsonii</i>	V	V	Known
Grey-crowned babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-	Known
Mammals				
Koala	<i>Phascolarctos cinereus</i>	V	V	Potential
Squirrel glider	<i>Petaurus norfolcensis</i>	V	-	Potential
Yellow-bellied sheath-tail bat	<i>Saccolaimus flaviventris</i>	V	-	Likely
Eastern bentwing-bat	<i>Miniopterus schreiberschii oceanensis</i>	V	-	Likely
Little pied bat	<i>Chalinolobus picatus</i>	V	-	Likely

Notes:

- 1 Likelihood of occurrence as determined in Appendix F of this report
CE Critically Endangered
E Endangered
EPBC Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
PV Proposed Vulnerable
TSC NSW *Threatened Species Conservation Act 1995*
V Vulnerable

4.5.2.2 Endangered Fauna Populations

No endangered fauna populations were recorded within the proposed disturbance area and none are expected to occur (refer to **Appendix E**).

4.5.2.3 Migratory Species

Table 4.17 lists the five migratory species (listed as individual migratory species on the EPBC Act) that are known to occur or are considered likely to occur or have potential to occur within the proposed disturbance area.

**Table 4.17 – Threatened Migratory Species Assessed as Likely to Occur
or with Potential to Occur Within the Proposed Disturbance Area**

Common Name	Scientific Name	Legal Status		Likelihood of Occurrence ¹
		TSC Act	EPBC Act	
Fork-tailed swift	<i>Apus pacificus</i>	-	MIG	Potential
White-throated needletail	<i>Hirundapus caudacutus</i>	-	MIG	Potential
Lathams snipe	<i>Gallinago hardwickii</i>	-	MIG	Potential
Great egret	<i>Ardea alba</i>	-	MIG	Likely
Rainbow bee-eater	<i>Merops ornatus</i>	-	MIG	Likely

Notes:

- 1 Likelihood of occurrence as determined in Appendix F of this report
 EPBC Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
 MIG Listed Migratory species under the EPBC Act
 TSC NSW *Threatened Species Conservation Act 1995*

5.0 Impact Assessment

The Project will result in the clearing of up to 52 hectares of native vegetation communities. The clearing associated with the Project and assessed as part of this Ecological Assessment includes 37 hectares of native woodland and 15 hectares of derived native grassland. In addition to the loss of native vegetation communities, the Project will result in the loss of 25 hectares of plantation, 39 hectares of exotic grassland, 112 hectares of cultivated land and 11 hectares of disturbed land.

Further to actions undertaken by NPM to avoid and minimise impacts on ecological values (refer to **Section 5.1**), substantial impact mitigation measures (refer to **Section 6.0**) and a Biodiversity Offset Strategy (refer to **Section 7.0**) are proposed to ameliorate the impact of the Project on ecological values.

5.1 Project Changes to Avoid and Minimise Impacts

The potential impacts of the Project on the ecological values of the proposed disturbance area were recognised early in the Project. NPM has undertaken detailed concept and pre-feasibility studies into the proposed mining operation and as part of this process numerous alternative mine and infrastructure plans were considered. Minimising environmental and community impacts and maximising economic resource recovery have been major considerations in the evaluation of alternative options as discussed in **Section 1.4**.

Throughout the Project planning process, NPM have further refined the Project which has resulted in the avoidance of substantial impacts on the significant ecological features of the Project Area. Refinement of the Project down to the proposed disturbance area has resulted in the avoidance of the following impacts:

- avoidance of 57 hectares of White Box – Yellow Box – Blakely's Red Gum Woodland (CEEC – EPBC Act/EEC – TSC Act);
- avoidance of 486 hectares of Grey Box Grassy Woodlands (EEC – EPBC Act/EEC – TSC Act);
- avoidance of up to 2.8 hectares of Weeping Myall Woodland EEC;
- avoidance of approximately 430 hectares of potential habitat for the swift parrot and regent honeyeater; and
- avoidance of approximately 3 hectares of potential superb parrot breeding habitat, represented by mature river red gums, along Bogan River.

NPM has revised the proposed TSF 3 and waste dump footprints to avoid the disturbance of TECs, including White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (critically endangered) and Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (endangered). The proposed TSF 3 and waste dump footprints are generally located in areas that have been previously disturbed, and active operational areas, to the largest extent possible to minimise areas of additional disturbance associated with the Project.

Further to the minimisation and avoidance steps already undertaken, NPM will institute a range of mitigation measures to manage threats. The full range of impact mitigation strategies are detailed in **Section 6.0**.

5.2 Impact of the Project on Ecological Values

5.2.1 Potential Ecological Impacts of the Project

Without consideration of mitigation actions or biodiversity offsetting (see **Figure 1.4**), the Project has the potential to result in a variety of impacts on the ecological features of the proposed disturbance area. The majority of these impacts will be direct impacts from the extension and expansion of existing open cut mining operations, tailing storage facility 3 (TSF 3) and associated infrastructure, however there are also likely to be ongoing impacts as a result of Project. The assessment of potential ecological impacts documented in this section does not take into consideration any mitigation or offsetting measures, consistent with the requirements of both state and Commonwealth significant impact assessment guidelines (DECC 2007; DEHWA 2009).

During all steps the precautionary principle was applied to ensure that wherever there was uncertainty resulting from lack of data or knowledge, or uncertainty in the level or extent of impact, the most reasonable worst case was assumed. The application of the precautionary principle in the Project assessment is detailed in **Section 5.2.6**.

Potential impacts from the Project are likely to occur at different scales across the proposed disturbance area. The following discussion of potential impacts relates to the concept of the impact but not necessarily the scale of the impact at the proposed disturbance area level. Potential impacts from the Project would include the following:

- **Clearance of Vegetation/Loss of Habitat:** the clearing of vegetation will comprise the main impact of the Project. This impact will come from the direct removal of vegetation (including constituent flora) as well as the removal of foraging and breeding habitat for fauna. The potential impacts of the clearance of vegetation/loss of habitat are to be mitigated via a tree felling procedure and nest box installation (**Section 6.1.4**). The potential residual impacts will be mitigated via a BOS to secure, manage and improve appropriate habitat areas (**Section 7.0**).
- **Felling of Hollow-bearing Trees:** this has the potential to impact considerably on hollow-dependent fauna species occurring in the proposed disturbance area, particularly during the felling process. As the majority of hollow-dependent species are nocturnal, they are likely to be sheltering within hollows at the time of felling, greatly increasing the possibility of injury and death as trees are felled. Added risk comes from species that enter torpor or hibernation and are not able to readily vacate hollows when trees are disturbed. This potential impact will be reduced by adopting mitigation/management actions such as rigorous pre-clearing surveys, fauna-sensitive felling practices and provision of alternate habitat to compensate for the loss of tree hollows. These actions have been adopted as part of the Project, and are discussed further in **Section 6.1.4**.
- **Fragmentation:** the clearing of vegetation within the proposed disturbance area will increase the levels of fragmentation in the local area. Such fragmentation is likely to impact a suite of species that are unwilling/unable to cross large open spaces. Such species include numerous woodland birds such as the threatened grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), as well as smaller terrestrial mammals, reptiles and amphibians. Arboreal mammals can also be impacted by fragmentation, particularly from predation while travelling across the ground between habitat patches.

A secondary impact from increased isolation and fragmentation results from a reduced gene flow throughout the landscape. Limited genetic flow into or out of a particular area can lead to reduced genetic variation and inbreeding depression within flora and fauna species. This can lead to isolated populations being placed at increased risk of extinction due to a reduced ability to cope with stochastic events and environmental change.

- **Increased Competition for Resources:** the removal of areas of habitat for fauna species will create the need for individuals to disperse into new areas and compete with existing residents for foraging, roosting and breeding resources. Such resources will include suitable hollows, territories and home ranges, mates and other habitat features such as specific feed species and foraging resources. Where the habitat is isolated, overcrowding can occur, further exacerbating conflict for resources. Increased competition has the potential to cause the death of individuals, either due to direct conflict, resulting injuries or inability to access resources. Suitable mitigation measures can be implemented that will reduce the impact of this on native fauna species, particularly threatened species. The potential impacts of an increase in competition for resources are managed via the implementation of a tree felling procedure and associated nest-box installation (refer to **Section 6.1.4**), and are mitigated via a BOS to secure, manage and improve habitat areas (refer to **Section 7.0**).
- **Disease:** the incidence of disease is often increased when normal population thresholds are pressured, and overcrowding occurs. This is particularly so with fauna species, when overcrowding facilitates the rapid spread of some diseases throughout a population. The impacts of a potential increase in the incidence of disease are managed via the implementation of a tree felling procedure and associated habitat augmentation through nest box installation and hollow salvage (refer to **Section 6.1.4**), and are mitigated via a BOS to secure, manage and improve habitat areas (refer to **Section 7.0**).
- **Edge Impacts:** many native species are known to be sensitive to edge-effects. Such edge effects result in the deterioration of the quality of vegetation along the interface with cleared or disturbed environments. Such habitat deterioration can result from impacts such as increased weed invasion, rubbish dumping, increased predation, increased presence of introduced species or increased human presence. Edge effects from the Project could include minor weed issues, pest species movements, noise, light and dust. There is a potential that edge effects as a result of the Project may have some marginal impacts on adjoining areas. The design of the Project includes measures to minimise the potential for air quality, fugitive light and noise impacts. However, edge effects are unlikely to significantly affect the ecology of the adjoining areas. The potential impacts from edge effects are managed via ongoing weed and feral animal control as outlined in **Section 6.1.1**.
- **Introduced Species:** importation of materials to the proposed disturbance area, management activities, increased human presence and clearing of vegetation all have the potential to increase the incidence of introduced species within the proposed disturbance area. Weed species may be inadvertently brought into the proposed disturbance area with imported materials, or encouraged by removal of native vegetation. An increase in introduced species within the proposed disturbance area could have considerable impacts on existing native species. The presence of introduced species is discussed in **Sections 4.3.7** and **4.4.2.2** and introduced species are to be managed via weed (refer to **Section 6.1.1**) and feral animal control (refer to **Section 6.1.2**) programs.

5.2.2 Indirect and Off-site Impacts on Ecological Values

The Project is expected to result in some off-site impacts to ecological values occurring adjacent to the proposed disturbance area.

The removal of areas of native vegetation from within the proposed disturbance area would likely impact on the ability of some local fauna species to move throughout the landscape through a reduction in 'stepping stone' habitat areas. Isolated or fragmented areas of suitable habitat for species provide short to medium term refuges (or 'stepping stones' for species as they move from one area of habitat to another, travelling across unsuitable habitat areas

between the 'stepping stones') for species as they disperse, migrate or move throughout the landscape. The loss of 'stepping stone' habitat areas for some species may result in an increased level of isolation of populations where species are unable or unwilling to travel across the increased distance between habitat areas ('stepping stones').

The additional infrastructure proposed for the Project may also change the water flow regimes and runoff into the offsite areas, including within the Bogan River catchment. NPM operations are supported by an extensive existing water management system (WMS) which includes catch drains, diversion bunds, sediment dams and process water dams that manage water within and surrounding the NPM site. The WMS aims to separate clean, dirty and contaminated water, and in doing so seeks to prevent the contamination of clean water by mining activities and ensure compliance with NPM statutory obligations. The existing water management system at NPM will continue to be implemented to control and treat runoff from the site, with all pit water and mine surface runoff directed to the mine water management system. The existing WMS will be extended to incorporate the additional disturbance areas located within the proposed disturbance area, integrating these areas into the existing surface water management control measures at NPM.

The surface water resources within and surrounding the proposed disturbance area, including the Bogan River are ephemeral and only flow after prolonged rainfall. The extension of the NPM WMS will result in a reduction in the natural catchment area of the Bogan River by approximately 203 hectares, which represents a net reduction in catchment of approximately 0.2 per cent (to Bogan Weir). It is therefore considered that the proposed action is unlikely to result in significant changes in flow volumes within the Bogan River system. Additionally, all infrastructure associated with the proposed action has been located and designed to avoid impacts to the flooding regimes within the Bogan River, and associated tributaries.

There are no identified high priority Groundwater Dependent Ecosystems (GDEs), including the EPBC listed Threatened Ecological Communities, within or surrounding the proposed disturbance area. The closest identified high priority GDE is located approximately 50 kilometres to south-east of the proposed disturbance area. The Project is unlikely to have a significant impact on any GDEs.

Construction and operational fugitive light emissions have the potential to adversely impact native species. Potential impacts include:

- a reduction in the navigational signal ability for some nocturnal animals (Kyba *et al.* 2011);
- delaying bats from emerging from roost access points and shortening the amount of time available to them for foraging (Bat Conservation Trust 2008); and
- changes to frog reproduction, foraging, predator avoidance, and social interactions (The Urban Wildlands Group and UCLA Institute of the Environment 2002).

Construction and operational noise and air quality (dust) impacts have the potential to adversely impact native species. Potential impacts include:

- dust covering vegetation thereby reducing vegetation health and growth;
- noise/vibration disturbing the roosting and foraging behaviour of fauna species; and
- noise/vibration reducing the occupancy of areas of suitable habitat.

The design of the Project will include measures to minimise the potential for adverse air quality, fugitive light and noise impacts. These impacts are collectively likely to have a minor impact but have been considered nonetheless. The potential for impacts to affect habitat proximate to the Project operational area have been considered in the preparation of the assessment of the impact of the Project on ecological values, as detailed in the remainder of **Section 5.0**.

5.2.2.1 Cumulative Ecological Impact Considerations

Cumulative impacts are those that occur as a result of successive additions of impacts (including those not associated with NPM). The results of cumulative impacts can be greater than the sum of the individual impacts and can become a significant issue when the critical threshold is unknown or poorly understood.

The cumulative impacts likely to occur as a result of the Project are:

- loss of connectivity and increased fragmentation;
- loss of genetic biodiversity; and
- increased pressure on the remaining ecological resources due to competition from displaced individuals.

The Project would result in cumulative impacts on vegetation communities and fauna habitats in the local area and region (i.e. contribute to other pressures on ecology within the surrounding area). The cumulative loss of fauna habitat areas throughout the region, particularly those that provide dispersal, migration or movement pathways or stepping stone habitats may result in a reduced ability of species to move within the landscape of the region. As patches of suitable habitat are removed and the remaining patches become increasingly fragmented and isolated, the movement ability of species within the landscape declines. Highly mobile species such as birds and bats are least affected but all species have a distance between remnants threshold beyond which they are unlikely to attempt movements across unsuitable habitat in the search for habitat areas within the landscape. Although the thresholds of individual species are not known and the scale of the cumulative impact cannot be quantified, the Project can be assumed to contribute to a cumulative loss of habitat areas and a reduced dispersal/migration/movement ability of some fauna species within the landscape.

The cumulative impact of the Project has been taken into consideration in the assessments of significance documented in **Appendices F** and **G**. Threats to species listed under the TSC Act, FM Act and EPBC Act include those that are cumulative in nature, and the assessments undertaken implicitly consider the contribution of cumulative impacts on those species.

5.2.2.2 Summary of the Impact of the Project on Ecological Values

Based on the ecological values of the proposed disturbance area described in **Section 4.0** and the potential impacts of the Project described in **Section 5.2.1** the Project is likely to impact on a range of ecological matters. A detailed impact mitigation strategy is proposed (refer to **Section 6.0**) and a BOS will be prepared to address residual ecological impacts (refer to **Section 7.0**).

The Project would result in the removal of vegetation, disturbed land and fauna habitats, including approximately:

- 52 hectares of native vegetation communities comprising approximately:
 - 23 hectares of Grey Box Grassy Woodland EEC (TSC and EPBC Act);
 - 15 hectares of Grey Box Grassy Woodland - DNG EEC (TSC and EPBC Act);
 - 0.28 hectare of White Box – Yellow Box – Blakely's Red Gum Woodland EEC (TSC Act)/CEEC (EPBC Act);
 - 12 hectares of Bimble Box – White Cypress Pine Woodland;
 - 1.7 hectares of Bimble Box – White Cypress Pine Woodland – Exotic Understorey;
- 187 hectares of disturbed, planted and non-vegetation areas comprising approximately:
 - 25 hectares of Plantation;
 - 123 hectares of Disturbed Land;
 - 39 hectares of Exotic Grassland;
- Threatened species comprising:
 - known habitat for two threatened fauna species, the superb parrot (*Polytelis swainsonii*) and grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
 - likely habitat for one threatened amphibian, nine threatened bird species, including swift parrot (*Lathamus discolor*) (listed as endangered under the TSC Act and the EPBC Act) and four threatened mammal species; and
 - potential habitat for six threatened flora species, four threatened mammals and a further 20 threatened bird species.

The following impact assessment details the impacts of the Project on the flora species, vegetation communities, fauna habitats and species, and aquatic habitats and species occurring or potentially occurring in the proposed disturbance area.

5.3 Impact of the Project on Non-threatened Ecological Communities and Species

Section 5.3 and its subsections discuss the potential impacts of the Project on non-threatened ecological communities, flora species, fauna species and fauna habitat. The discussion of potential impacts on non-threatened ecological entities is followed by **Section 5.4** and its subsections which discuss the potential impacts of the Project on TECs, EPs, threatened species and migratory species.

5.3.1 Impact of the Project on Non-threatened Flora

The clearing of vegetation will comprise the main ecological impact for the Project. This impact will come from the direct removal of 239 hectares of native and non-native vegetation (including 0 constituent flora). This removal of vegetation within the disturbance area is not likely to result in a significant loss of floristic diversity in the local area or region.

5.3.2 Impact of the Project on Non-threatened Vegetation Communities

A total of 78 hectares of non-threatened vegetation communities would be removed from the proposed disturbance area (Table 5.1).

Table 5.1 – Area of Non-threatened Vegetation Communities to be Removed as Part of the Project

Vegetation Community	Area of Impact (ha) ¹	Community Extent within the South-western Slopes Bioregion ² (ha)	Per cent to be Cleared ³
Native Non-threatened Vegetation Communities			
Bimble Box – White Cypress Pine Woodland	12	400,000	0.003
Bimble Box – White Cypress Pine Woodland – Exotic Understorey	1.7	400,000	0.0004
Sub total	14		
Non-native Vegetation Communities and Other Areas			
Exotic Grassland	39	-	-
Plantation	25	-	-
Disturbed Land	123		
Sub total	187		
Total	201		

Note:

- 1 Area to be cleared based on proposed disturbance area.
- 2 Extent based on Benson *et al.* 2010 vegetation mapping of the South-western Slopes Bioregion. Those vegetation communities without values were not listed in Benson *et al.* 2010.
- 3 Based on the extent of the community to be cleared in the proposed disturbance area relative to the extent remaining in the South-western Slopes Bioregion.

5.3.3 Impact of the Project on Non-threatened Regionally Significant Species

No Rare or Threatened Australian Plants (ROTAP species) or regionally significant flora species, other than those also listed under the TSC or EPBC Acts, were recorded or considered to have the potential to occur within the proposed disturbance area.

5.3.4 Impact of the Project on Non-threatened Fauna Species

A total of 126 non-threatened fauna species have been recorded in the Wider Study Area. Records of fauna species should be interpreted carefully as many species are highly mobile (particularly many birds) thus these species can readily occur in areas other than where they were recorded. For this reason, fauna records obtained from surveys throughout the Wider Study Area (including areas that will not be impacted by the current proposal) are generally considered to indicate the presence of those species also in the proposed disturbance area (where appropriate habitat is also present in the proposed disturbance area).

Amphibians

A total of 11 non-threatened amphibians were recorded across the Wider Study Area. The amphibian habitats provided within the proposed disturbance area comprised of farm dams and low lying road verges. These are commonly represented throughout the region and are not considered to be under threat. Although the Project would involve the removal of farm dams which may provide some habitat for common amphibian species, it is not likely that this would have a significant impact on any of the 11 species.

Reptiles

A total of 13 non-threatened reptiles were recorded across the Wider Study Area, none of which are listed as threatened species under either the TSC Act or the EPBC Act.

The reptile habitats (grassland and woodland habitats) provided within the proposed disturbance area are commonly represented throughout the region and are not considered to be under threat. Although the Project would involve the removal of approximately 116 hectares of habitat (all vegetation communities except Disturbed Land and Cultivated Agricultural Land) for common reptile species, it is not likely that this would have a significant impact on any of these species.

Birds

A total of 82 non-threatened bird species were recorded within the Wider Study Area. The Project would require the removal of approximately 116 hectares of habitat for these bird species (all vegetation communities except Disturbed Land and Cultivated Agricultural Land), comprising 62 hectares of woodland habitat and 54 hectares of grassland habitat. Despite the removal of approximately 116 hectares of habitat from the proposed disturbance area, large areas of suitable habitat occur in the vicinity of the proposed disturbance area as well as in large conservation reserves such as Goobang National Park to the east.

Although the Project would involve the removal of approximately 116 hectares of habitat for common bird species, it is unlikely it would have a significant impact on any of the common species.

Mammals

A total of 20 native non-threatened mammal species have been recorded within the Wider Study Area. The Project will require the removal of approximately 116 hectares of habitat for these species (all vegetation communities except Disturbed Land and Cultivated Agricultural Land). Large areas of suitable habitat occur in the vicinity of the proposed disturbance area as well as in large conservation reserves such as Goobang National Park to the east.

Although the Project would involve the removal of approximately 116 hectares of habitat for common mammal species, it is unlikely it would have a significant impact on any of the common species.

5.3.5 Impact of the Project on Fauna Habitat

The proposed disturbance area is located in a region that has been subject to a long history of vegetation clearing for agricultural purposes, including both cropping and grazing, and in the last 17 years open cut and underground gold and copper mining. This has led to the current condition where the vegetation of the region is highly fragmented and disturbed.

The Project will result in the loss of approximately 116 hectares of fauna habitat within the proposed disturbance area. This comprises approximately 62 hectares of woodland habitat and approximately 54 hectares of grassland habitat. The remainder of the proposed disturbance area (123 hectares) comprises disturbed or cleared land which provides no fauna habitat value. The Project will also result in the potential loss of up to 1800 hollow-bearing trees containing up to a 4200 hollows of various sizes.

Detailed ameliorative measures will be implemented as part of the Project to limit impacts on fauna species and habitats. The proposed impact mitigation strategy and BOS is discussed in detail in **Sections 6.0** and **7.0**, respectively.

Woodland Habitat

Woodland habitat within the proposed disturbance area provides potential foraging habitat for fauna species in the form of canopy vegetation, tree trunks, large branches and bark sub surfaces. Associated with the extensive tree canopies of woodland habitats are moderate levels of leaf litter coverage, as well as fallen timber. Such features form an important foraging resource for some of the threatened fauna species recorded in the proposed disturbance area and Wider Study Area.

Tree hollow density within woodland habitats ranged between moderate to high. Very small (<25 millimetres diameter), small (25 to 50 millimetres diameter) and medium (51 to 100 millimetres diameter) hollows were the most commonly recorded size classes. Large hollows (101 to 300 millimetres diameter) and very large (>300 millimetres diameter) were also recorded. Tree hollows provides valuable habitat for a range of hollow-dependent fauna including threatened species such as little pied bat (*Chalinolobus picatus*), squirrel glider (*Petaurus norfolcensis*) and masked owl (*Tyto novaehollandiae*).

The Project would remove approximately 1812 hollow-bearing trees containing approximately 4202 hollows of various sizes (refer to **Section 4.4.2**). These estimates are based on abundance data that was collected in small areas and multiplied across larger areas and as such, should be considered indicative only. This represents the removal of all hollow-bearing trees from the proposed disturbance area.

Woodland habitat is also valuable to non-hollow dependent threatened species such as the grey-crowned babbler (*Pomatostomus temporalis temporalis*) and a wide range of non-threatened fauna species.

The loss of approximately 62 hectares of woodland habitat is expected to have an impact on native fauna species assemblages within the proposed disturbance area, with most woodland dependent species unlikely to occur in the proposed disturbance area following the removal of woodland areas.

Grassland Habitat

Grassland habitat is likely to provide foraging habitat for some threatened fauna species adjoining woodland habitat areas. Such habitat is most likely to benefit species that favour woodland margins and open areas such as the insectivorous hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*), as well as species that would benefit from ecotones for foraging, such as the likely occurring spotted harrier (*Circus assimilis*) and masked owl (*Tyto novaehollandiae*).

Approximately 15 hectares of DNGs and 39 hectares of exotic grassland will be removed as part of the Project.

5.4 Impact of the Project on Threatened Species, Populations, Ecological Communities and Migratory Species In Accordance with the EP&A Act 1979

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

1. avoid direct impacts and retain habitat;
2. minimise impacts where ever possible;

3. mitigate or ameliorate impacts; and as a last resort, and
4. compensate or offset for any unavoidable impacts (refer to **Section 5.1**).

Section 5.1 described the impact avoidance implemented during Project planning. The following sections provide a detailed assessment of significance of impacts on threatened species, EPs, TECs and migratory species using the relevant tests of significance under NSW (EP&A Act) legislation. The following assessments **do not** take into account the mitigation measures documented in **Section 6.0** or the BOS documented in **Section 7.0**.

The precautionary principle has been consistently applied when assessing the potential impacts of the Project on threatened and migratory species and communities. The EP&A Regulation 2000 defines the precautionary principle as:

Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
- (ii) an assessment of the risk-weighted consequences of various options.

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

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

In light of the above, where there was lack of scientific certainty, the maximum reasonable potential impact was assumed. The development of mitigation and offset strategies were based on the outcomes of the impact assessment, as displayed in **Figure 1.4**. The precautionary principle was also applied in the development of the mitigation and will be applied as part of the development of offset strategies to ensure that uncertainties were compensated for with more robust mitigation or more substantial offset outcomes.

The application of the precautionary principle described above is illustrated in **Figure 5.1**.



Figure 5.1 – Application of the Precautionary Principle to the Impact Assessment and Development of Mitigation and Offset Strategies

Section 4.5 above identified the individual threatened species, migratory species, EPs and TECs that are considered likely or known to occur within the proposed disturbance area.

The likely level of impact on threatened species, migratory species, EPs and TECs determined via assessments under the EP&A Act and EPBC Act are provided in **Appendices F** and **G**. **Appendix F** details the results of 'seven-part tests' undertaken according to the EP&A Act. **Appendix G** details the assessments undertaken according to the 'significant impact criteria' of the EPBC Act. In addition to the assessments undertaken in **Appendices F** and **G** the following sections discuss the likely level of impact from the Project on each of the individual threatened species, migratory species, EPs and TECs that are considered likely or known to occur within the proposed disturbance area.

5.4.1 Impact of the Project on Threatened Species, EPs and TECs Assessed Under the NSW *Environmental Planning and Assessment Act 1979*

In accordance with the DGRs issued for the Project, the potential level of impact on threatened species, EPs and TECs was assessed using the 'seven part test' as detailed in s.5A of the EP&A Act.

The assessment of significance was undertaken using an initial screening process to identify species that may be potentially impacted by the Project (Tables 1 and 2 of **Appendix E**), with a consequential full assessment of the likely significance of impacts being completed for those species. The Assessment of Significance does not take into account the full range of impact mitigation strategies and biodiversity offsets proposed for the Project, rather it considers the impacts of the Project without any mitigation or offsetting, consistent with the requirements of both state and Commonwealth significant impact assessment guidelines (DECC 2007; DEHWA 2009). The Assessment of Significance was completed for the following threatened species and TECs (refer to Tables 1 and 2 of **Appendix E**), either due to their recorded presence or the presence of potential habitat in the proposed disturbance area, and the potential for the species or TECs to be impacted:

Endangered Ecological Communities

- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penplain, Nandewar and Brigalow Belt South Bioregions (EEC); and
- White Box Yellow Box Blakely's Red Gum Woodland (EEC).

Threatened Flora Species

- *Austroptipa metatoris*;
- *Austroptipa wakoolica*;
- Pine donkey orchid (*Diuris tricolor*);
- Slender Darling-pea (*Swainsonia murrayana*);
- Silky Swainson-pea (*Swainsonia sericea*); and
- *Tylophora linearis*.

Threatened Fauna Species

- Sloanes froglet (*Crinia sloanei*);
- Grey falcon (*Falco hypoleucus*);
- Black falcon (*Falco subniger*);
- Spotted harrier (*Circus assimilis*);
- Square-tailed kite (*Lophoictinia isura*);
- Black-breasted buzzard (*Hamirostra melanosternon*);
- Little eagle (*Heiraaetus morphnoides*);

- Brolga (*Grus rubicunda*);
- Bush stone-curlew (*Burhinus grallarius*);
- Superb parrot (*Polytelis swainsonii*);
- Swift parrot (*Lathamus discolor*);
- Barking owl (*Ninox connivens*);
- Masked owl (*Tyto novaehollandiae*);
- Brown treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- Speckled warbler (*Chthonicola sagittata*);
- Painted honeyeater (*Grantiella picta*);
- Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*);
- Varied sittella (*Daphoenositta chrysoptera*);
- Hooded robin (south-eastern form) (*Melanodryas cucullata cucullata*);
- Diamond firetail (*Stagonopleura guttata*);
- Koala (*Phascolarctos cinereus*);
- Squirrel glider (*Petaurus norfolcensis*)
- Yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*)
- Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*); and
- Little pied bat (*Chalinolobus picatus*).

The detailed assessments of significance for the TEC's and threatened species listed above (refer to **Appendix F**) concluded that the Project has the potential to significantly impact upon one species, the pine donkey orchid (*Diuris tricolor*). Refer to **Section 5.4.2** for further discussion on the potential impact to the pine donkey orchid. All other species and TEC's are unlikely to be significantly impacted by the Project. Detailed justifications to support the finding that the Project would be unlikely to result in a significant impact on threatened species (except the pine donkey orchid), and TECs listed above are provided for each entity in **Appendix F**; however some of the key recurrent factors which were relevant to a number of species included:

- the proposed disturbance area is not at the limit of the species' or TECs' distributions;
- the Project is not considered likely to result in the extinction of the local population of the species;
- the proposed disturbance area provides only foraging habitat for the species;
- the proposed disturbance area does not provide breeding habitat for the species;
- the proposed disturbance area provided only a very small or negligible percentage reduction in the regional distribution of the species' habitat or TECs' habitat area;

- the proposed disturbance area does not provide habitat that is important to support the life cycle requirements of the species;
- the proposed disturbance area does not provide an important area of habitat for the species; and
- the proposed disturbance area does not provide known habitat for the species.

5.4.2 Key Species, EPs and TECs Subject to a Potentially Significant Impact

Based on the threatened species assessment detailed in **Appendix F** and applying the precautionary principle (as documented above), the Project could potentially result in a significant impact on the pine donkey orchid (*Diuris tricolor*) and Sloanes froglet (*Crinia sloanei*).

Pine Donkey Orchid (*Diuris tricolor*)

The pine donkey orchid (*Diuris tricolor*) is listed as a vulnerable species under the TSC Act. It has not been recorded within the Proposed Disturbance Area, but a population of 234 plants was recorded in a patch of White Cypress Pine Woodland within the Wider Study Area (see **Figure 4.4**). Approximately a quarter of this population occurs just inside the northern boundary of the Project Area. It is also known to occur in Blow Clear West State Forest and Strahorn State Forest within the surrounding region.

Occurring in New South Wales and Queensland, its suitable habitat includes grassy sclerophyll forests. Species that pine donkey orchid (*Diuris tricolor*) is commonly associated with and that have been recorded in the Wider Study Area include white cypress pine (*Callitris glaucophylla*) and bimbale box (*Eucalyptus populnea* subsp. *bimbale*) (OEH 2012b). The pine donkey orchid (*Diuris tricolor*) occurs in sandy soils on flats or small rises (OEH 2012b).

The pine donkey orchid (*Diuris tricolor*) has not been recorded within the proposed disturbance area, but targeted flora searches for this species have only been undertaken across a small section (2.7 hectares) of potentially suitable habitat areas within the proposed disturbance area, where the species was not recorded. No patches of White Cypress Pine Woodland occur within the Proposed Disturbance Area however, up to 37 hectares of suitable habitat for the species occurs, particularly in open areas of the Grey Box Woodland and Bimbale Box – White Cypress Woodland where white cypress pine (*Callitris glaucophylla*) is locally dominant. Such habitat occurs, albeit in small areas, within the Adavale Lane and McClintocks Lane road reserves. Additional areas include the woodland north of the existing subsidence site. The total area of potential habitat likely occurs as areas dominated by white cypress pine occurring in areas of Grey Box Woodland and Bimbale Box – White Cypress Woodland and is likely considerably less than 37 hectares.

If the pine donkey orchid occurs within the proposed disturbance area it is unknown if its pollination vectors (probably native bees) would be able to reach the population 2 kilometres to the north as existing tailings dams present a movement barrier and the movement ability of the unknown pollinator(s) is unknown.

Because targeted surveys have not been undertaken across all areas of potential habitat, the potential presence of pine donkey orchid (*Diuris tricolor*) within the proposed disturbance area cannot be discounted. Areas of suitable habitat within the proposed disturbance area are considered to have the potential to contain a (or large portion of a) viable population thus the removal of this habitat could potentially have a significant impact on a local population of pine donkey orchid (*Diuris tricolor*) where it may occur within the proposed disturbance area.

Sloanes Froglet (*Crinia sloanei*)

Sloanes froglet is listed as a vulnerable species under the TSC Act. This species was not recorded within the proposed disturbance area, however this species was identified by call and brief capture during nocturnal amphibian surveys in summer following a period of prolonged and heavy rainfall within the Wider Study Area. This species was recorded within an inundated area of farmland to the south of McClintocks Lane approximately 500 metres west of the proposed disturbance area.

Sloanes froglet is a small ground-dwelling frog that is typically associated with periodically inundated areas in grasslands, woodland and disturbed habitats (OEH 2013). Sloanes froglet shelters under logs and other debris, usually in moist depressions or near water (Frogs of Australia 2013). This species is known to call throughout the cooler months and generally following heavy rain where they call whilst floating in inundated area (Cogger 2000).

The proposed disturbance area provides up to 130 hectares of potential habitat (grassland, woodland and disturbed habitats [excluding cultivated land] that are associated with nearby water sources, and that become inundated during rainfall events) for the species throughout the proposed disturbance area, especially in low lying areas which may become inundated during rainfall events. The precise area of potentially suitable habitat for the species would be restricted to areas prone to inundation during moderate to heavy rainfall events, within the 130 hectares. The mapping of inundation prone areas was beyond the scope of this assessment. Up to 130 hectares of potentially suitable habitat for this species would be removed as part of the Project.

Given the proximity of the known record to the proposed disturbance area and because targeted surveys have not been undertaken across the proposed disturbance area, the presence of Sloanes froglet within the proposed disturbance area cannot be discounted. As the dispersal ability of the species is unknown, we have assumed it is highly limited and that occurrences of the species not directly linked by areas of suitable habitat may form individual populations. All potential habitat within the proposed disturbance area is considered to have the potential to contain a (or large portion of a) viable population thus the removal of this habitat could potentially have a significant impact on a local population of Sloanes froglet (*Crinia sloanei*) where this species may occur in the proposed disturbance area.

5.4.3 Impact of the Project on Threatened Species and TECs Assessed Under the *Fisheries Management (FM) Act 1994*

No FM Act listed threatened aquatic flora or fauna species were recorded and no natural aquatic habitat occurs within the proposed disturbance area. Searches of the OEH Atlas of NSW Wildlife, DP&I Website and the DSEWPC Protected Matters Database identified the following three species and three aquatic TECs with the potential to occur:

- Silver perch (*Bidyanus bidyanus*);
- Murray cod (*Maccullochella peelii*);
- Freshwater catfish (*Tandanus tandanus*);
- Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River;
- Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River; and
- Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment.

No suitable aquatic habitat areas occur within the proposed disturbance area for any of the above threatened aquatic flora, aquatic fauna species or aquatic TEC's listed on the FM Act. Further assessment under the FM Act is not required.

5.5 Impact of the Project on SEPP 44 Koala Habitat

Two SEPP 44 tree species, white box (*Eucalyptus albens*) and bimple box (*Eucalyptus populnea*), were recorded within the proposed disturbance area and were found to comprise greater than 15 per cent of the canopy in these areas. The proposed disturbance area is therefore considered to provide 'potential koala habitat' as defined by SEPP 44.

There are two known records of the koala within a 20 kilometre radius of the Project Area with one positioned approximately 5 kilometres south-west of the proposed disturbance area. This record is noted to have come from a community based survey. Community based survey records should only be considered as anecdotal as they rely on the recorder recalling past sightings of a species that may have occurred tens of years ago. Community based survey results typically have a high degree of error in the precision of their location details. The other record is approximately 18.5 kilometres north-east of the proposed disturbance area and was a road death from 1993.

To determine if the proposed disturbance area forms 'core koala habitat' as defined by SEPP 44, a number of survey methods were undertaken to survey for the koala. A total of 15 SAT searches, containing a total of 450 trees, were undertaken throughout the Wider Study Area including 2 SAT searches within the proposed disturbance area. In addition to this, 11 call-playback sessions and 10 person hours of walking spotlighting surveys were undertaken within the Wider Study Area (**Figure 3.3**).

No koalas were identified during walking or driving spotlight searches; no koalas responded to call playback sessions; no koala scats were collected during SAT searches; and no koalas were recorded during any other aspect of field surveys.

Despite the failure to identify resident koalas within the proposed disturbance area, koalas may occur within the proposed disturbance area on a rare basis during dispersal movements throughout the landscape. although the absence of records in the OEH Atlas data would suggest this is still unlikely. The proposed disturbance area is therefore not considered to form an area of 'core koala habitat' according the SEPP 44. Further assessment and a koala plan of management under SEPP 44 are not required.

5.6 Impact of the Project on Threatened Species, Threatened Ecological Communities and Migratory Species Listed under the *Environment Protection and Biodiversity Conservation Act 1999*

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

- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;

- the Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Great Barrier Reef Marine Park; and
- nuclear actions.

Relevant matters for the Project included consideration of impacts on threatened species, threatened ecological communities and migratory species protected under international agreements. The impact area for the MNES is larger than the impact area assessed under the EP&A Act as state approval already exists for certain areas. The impact area for MNES is referred to as the Referral Area and is shown in **Figure 1.3**.

The assessment of significance was undertaken using an initial screening process to identify species that may be potentially impacted by the Project (Tables 3 and 4 of **Appendix E**), with a full assessment of the likely significance of impacts completed for those species. The Assessment of Significance does not take into account the full range of impact mitigation strategies and biodiversity offsets proposed for the Project, rather it considers the impacts of the Project without any mitigation or offsetting, consistent with the requirements of the Commonwealth significant impact assessment guidelines (DEHWA 2009a). The Assessment of Significance was completed for the following threatened species and TECs (refer to Tables 3 and 4 of **Appendix E**), either due to their recorded presence or the presence of potential habitat in the Referral Area, and the potential for the species or TECs to be impacted.

Table 5.2 – Communities and Species Assessed for Significance under the EPBC Act

Critically Endangered Ecological Community	
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	
Endangered Ecological Community	
Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	
Common Name	Scientific Name
Endangered Species	
Swift parrot	<i>Lathamus discolor</i>
	<i>Austrostipa wakoolica</i>
Vulnerable Species	
Superb Parrot	<i>Polytelis swainsonii</i>
Koala	<i>Phascolarctos cinereus</i>
Slender Darling-pea	<i>Swainsona murrayana</i>
	<i>Austrostipa metatoris</i>
Migratory Species	
Rainbow bee-eater	<i>Merops ornatus</i>
Great egret	<i>Ardea alba</i>
Latham's snipe	<i>Gallinago hardwickii</i>

The EPBC Act lists criteria which are used to determine whether an action is likely to have a significant impact on MNES. These criteria are addressed in the Assessment of Significance (**Appendix G**) for each of the threatened species, migratory species and TECs listed in **Table 5.2** above.

If the action is likely to have a significant impact upon a MNES a decision will be made by DSEWPC that it is a controlled action and additional assessment of the impacts upon the MNES will be required by DSEWPC. The assessment undertaken in **Appendix G** indicates that the Project is not considered a controlled action as the Project is unlikely to have a significant impact on any MNES. Assessments of significance of the relevant TECs, threatened species and migratory species identified that the Project is unlikely to have a significant impact on any TEC, threatened species or migratory species.

An assessment of significance of the proposed removal of 38 hectares of Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC (23 hectares woodland and 15 hectares DNG) identified that it represented a 0.01 per cent reduction in the community's known extent within NSW and a 0.009 per cent reduction across Australia. Reductions of 0.01 and 0.009 per cent in the EEC's known extent were considered unlikely to result in a significant impact on it.

An assessment of significance of the removal of 0.28 hectare of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC identified that it represented a 0.0001 per cent reduction in the community's known distribution within NSW and a 0.00006 per cent reduction across Australia. Reductions of 0.0001 and 0.00006 per cent in the CEEC's known extent were considered unlikely to result in a significant impact on it.

The swift parrot was recorded in a Wider Study Area. The refinement of the footprint associated with the Project resulted in the avoidance and minimisation of impacts on TECs which also reduced the level of impact on areas of potential foraging habitat for the swift parrot. An assessment of significance on the swift parrot identified that the swift parrot was unlikely to be significantly impacted by the Project due to the species' highly mobile migratory nature and the availability of other suitable foraging areas in the region and wider.

The superb parrot was recorded in the Referral Area and Wider Study Area during all field surveys conducted over four seasons. An assessment of significance on the superb parrot identified that the superb parrot was unlikely to be significantly impacted by the Project due to the species' highly mobile nature, the small area of impact relative to the potential foraging habitat of the species (eucalypt woodlands and native grasslands) in the region and wider, and the absence breeding habitat in the impact areas.

No other MNES were recorded in the Referral Area and no significant impacts are expected upon any threatened or migratory species which have not been recorded in the Referral Area but for which potentially suitable habitat occurs in the Referral Area. For the above reasons the Project is considered to NOT be a controlled action.

5.7 Impact of the Project on Key Threatening Processes

There are currently 49 key threatening processes (KTPs) (including those pending finalisation) listed under the schedules of the TSC Act, FM Act and EPBC Act. The following key threatening processes are relevant to the potential impacts of the Project and are discussed in detail where relevant within the Tests of Ecological Significance for individual species (refer to **Appendix F**):

- bushrock removal (TSC Act);

- clearing of native vegetation (TSC and EPBC Act);
- human-caused climate change (TSC, FM and EPBC Act);
- loss of hollow-bearing trees (TSC Act);
- removal of dead wood and dead trees (TSC Act); and
- decline in woodland and forest birds due to aggressive exclusion by abundant Noisy Miners (Preliminary Determination TSC Act).

The Project is likely to result in an increase in the operation of each of the above KTPs. The Project will result in the removal of bushrock, the clearing of native vegetation, human-caused climate change, the loss of hollow-bearing trees, the removal of dead wood and a potential increase in the decline in woodland and forest birds due to aggressive exclusion by noisy miners.

5.8 Impacts of the Project on Critical Habitat

The Project will not impact on any areas of declared critical habitat (under the TSC Act). No areas of declared critical habitat occur within a 20 kilometre radius of the proposed disturbance area.

5.9 Impacts of the Project on Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have their species composition and their natural ecological processes determined by groundwater (DLWC 2002). According to the Groundwater Dependent Ecosystem Policy (DLWC 2002), ecosystems which depend on groundwater are:

- wetlands and red gum forests;
- other terrestrial vegetation;
- ecosystems in streams fed by groundwater;
- limestone cave systems;
- springs; and
- hanging valleys and swamps.

None of the above ecosystem types which depend on groundwater are present in the proposed disturbance area. No creeklines or streams that may be fed by groundwater flow through the proposed disturbance area (see **Figure 2.1**).

6.0 Impact Mitigation Strategy

NPM has sought to avoid and minimise potential impacts of the Project on the ecological values of the proposed disturbance area throughout the Project planning process. This has included avoidance and minimisation of disturbance of key vegetation communities.

The ecological impact assessment documented in **Section 5.0** concluded that the Project is unlikely to have a significant impact on any threatened species, migratory species, EP or TEC listed under the TSC Act, FM Act or EPBC Act:

NPM has committed to the design and implementation of a comprehensive mitigation strategy to mitigate the unavoidable impacts of the Project. This mitigation is described in this section. Further to this, a comprehensive BOS will be developed, which includes the protection and enhancement of native vegetation and threatened species habitat, to develop a positive long-term outcome for the threatened species and key ecological features affected by the Project. The proposed BOS is outlined in **Section 7.0**.

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

6.1 General Biodiversity Management Strategies

A number of general management strategies will be employed across the proposed disturbance area to limit the impact of the Project on significant ecological features. The existing Flora and Fauna Management Plan (FFMP) (NPM 2008) will be reviewed and expanded to include areas to be impacted by the Project. The general biodiversity management strategies will include:

- feral animal and noxious weed control consistent with existing practices at the NPM;
- rehabilitation of disturbed areas to provide soil stabilisation and protection and possible future farming opportunities;
- adaptive management, as required, if a previously unrecorded or unassessed threatened species is identified in the proposed disturbance area during operations;
- ongoing monitoring and maintenance of any revegetation works and habitat enhancement activities; and
- establishment of an ongoing monitoring program to monitor native flora and fauna across the Project Area.

6.1.1 Weed Control

Weed species could inadvertently be brought into the proposed disturbance area with imported materials, machinery, or stock movement, or allowed to invade naturally through removal of native vegetation. The presence of weed species has the potential to significantly decrease the value of vegetation to native species, particularly threatened species. The presence of weeds would also devalue rehabilitation activities.

Weed management at the NPM is undertaken on an as needs basis in accordance with the existing FFMP (NPM 2008). This will be reviewed and expanded to include areas to be impacted by the Project.

6.1.2 Feral Animal Control

The presence of feral animals is monitored in the Project Area via reporting from NPM personnel and control is undertaken on an as needs basis in accordance with the FFMP (NPM 2003).

6.1.3 Rehabilitation Strategy

The proposed disturbance area will be rehabilitated to a land use reflective of the land use of the Project Area prior to the start of mining activities within the Project Area. Mine disturbance areas will be rehabilitated to provide soil stabilisation and protection and possible future grazing land.

6.1.4 Protection and Management of Arboreal Species and Habitat

6.1.4.1 Tree Felling Procedure

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

- comprehensive pre-clearing surveys by a suitably experienced and licensed ecologist, no more than two weeks prior to felling. This will include marking of hollow-bearing trees, as well as any other notable features such as fallen timber, hollow logs or boulders suitable for salvage; active nests, dreys or dens requiring consideration; and seed-bearing trees for salvage. Surveys will include detailed searches for threatened flora and fauna species, including micro-bats;
- removal of non hollow-bearing trees/vegetation as close to the hollow-bearing tree felling date as possible (in order to discourage fauna usage of the area). It is not considered necessary for a suitably experienced and licensed ecologist to be present to supervise such works, providing pre-clearing surveys have been completed within the designated timeframe; and
- detailed hollow-bearing tree felling procedures, including (but not limited to):
 - supervision of all hollow-bearing tree felling works by a suitably experienced and licensed ecologist. If an ecological issue is encountered, the ecologist is to advise on the most appropriate measures to ensure minimal impact on fauna species, particularly threatened species;
 - visual canopy inspection on the day of the felling of hollow-bearing trees for fauna species and active nests;
 - shaking of hollow-bearing tree (with heavy machinery) for at least 30 seconds to encourage resident fauna to abandon tree, prior to felling;
 - lowering of hollow-bearing trees as gently as possible with heavy machinery;
 - inspection of all hollows in felled trees by a suitably experienced and licensed ecologist;
 - capture of any displaced/injured fauna by a suitably experienced and licensed ecologist;
 - release of unharmed fauna into nearby secure habitats by a suitably experienced and licensed ecologist;

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

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

Site personnel (particularly vehicle operators) will be briefed on fauna awareness issues and will be required to report incidents involving injury to native wildlife. Assistance from a wildlife carer or veterinarian will be sought if injured native wildlife are encountered.

6.1.4.2 Nest Boxes

One of the ecological impacts of the Project will be the removal of tree hollows, which are critical to the survival of numerous threatened species potentially occurring within the proposed disturbance area. The availability of suitable hollows within a landscape is a recognised limiting factor to the survival of hollow-dependent species (DECC 2004). In particular, the loss of suitable hollows is a major factor contributing to the listing of many threatened species as Vulnerable or Endangered under the State and Commonwealth threatened species legislation.

To address the loss of hollows from clearing activities, the following will be undertaken:

- Augmentation of existing hollows within retained woodland remnants within the Project Area (see below). The amount of nest boxes to be used for this purpose will be developed based on further surveys of the proposed disturbance area during pre-clearing surveys.
- Staged mitigation of hollow loss from the proposed disturbance areas by placing nest boxes in surrounding vegetation.

The type of nest box to be used will be dependent on the size of the hollows being removed and the type of species likely to be utilising the hollows. In general, the likely composition of nest box types will include a mix of bat roost boxes, parrot boxes, glider boxes, possum boxes and owl boxes. The number of nest boxes to be established will be dependent on the number of hollows to be removed and the existing provision of tree hollows in areas targeted for the addition of nest boxes.

Hollow densities within the Wider Study Area were relatively high and the Project could potentially remove up to 4200 hollows of various sizes (see **Section 5.3.5**). Hollow-bearing tree surveys will be undertaken prior to clearing to determine the number of hollows to be impacted but given the abundance of hollows across the Wider Study Area, it is considered that hollow replacement should be undertaken at a ratio of one nest box (or suitable salvaged hollow) for every two natural hollows removed during felling.

The following program is proposed for the nest box establishment program:

- nest boxes will be appropriately designed for targeted threatened species (micro-bats, superb parrot, masked owl, brown tree creeper and squirrel glider) and recorded non-threatened species;
- all nest boxes will be constructed out of marine grade plywood or other similar suitably durable material;
- a variety of nest box designs will be used;
- nest boxes will be appropriately positioned within the landscape and within trees;
- all nest boxes will be subject to appropriate, regular maintenance of their structural integrity and attachment; and
- all nest boxes will be monitored annually for nest box condition and function, and every two to five years to assess nest box utilisation patterns (and cleared if feral species are present).

Nest boxes will be placed in non-impacted woodland areas of the Project Area or other NPM owned land nearby and within the Wider Study Area.

The number and types of nest boxes to be established will be determined during pre-clearing inspections for the Project.

6.1.4.3 Hollow Salvage

Due to the ability of nest boxes to provide habitat for target species (for most species), nest boxes are favoured over the salvage of tree hollows for the creation of compensatory tree hollow habitat. However, wherever suitable tree hollows (appropriate size, weight and condition) are encountered during tree felling inspections reasonable efforts will be made (considering timing and budgetary constraints) to salvage the hollows for relocation. This approach will ensure the optimal re-use of existing habitat resources and, combined with nest box establishment, will address the loss of nesting and roosting habitat within the proposed disturbance area.

Pre-clearance surveys will be used to clearly mark hollow-bearing trees. Hollow salvage operations will then be incorporated into the clearing phase (where appropriate), and will involve the careful removal of identified suitable hollows, hollow capping and any other restorative/protection works required. Hollows will be re-erected in trees in suitable positions within the non-impacted woodland areas within the Project Area.

Salvaged and re-erected hollows will be subject to the same levels of maintenance and monitoring as nest boxes.

6.1.4.4 Replacement of Other Specific Habitat Features

The salvage and relocation of hollow logs, fallen timber and boulders will be undertaken wherever possible. Such features can be selectively placed within the non-impacted remnant woodland areas in the Project Area where these resources may occur in low abundance. The addition of specific habitat features to existing woodland areas will increase the habitat complexity and quality of such areas for target threatened species and non-threatened species. In such cases, specific habitat features can be identified during pre-clearing surveys and marked for moving into designated areas.

6.2 Ecological Monitoring

The aim of the ecological monitoring program will be to assess the adequacy of the Impact Mitigation Strategy (**Section 6.0**) and the Biodiversity Offsets Strategy (**Section 7.0**). This will require the design and implementation of a rigorous and systematic monitoring program that includes a positive feedback loop, to allow for the adaptive management of all aspects of the monitoring program.

Currently no annual ecological monitoring is undertaken at NPM. As part of the revision of the existing FFMP (NPM 2008) for this Project it is proposed that an ecological monitoring program is established, focusing on the monitoring of utilisation and function of nest boxes to be installed following clearing activities (see **Section 6.1.4.2**) and flora and fauna monitoring of biodiversity offset areas, both existing and proposed. The proposed ecological monitoring program will include various targeted ecological surveys which:

- provide a good indication of the status of the ecological values being monitored;
- are relatively simple to measure and are reproducible; and
- are cost effective.

Details on the monitoring program will be documented within the revised FFMP (NPM 2008), to be completed post-approval, and prior to the commencement of works in the proposed disturbance area. This document will contain the specific requirements of the monitoring program, including methods to be used, monitoring frequencies and locations.