Appendix B

Biodiversity assessment

Boggabri Coal Expansion Project

Ecological Assessment for Boggabri Coal Project Modification

Modification 4

16 December 2014

PARSONS BRINCKERHOFF

Document information
Client: Boggabri Coal Expansion Project Title: Ecological Assessment for Boggabri Coal Project Modification Subtitle: Modification 4 Document No: 2119017A-ENV-REP-001 RevE Date: 16 December 2014

Rev	Date	Details
A	03/11/2014	Draft
B	07/11/2014	Draft
C	03/12/2014	Final
D	12/12/2014	Final
E	16/12/2014	Final

Author, Reviewer and Approver details			
Prepared by:	Tanya Bangel	Date: 03/12/2014	Signature: 
Reviewed by:	Alex Cockerill	Date: 03/12/2014	Signature: 
Approved by:	Alex Cockerill	Date: 03/12/2014	Signature: 

Distribution
Boggabri Coal Expansion Project , Parsons Brinckerhoff file, Parsons Brinckerhoff Library

Document owner
Parsons Brinckerhoff Australia Pty Limited *ABN 80 078 004 798* Level 3 51-55 Bolton Street Newcastle NSW 2300 PO Box 1162 Newcastle NSW 2300 Australia Tel: +61 2 4929 8300 Fax: +61 2 4929 8382 www.pbworld.com *Certified to ISO 9001, ISO 14001, OHSAS 18001*

Contents

List of tables

Page number

List of figures

Page number

List of appendices

Glossary

BCEP	Boggabri Coal Expansion Project.
Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: 1. genetic diversity — the variety of genes (or units of heredity) in any population 2. species diversity — the variety of species 3. ecosystem diversity — the variety of communities or ecosystems.
Bioregion (region)	A bioregion defined in a national system of bioregionalisation. The Modification Study Area is in the Brigalow Belt South bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).
Critical habitat	The whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, an Endangered population or an endangered ecological community that is critical to the survival of the species, population or ecological community (Department of Environment and Conservation 2004). Critical habitat is listed under either the TSC Act or the EPBC Act and both the state (Office of Environment and Heritage) and Federal (Department of the Sustainability, Environment, Water, Population and Communities) Both of these departments maintain a register of this habitat. Capitalisation of the term 'Critical Habitat' in this report refers to the habitat listed specifically under the relevant state and Commonwealth legislation.
Ecological community	An assemblage of species occupying a particular area.
EEC	Endangered ecological community (TSC Act, EPBC Act).
Environmental weed	Any plant that is not native to a local area that has invaded native vegetation.
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
Exotic	Introduced from outside the area (Ensbey & Johnson 2009). Used in the context of this report to refer to species introduced from overseas.
FM Act	NSW *Fisheries Management Act 1994.*
GPS	Global positioning system- a navigational tool which uses radio receivers to pick up signals from four or more special satellites to provide precise determination of location.
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic components.
Indigenous	Native to the area: not introduced (Royal Botanic Gardens and Domain Trust 201).
Introduced	Not native to the area: not indigenous (Ensbey & Johnson 2009). Refers to both exotic and non-indigenous Australian native species of plants and animals.
Key threatening processes	A process that threatens, or could threaten, the survival, abundance or evolutionary development of native species, populations or ecological communities (Department of Environment and Conservation 2004). Key Threatening Processes are listed under the TSC Act, the FM Act and the EPBC Act. Capitalisation of the term 'Key Threatening Processes' in this report refers to those processes listed specifically under the relevant state and Commonwealth legislation.
Likely	Taken to be a real chance or possibility (Department of Environment and

	Conservation 2004).
Local population	The population that occurs within the site, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the Boundary can be demonstrated as defined by Department of Environment and Climate Change (2007).
Locality	The area within a 10 km of the site.
Migratory species	Species listed as migratory under the EPBC Act relating to international agreements to which Australia is a signatory. These include Japan-Australia Migratory Bird Agreement, China-Australia Migratory Bird Agreement, Republic of Korea-Australia Migratory Bird Agreement and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Capitalisation of the term 'Migratory' in this report refers to those species listed as Migratory under the EPBC Act.
Modification	Modification includes the following proposed Modification to Project Approval 09_0182: ■ project boundary adjustments to include infrastructure and borrow pits built prior to the project approval ■ alterations to existing infrastructure within the mine, including expansion of two dirty water dams, realignment of a haul road, expansion of the run-of-mine (ROM) coal stockpile and construction of new hardstand areas within the Mine Infrastructure Area (MIA) ■ construction of a security fence and firebreak along the approved project boundary ■ use of additional portable fuel storages within operational areas.
Noxious weed	An introduced species listed under the NSW *Noxious Weeds Act 1993*. Under the Act, noxious weeds have specific control measure and reporting requirements.
NSW	New South Wales
Office of Environment and Heritage	Broadly, the Office of Environment works towards a healthy environment cared for and enjoyed by the whole NSW community: manages the state's natural resources, including biodiversity, soils and natural vegetation: manages natural and cultural heritage across the state's land: acts to minimise the impacts of climate change: promotes sustainable consumption, resource use and waste management: regulates activities to protect the environment: and conducts biodiversity, plant, environmental and cultural heritage research to improve decision making. Previously known as: ■ Department of Environment, Climate Change and Water (DECCW) ■ Department of Environment and Climate Change (DECC).
Project Boundary	Project Boundary describes the area approved under Project approval 09_0182 for the BCEP.
Project Boundary Modification	Project Boundary Modification is defined as the area impacted by the Modification, outside the previous Project Boundary
Protected species	Those species defined as protected under the *National Parks and Wildlife Act 1974*. Includes all native animals, as well as all native plants listed on Schedule 13 of the *National Parks and Wildlife Act 1974*.
Recovery plan	A plan prepared under the TSC Act, FM Act or the EPBC Act to assist the recovery of a Threatened species, population or ecological community.
Significant	Important, weighty or more than ordinary as defined by Department of Environment, Climate Change and Water (2007).
Species richness	Species richness is simply the number of species present in a sample, community, or taxonomic group. Species richness is one component of the concept of species diversity, which also incorporates evenness, that is, the relative abundance of species (Office of Environment and Heritage 2012b).

Modification study area	Areas within the locality that could potentially be affected by the Modification. This includes the modification sites and all areas adjacent to the proposed Modification sites and potential construction work sites associated with the proposed Modification.
Subject site	The extent of direct impacts from the proposed Modification. This includes the footprint of the Modification related to infrastructure and potential construction work sites.
Threatened biodiversity	Threatened species, populations or ecological communities as listed under the TSC Act, FM Act or the EPBC Act.
Threatened species, populations and ecological communities	Species, populations and ecological communities listed as Vulnerable, endangered or critically endangered (collectively referred to as threatened) under the TSC Act, FM Act or the EPBC Act. Capitalisation of the terms 'vulnerable', 'endangered' or 'critically endangered' in this report refers to listing under the relevant state and/or Commonwealth legislation.
TSC Act	NSW *Threatened Species Conservation Act 1995.*
Viable local population	A population that has the capacity to live, develop and reproduce under normal conditions, unless the contrary can be conclusively demonstrated through analysis of records and references (Department of Environment and Climate Change 2007).
Weed	A plant growing out of place or where it is not wanted: often characterised by high seed production and the ability to colonise disturbed ground quickly (Ensbey & Johnson 2009). Weeds include both exotic and Australian native species of plant naturalised outside of their natural range.

1. Introduction

Boggabri Coal Pty Limited (Boggabri Coal) is a wholly owned subsidiary of Idemitsu Australia Resources Pty Limited, which operates the Boggabri Coal Mine. Boggabri Coal is located 15 km north-east of Boggabri in the North West Region of NSW. Following the grant of PA 09_0182, Boggabri Coal has conducted detailed design studies for the infrastructure required to facilitate the Project. These studies have identified the need for amendments to the conceptual Project layout for which approval was originally granted. Modification is being sought under Section 75W of the EP&A Act to facilitate these changes.

Parsons Brinckerhoff Australia Pty Ltd (Parsons Brinckerhoff) was commissioned by Boggabri Coal to prepare an Environmental Assessment (EA) to modify the Project Approval under section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This report presents a brief outline of the ecological assessment and field survey methods, the existing environment of the Modification study area, potential impacts on threatened biodiversity associated with the proposed Modification of the Boggabri Coal Project Area in Boggabri NSW (henceforth referred to as the proposed Modification) by Boggabri Coal Pty Limited (Boggabri Coal). The proposed Modification specifically includes:

- **project boundary adjustments** to include infrastructure and borrow pits built prior to the project approval
- **alterations to existing infrastructure** within the mine, including expansion of two dirty water dams, realignment of a haul road, expansion of the run-of-mine (ROM) coal stockpile and construction of new hardstand areas within the Mine Infrastructure Area (MIA)
- **construction of a security fence and firebreak** along the approved project boundary
- use of **additional portable fuel storages** within operational areas.

The proposed Modification occurs within agricultural tenures and the Namoi Biodiversity Offset Area and within the MIA. Within the Namoi Biodiversity Offset Area the proposed Modification largely occurs in areas mapped for habitat restoration, but also includes areas of corridor enhancement and habitat management (refer to Figure 1.1).

This report examines flora and fauna assemblages as well as habitats within the Modification Study Area and identifies impacts to the ecological aspects, including species, populations and communities within the Project Modification. The report looks at impacts associated with construction and operation of the Modification. This report also outlines the mitigation measures and provides assessments of significance required under EP&A Act and the (Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Providing background to this EA is a number of related ecological studies which were undertaken for Boggabri Coal Project and are listed in Section 3.3. This includes assessments completed for the continuation of Boggabri Coal Mine – Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a) and the Boggabri Coal Mine – Biodiversity Offsets Strategy (Parsons Brinckerhoff 2010b), which included broad vegetation mapping conducted over the Modification Study Area.

1.1 Legislative context

This report is to support an EA for the Modification, being prepared by Parsons Brinckerhoff. The Parsons Brinckerhoff EA will assess the environmental impacts of the proposed Modification to Project Approval (09_0182) for the Boggabri Coal Project under section 75W of the EP&A Act.

This EA has been completed in consideration of Commonwealth and state legislation and planning policies relevant to the protection of flora, fauna and biodiversity, including:

- *Environmental Planning & Assessment Act 1979* (EP&A Act)
- *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Threatened Species Conservation Act 1995* (TSC Act)
- *Native Vegetation Act 2003* (NV Act)
- *Water Management Act 2000* (WM Act)
- *Fisheries Management Act 1994* (FM Act)
- *National Parks and Wildlife Act 1974* (NPW Act)
- *Noxious Weeds Act 1999* (NW Act)
- Boggabri Coal Mine Project Approval (09_0182).

These Acts and policies have been addressed where they apply.

1.2 Assessments of significance

Significance assessments as required under Section 94 of the TSC Act and Section 5A of the EP&A Act were undertaken if the species or community was recorded or its habitat was present in the areas proposed to be impacted by this Modification.

The significance assessments relating to biodiversity listed under the TSC Act are based on the Threatened Species Assessment Guidelines(Department of Environment and Conservation 2005), indicating the significance of the impacts relative to the conservation importance of the habitat, individuals and populations likely to be affected. Threatened biodiversity under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was assessed following the Principal Significant Impact Guidelines (Department of the Environment Water Heritage and the Arts 2009).

1.3 Biodiversity offsets

The need for biodiversity offsets is founded in the theory of 'avoid, minimise and mitigate' the impacts of proposals. Traditional approaches to environmental mitigation require that, in the first instance, environmental impacts are avoided or minimised as far as possible and subsequently reduced to acceptable levels through appropriate mitigation techniques. Where measures to avoid and mitigate impacts are neither feasible nor cost effective, offset strategies can be used to compensate the residual impacts of the development on biodiversity. Ideally offsets should be undertaken before development to provide certainty that the offsets are effective and to ensure that there will be no net loss in biodiversity (Department of Environment and Conservation 2005).

Fundamental to proposed offsets under the NSW legislation is the requirement for a Project to demonstrate a 'improve or maintain' outcome for impacts on biodiversity.

A biodiversity offsets strategy (BOS) was prepared for the continuation of Boggabri Coal Mine (Parsons Brinckerhoff 2010b). Consideration of biodiversity offsets included surveys completed in accordance with the quantitative site assessment methodology of the Biobanking Operation Manual (Department of Environment Climate Change 2009) as well as in consideration of the 13 principles for the use of biodiversity offsets in NSW (Department of Environment and Climate Change 2008a) and the objectives of the National Recovery Plan for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Grassy Woodland).

Some components of the Modification are within the identified biodiversity offsets in the Boggabri Coal Mine BOS (Parsons Brinckerhoff 2010b). In particular these include adjustments to the Project Boundary at the Boggabri coal terminal (BCT), Daisymede Property and private haul road are required to incorporate existing infrastructure and disturbances and are shown in Figure 1.1.These purposed Project Boundary modifications will require revisions to the Biodiversity Offset Strategy approved under Project Approval 09_0182.

In addition to the proposed Project Boundary modifications above, the Modification will result in new impacts within the MIA (including extension of stockpile and laydown areas, minor amendment of haul road alignment and increasing sediment dam capacities) not subject to assessment under the previous PA 09_0182. These new impacts will require additional offsets and are discussed in detail in Section 8.

In March 2014, the Draft NSW Biodiversity Offsets Policy for Major Projects (Draft Policy) was released for public exhibition. The Draft Policy has now been finalised (Offset Policy 2014) and will be implemented from 1 October 2014 when it will be mandatory for all SSD and SSI projects. The Offset Policy 2014 reduced the number of offset principles to six and introduced the use of a new assessment methodology, the Framework for Biodiversity Assessment (FBA).

While Boggabri Coal is committed to providing offsets for the impacts of the Modification in accordance with the approved BOS, the recent NSW Biodiversity Offsets Policy for Major Projects (Offset Policy 2014) has been considered and is discussed in Section 8.

1.4 Proposed Modification

As part of the ongoing development of the Boggabri Coal Project, BCPL has identified the need for amendments to the conceptual Project design approved under PA 09_0182 to provide for the following activities:

- amendment of the Project Boundary to include infrastructure built under other approvals or by other proponents – this will allow for existing infrastructure used by the BCPL to be included in the Project area and managed as part of the overall operation
- modifications within the MIA (including extension of stockpile and laydown areas, minor amendment of haul road alignment and increasing sediment dam capacities)
- other additions required to augment the Project – including: construction of a Boundary fence, use of additional portable fuel storage containers, creation of an equipment recycling yard and Modification of water management structures.

Individual components of the Modification are summarised in Table 1.1. Figure 1.1 provides an overview of where each component of the Modification is located within Boggabri Coal Mine.

Table 1.1 Summary of proposed Modification activities

Site Number	Proposed activity	Additional Ground disturbance required?(1)	Project Boundary adjustment required?(2)
1	▪ **adjust Project Boundary at BCT** - Project Boundary adjustment to include infrastructure built as part of previous approvals, including: product stockpiles, vehicle loop and contour drains	No	Yes
2	▪ **adjust Project Boundary at Daisymede Property** - Project Boundary adjustment to include a production bore and access tracks built as part of previous approvals	No	Yes

Site Number	Proposed activity	Additional Ground disturbance required?(1)	Project Boundary adjustment required?(2)
3	▪ **adjust Project Boundary at private haul road** - Project Boundary adjustment to include existing infrastructure built as part of other approvals, including: ▸ 11kV and 132kV powerlines ▸ service tracks and construction pads used during construction of the BCT Haul Road ▸ underground power line built prior to PA 09_0182 ▸ borrow pits used during construction of the BCT Haul Road (built under DA 38/88) prior to PA 09_0182	No	Yes
4	▪ **change alignment for ROM haul road** – adjustment to alignment of ROM Haul Road approved under PA 09_0182 and ancillary clean and dirty water drainage ▪ **change alignment for Rejects haul road** – additional branch to ROM Haul Road to provide for haulage of rejects on the ROM Haul Road	Yes	No
5	▪ **expand sediment dam 3** – increase of capacity to 260 ML to provide capacity consistent with revised site water balance	Yes	No
6	▪ **expand sediment dam 12** – increase of capacity to 125 ML to provide capacity consistent with revised site water balance	Yes	No
7	▪ **establish dozer maintenance area within MIA** – implementation of a hardstand area where dozers and other equipment would be serviced, this would include widening of an existing culvert crossing	Yes	No
8	▪ **expand ROM stockpile within MIA** – construction of an extension to the ROM stockpile to provide for separation of different ROM grades and additional stockpiling	Yes	No
9	▪ **establish equipment recycling yard** – establishment of a hardstand area where surplus plant and equipment is stored for use as spare parts	Yes	No
10	▪ **construct Boundary fence** – construction of a security fence, firebreak and access road around the Project Boundary	No	No
11	▪ **additional portable fuel storages** – use of additional portable fuel storages within active mining areas and the MIA	No	No

(1) This identifies where there is a requirement for additional ground disturbance or clearing for the modification activity outside the existing approved disturbance boundary of PA09_0182

(2) Project Boundary adjustments refer to activities occurring outside the current approved Boundary of PA 09_0182

1.5 Definitions used in this report

For the purpose of this report the following definitions apply:

- **Project Boundary** describes the area approved under Project Approval (09_0182)
- **Modification within existing project area** describes the proposed modifications that will occur within the Project boundary but not previously assessed under Project Approval (09_0182). These modifications will require removal of vegetation and/or ground disturbance (refer Figure 1.1 and Table 1.1).

- **Proposed new project area** is a modification of the approved Project boundary which will incorporate existing infrastructure and no additional ground disturbance (refer to Figure 1.1 and Table 1.1).
- **Modification study area** is defined as both the “Modification within existing project area” and the “Proposed new project area”.
- **locality** is defined as 10 km within the vicinity of the Modification study area boundary.
- **region** is a bioregion defined in a national system of bioregionalisation. For this study this is the Brigalow Belt South bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).

1.6 Modification Study Area

The Modification within the project area includes the locations of all components of the Modification and associated works, within the Project Boundary. The proposed new project area includes the footprint of all proposed modifications to existing or approved infrastructure and any disturbance associated with the operation or construction of the proposed Modification. Where applicable, the Modification within existing project area includes access tracks that will be used by vehicles or machinery, stockpiles of material, and any area likely to be impacted by the Modification and associated works and operation that occur outside of the approved Project Boundary.

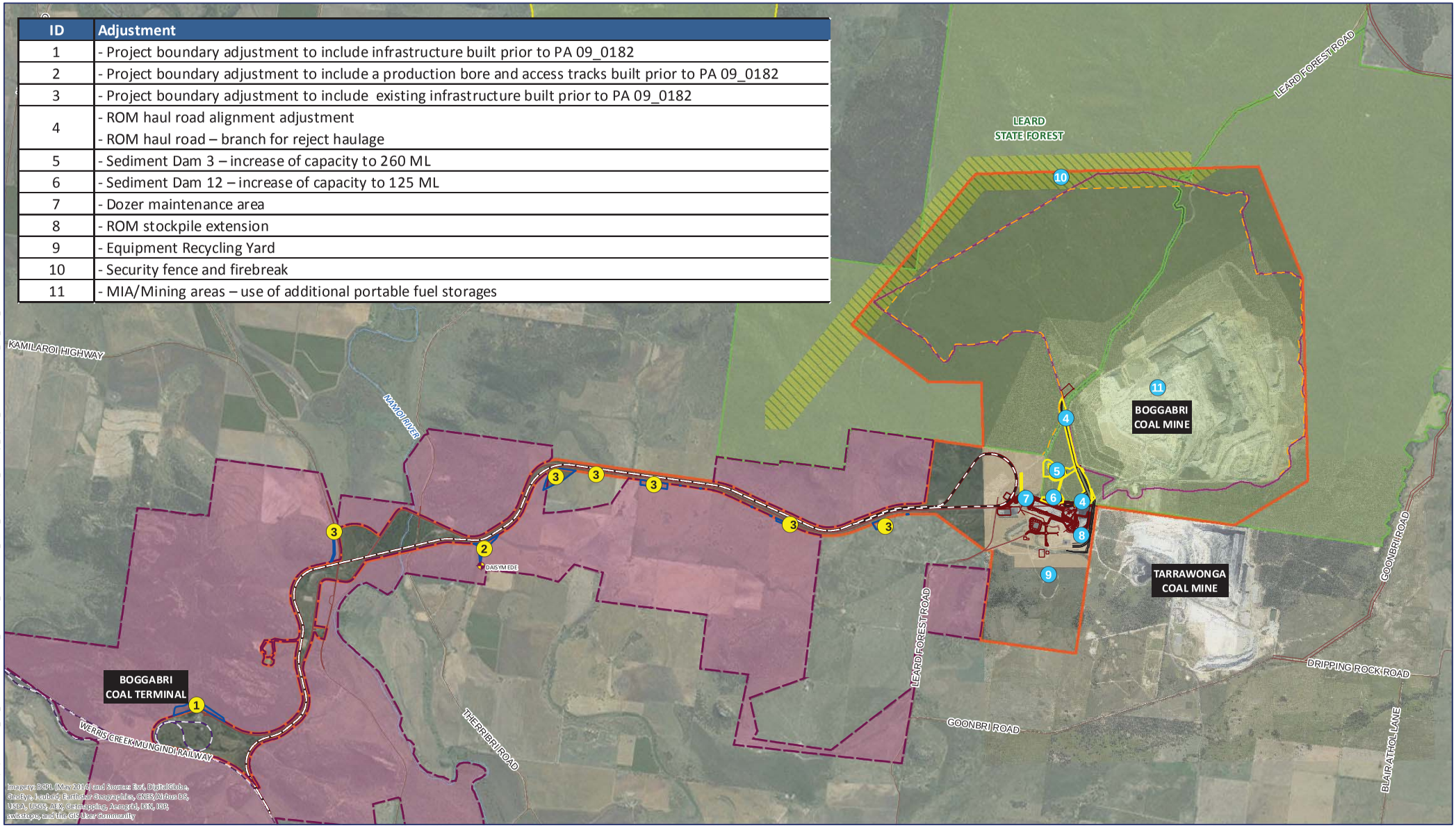
The Modification (modification within the project boundary) is predominantly inside the previously approved infrastructure layout and design (PA 09_0182) and within the previously identified BOAs, as described in the Continuation of Boggabri Coal Mine – Biodiversity Offset Strategy (Parsons Brinckerhoff 2010b). A relatively small area associated with the Project Boundary adjustments and associated infrastructure is located outside of the previously assessed and approved areas and therefore, has been targeted during this assessment. This area is designated as the Modification within existing project area in Figure 1.1 and this ecological assessment has only assessed this area as part of these reporting works.

Location information for the modification within existing project area is outlined in Table 1.2.

Table 1.2 Modification within existing project area location

Location information	Modification within existing project area
Bioregion	Brigalow Belt South, Namoi sub-region (Thackway & Cresswell 1995)
Botanical subregion	North Western Slopes
Local government area	Narrabri Shire
Catchment Management Authority, subregion	Namoi CMA, Maules sub-catchment
Mitchell landscapes	Bugaldie uplands and Liverpool Plains landscape

ID	Adjustment
1	- Project boundary adjustment to include infrastructure built prior to PA 09_0182
2	- Project boundary adjustment to include a production bore and access tracks built prior to PA 09_0182
3	- Project boundary adjustment to include existing infrastructure built prior to PA 09_0182
4	- ROM haul road alignment adjustment - ROM haul road – branch for reject haulage
5	- Sediment Dam 3 – increase of capacity to 260 ML
6	- Sediment Dam 12 – increase of capacity to 125 ML
7	- Dozer maintenance area
8	- ROM stockpile extension
9	- Equipment Recycling Yard
10	- Security fence and firebreak
11	- MIA/Mining areas – use of additional portable fuel storages



\\APNTLFPS01\proj\Idemitsu_Aus_Resources\22005454_BOGGABRI_MODIFICATION_EIS\10_GIS\Projects_Drawings_Figures_Sketches\22005454_GIS_F015_A2.mxd Author: SuansitR 16/12/2014

1 Project boundary adjustment, ground disturbance not required
2 Project boundary adjustment not required ground disturbance required

Existing bore
Proposed security fence
Proposed mine infrastructure
Existing mine infrastructure
Existing/operational rail
Proposed rail

Proposed new project area
Modification within existing project area
EPBC Approval boundary
Boggabri Project Approval Area
Mine infrastructure area

Biodiversity offset corridor
Leard State Forest
Leard State Conservation Area
Namoi offset area

0 0.5 1 1.5 km

Figure 1.1
Summary of proposed modifications

1.7 Study aims

The overall objective of this study was to assess the impacts of the Modification on the biodiversity values of the Modification within existing project area boundary. Specifically, this ecological assessment aimed to:

- determine and describe the characteristics and condition of the vegetation communities and flora and fauna habitats
- determine the occurrence, or likelihood of occurrence within the Modification within existing project area, of threatened species, populations and communities (biodiversity) listed under the TSC Act, FM Act and EPBC Act
- undertake significance assessments for threatened biodiversity that occur or have potential habitat within the Modification within existing project area
- propose further investigations and/or amelioration measures to mitigate impacts on the ecological values of the Modification within existing project area.

2. Project Boundary (PA 09_0182) ecological characteristics

2.1 Overview

A large portion of the land within the Boggabri Coal Project Boundary is located within Leard State Forest, which covers an area of 8,134 ha, the majority of which is natural vegetation. Surrounding land uses include mineral extraction and rural activities, including pasture improvement, cropping and cattle grazing.

The Project is located within an area that has previously been assessed at a broad scale under the Brigalow and Nandewar Western Regional Assessments (WRA). The Leard State Forest, was not identified for conservation in the regional assessments, rather the areas was identified for management under Zone 4, specifically set aside for forestry and mineral extraction.

The mining portion of the Boggabri Coal Project Boundary lies within a large relatively intact remnant patch of vegetation surrounded by a landscape that has been modified significantly through anthropogenic disturbance associated with the above listed land uses. The pattern of vegetation clearing and Modification within the locality has increased the significance of the remnant vegetation within the Project Boundary, both in terms of its conservation value and its role in the broad-scale corridor network.

The biodiversity values of the Project Boundary have been extensively assessed and documented from concept studies completed in 1976, to detailed surveys recently completed for the continuation of mining submission. Ecological surveys were completed within the locality for the following studies:

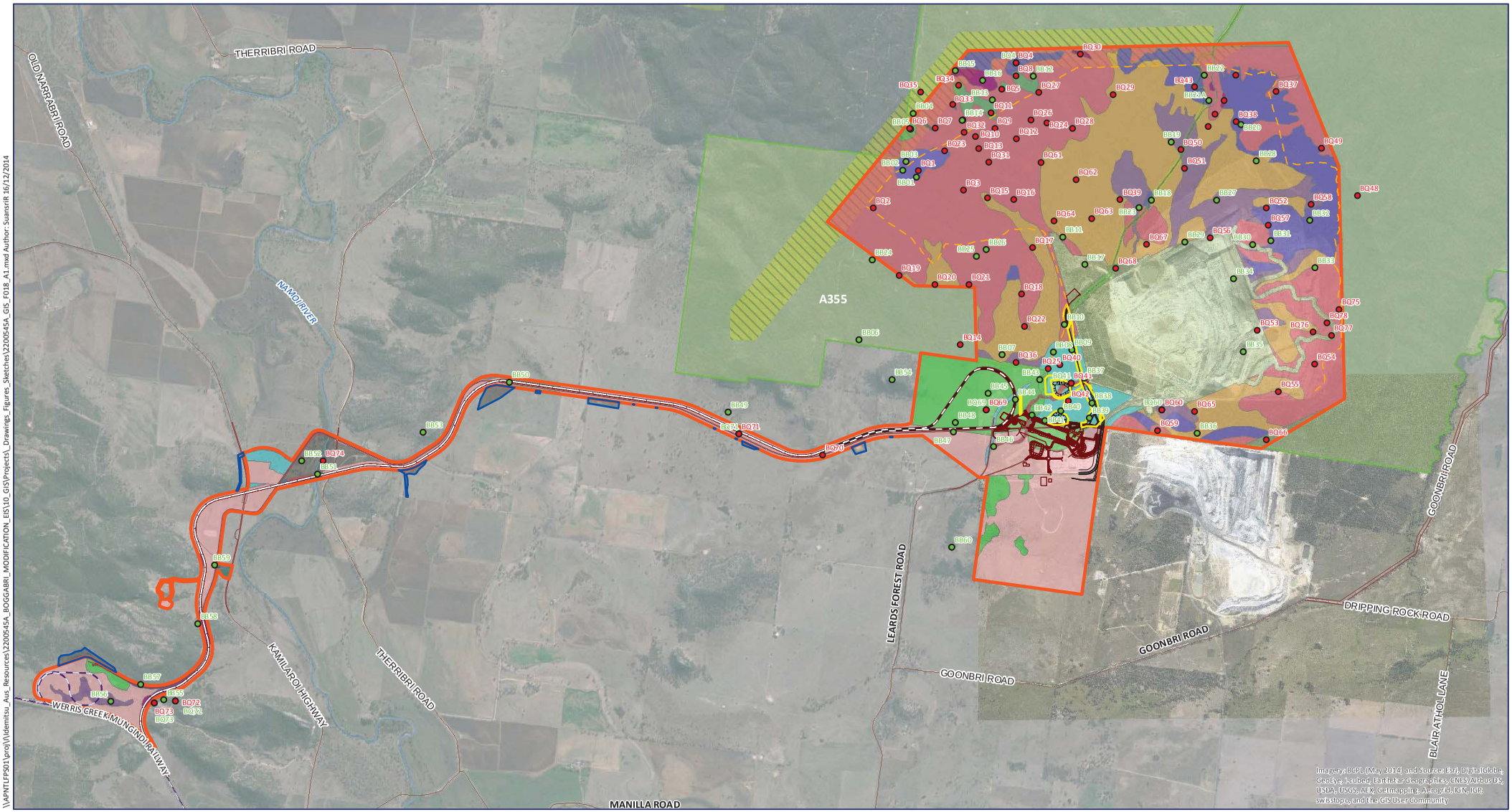
- Boggabri Coal – Biodiversity Monitoring, February 2006 – August 2012 (Parsons Brinckerhoff 2011a)
- Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a)
- Preliminary vegetation mapping and survey report for Boggabri Coal lease (Parsons Brinckerhoff 2009)
- Flora and Fauna Summary of the Boggabri Coal Project (Parsons Brinckerhoff 2005)
- Results of Fauna survey work undertaken by the NSW National Parks and Wildlife Service within Leard State Forest (Pennay 2001)
- Report on the botany, wildlife and ecology of the Leard State Forest. Draft Environmental Impact Statement for Amax-BHP Joint Venture Boggabri Coal Project (James B. Croft and Associates 1983).

Biodiversity values within the Project Boundary are described in Sections 2.2 and 2.3. This information is based on findings of previous studies noted above, particularly the results of seasonal surveys completed between December 2008 and September 2009 for the Continuation of Boggabri Coal Mine — Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a) and ongoing studies by Parsons Brinckerhoff.

This information is provided in order to outline the ecological context within which the Modification is located.

2.2 Flora values

The previous flora values identified (Parsons Brinckerhoff 2010a) within the Project Boundary are illustrated in Figure 2.1 below and described in the following sections. The updated flora values within the Modification within existing project area are illustrated in Figure 2.1.



Flora Survey Quadrats (Jan 2009)
Flora Survey Quadrats (April 2009)
Proposed security fence
Proposed mine infrastructure
Existing mine infrastructure
Existing/operational rail
Proposed rail
Proposed new project area
Modification impact area
Boggabri Project Approval Area

Identified Vegetation Communities within Study Area

Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
White Box – Narrow-leaved Ironbark - White Cypress Pine grassy open forest
Native Olive dry gully forest
Narrow-leaved Ironbark - Brown Bloodwood -White Cypress Pine shrubby open forest
Dwyer's Red Gum woodland
Derived native grassland
Exotic grassland
Pilliga Box - Poplar Box – White cypress pine grassy open forest (Low Condition)
Pilliga Box - Poplar Box – White cypress pine grassy open forest
Plains Grassland
River Red Gum Riparian woodland and forest
River Red Gum Riparian woodland and forest (Low Condition)
Silver-leaved Ironbark heathy woodland
White Box – White Cypress Pine grassy woodland (Low Condition)
White Box – Melaleuca riparian forest
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
White Box – White Cypress Pine grassy woodland
Yellow Box - Blakely's Red Gum grassy woodland

0 0.5 1 1.5 km

Figure 2.1
Flora values within the Project Boundary

2.2.1 Vegetation communities

Sixteen (16) distinct vegetation communities have been recorded in the Project Boundary (Parsons Brinckerhoff 2010) (Figure 2.1).

2.2.2 Threatened ecological communities

Three ecological communities listed under the EPBC Act, four ecological communities listed under the TSC Act and one ecological community listed under the FM Act have been recorded within the Project Boundary (Parsons Brinckerhoff 2010a). These threatened ecological communities and their corresponding vegetation communities within the Project Boundary are provided in Table 2.1.

Table 2.1 Threatened ecological communities and corresponding vegetation communities within the Project Boundary

Threatened ecological community	Corresponding vegetation community within the Project Boundary	Area removed within Project Boundary (ha) as part of existing EA and Modification 3
EPBC Act		
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered	White Box – White Cypress Pine grassy woodland White Box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest Yellow Box – Blakely's Red Gum grassy woodland	626.4
Weeping Myall Woodlands – Endangered	Weeping Myall grassy open woodland	0.3
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Qld – Critically Endangered	Plains Grassland	0.4
TSC Act/FM Act		
White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Woodland)	White Box – White Cypress Pine grassy woodland White Box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest Yellow Box – Blakely's Red Gum grassy woodland	This community corresponds with the EPBC Act listing[1]
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions	Weeping Myall grassy open woodland	As above
Native Vegetation on Cracking Clay Soils of the Liverpool Plains	Plains Grassland	As above
Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River[2]	The Namoi River and several creeks within the Project Boundary are included in the determination for this aquatic ecological community	0.6

(1) Corresponds with the Critically Endangered Ecological Community of White Box Yellow Box Blakely's Red Gum grassy woodland and derived native grassland as listed under the EPBC Act

(2) Listed as an Endangered Ecological Community (EEC) under the FM Act

2.2.3 Threatened flora species

A review of biodiversity databases undertaken for the original Environmental Impact Assessment (2010a) indicates that 12 threatened flora species have been recorded or are predicted to occur within 20 km of the Project Boundary. Two of these threatened flora species were recorded within the Project Boundary during seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010a) (Figure 2.1) with a further threatened species recorded in the Project Boundary in May 2014:

- *Pultenaea setulosa* – listed as Vulnerable under the EPBC Act
- *Pomaderris queenslandica* – listed as Endangered under the TSC Act
- *Tylophora linearis* – listed as Endangered under the EPBC Act and Vulnerable under the TSC Act. This species has recently been recorded in Leard State Forest for the Mauls Creek Project and within the Project Boundary. Further details for this species are provided in Section 5.3.

A further three threatened flora species have potential to occur in the Project Boundary with a moderate or greater likelihood:

- *Digitaria porrecta* – listed as Endangered under the EPBC and TSC Act
- *Diuris tricolor* – listed as Vulnerable under the EPBC Act and TSC Act
- *Prasophyllum sp*. Wybong (c. Phelps ORG 5269) – listed as Critically Endangered under the EPBC Act.

These species are described in detail in Section 4.2.3 of the Continuation of Boggabri Coal Mine — Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a) and Appendix E of this report.

2.2.4 Introduced and noxious weeds

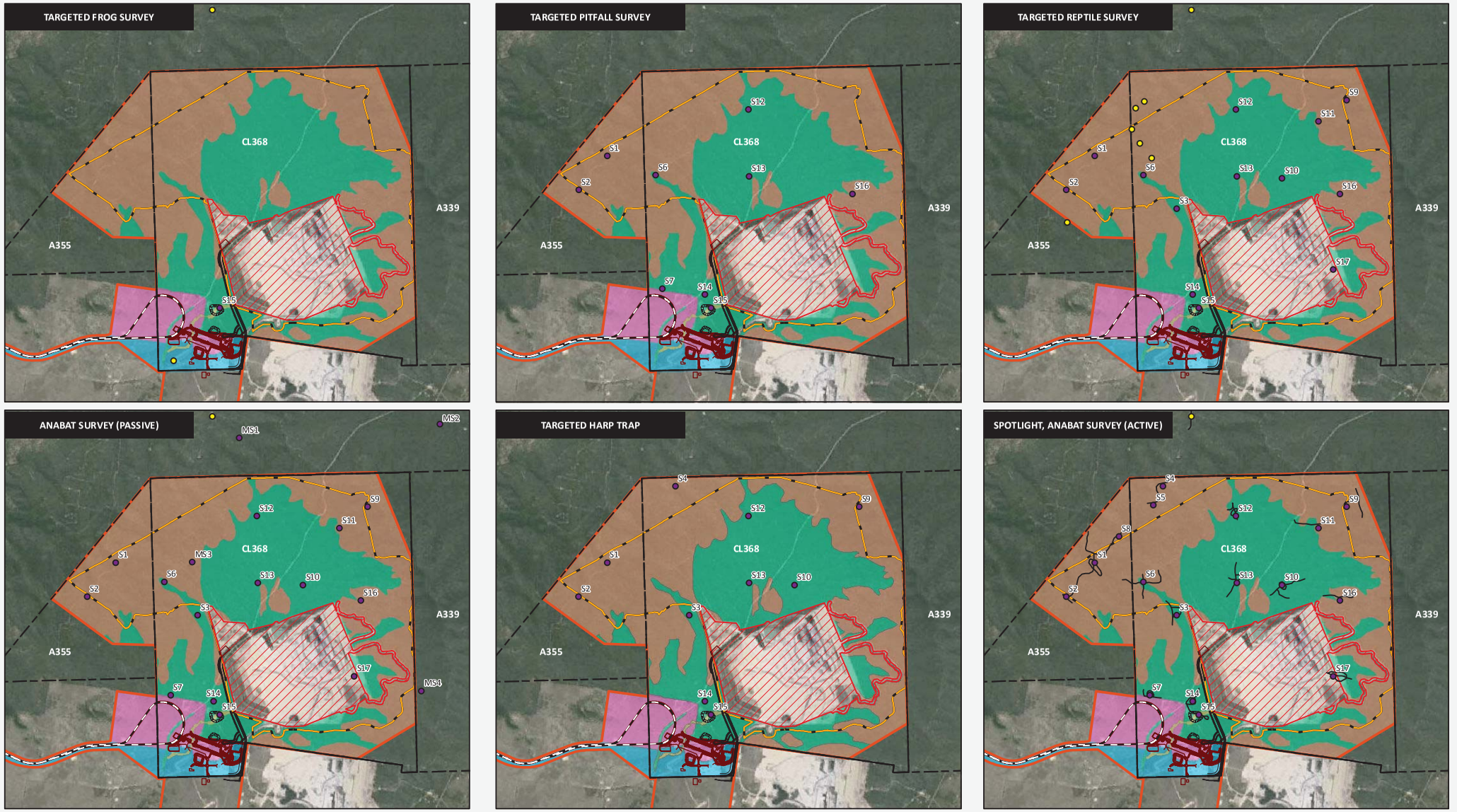
During seasonal surveys which were completed between December 2008 and September 2009 and further surveys conducted within and adjoining the project boundary (Parsons Brinckerhoff 2010a, 2011d, 2013a, 2014a) 62 species of introduced plants were recorded within the Project Boundary. Of the introduced species recorded, nine are declared Class 4 Weeds under the *Noxious Weeds Act 1993* for the Narrabri weed control area and two weeds (*Rubus ulmifolius* and *Senecio madagascariensis*) are classified additionally as a Weed of National Significance (WoNS) (Weeds Australia 2011). Further studies in the Project Boundary have recorded one additional weed. Noxious Weeds recorded are listed below:

- *Conium maculatum (*Hemlock*)*
- *Heliotropium amplexicaule (*Blue Heliotrope*)*
- *Opuntia aurantiaca (*Tiger Pear*)*
- *Opuntia stricta (*Prickly Pear*)*
- *Opuntia tomentosa (*Velvet Tree Pear*)*
- *Oxalis corniculata*
- *Rubus fruticosus (*Blackberry*)*
- *Senecio madagascariensis* (Fireweed)
- *Sclerolaena birchii (*Galvanised Burr*)*
- *Xanthium sp.*

A weed and pest management strategy for the Project Boundary is provided as Appendix C of the Boggabri Coal Mine – Biodiversity Management Plan (Parsons Brinckerhoff 2012).

2.3 Fauna values

Fauna values within the Project Boundary are illustrated in Figure 2.2 and described in the following sections.



Source: Google (2013)

- Targeted Survey
- Survey Location
- Spotlight Transect
- Proposed rail
- Proposed mine infrastructure
- Existing mine infrastructure
- Project Boundary
- Mine Tenement
- Mine Disturbance to 2011
- Proposed Disturbance Limit

Fauna Habitat Areas

- Derived Native Grassland
- Exotic Grassland
- River Red Gum Riparian Woodlands and Forests
- Shrubby Woodlands/Open Forest on Skeletal Soils
- White Box – Narrow-leaved Ironbark - White Cypress Pine Grassy Open Forest

0 1 2 3 km

Figure 2.2
Fauna Values within Project Boundary

2.3.1 Fauna habitat types

The suitability, size and configuration of the fauna habitats within the Project Boundary correlate broadly with the structure and quality of the local and regional vegetation types (Section 2.2.1). Fauna habitats, particularly those located in the Leard State Forest, provide moderate to good condition habitat for a range of woodland birds, mammals (particularly microchiropteran bats) and reptiles.

Habitat features recorded in the Project generally include those associated with grassy woodlands on fertile soils, shrubby woodlands/open forest on skeletal soils, riverine woodland and derived/exotic grassland.

Key aquatic habitats within the Project Boundary are associated with the Namoi River and its flood plain. Additional aquatic habitat features include minor ephemeral streams within the proposed open cut disturbance area and permanent water sources associated with artificial drainage contours and dams.

2.3.2 Threatened fauna

Twenty-one (21) threatened fauna species (15 birds and 6 mammals) were recorded within the Project Boundary during seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010a). A further 11 threatened fauna species are considered to have potential habitat and a moderate or greater likelihood of occurring within the Boggabri EA Project Boundary. Further studies within the Project Boundary have recorded an additional threatened fauna species of Pale-headed Snake and Swift Parrot have been recorded in 2014 during pre-clearing surveys (Parsons Brinckerhoff 2011d, 2014a).

2.3.3 Migratory species

Three species of bird (White-throated Needletail, Rainbow Bee-eater and Satin Flycatcher) listed under the migratory provisions of the EPBC Act were recorded during seasonal surveys completed between December 2008 and September 2009 (Parsons Brinckerhoff 2010a) and additional surveys conducted over subsequent years to date (Parsons Brinckerhoff 2013a). A further three migratory birds are considered likely to occur in the Project Boundary with a moderate or greater likelihood (Great Egret, Cattle Egret and Regent Honeyeater).

2.3.4 Introduced fauna and pest species

During seasonal surveys which were completed between December 2008 and September 2009 and further surveys undertaken within the Project boundary (Parsons Brinckerhoff 2010a, 2011d, 2013a) seven species of feral animal including Common Starling, Fox, Brown Hare, Rabbit, Black Rat, Common House Mouse and Pig were recorded.

A weed and pest management strategy for the Project Boundary is provided as Appendix C of the Boggabri Coal Mine – Biodiversity Management Plan (Parsons Brinckerhoff 2012).

3. Methodology

This ecological assessment is largely based on a series of field inspections within the Modification Study Area and surrounding landscape, a desktop review of available information for the Project Boundary and a review of previous studies (refer Section 3.3).

3.1 Nomenclature

Names of plants used in this document follow Harden (Harden 1992, 1993, 2000, 2002) with updates from PlantNet (The Royal Botanic Gardens and Domain Trust 2013). Scientific names are used in this report for species of plant. Scientific and common names are provided in plant lists in Appendix A.

Names of vegetation communities used in this report are based on the broad scale vegetation mapping of the Vegetation of the Namoi Catchment Management Authority (EcoLogical Australia 2008) and the threatened ecological community names where applicable. Flora species that are not native are marked with *.

Names of vertebrates used in this document follow the Australian Faunal Directory (ABRS 2009) and as used in the Bionet Atlas of NSW Wildlife (Office of Environment and Heritage 2012a; Woinarski *et al.* 2000). Common names are used in the report for species of animal. Scientific and common names are provided in the list of animals recorded in Appendix B.

3.2 Personnel

The contributors to the preparation of this report, their qualifications and roles are listed in Table 3.1.

Table 3.1 Contributors and their roles

Name	Qualification	Role
Tanya Bangel	BEnvSc (Hons), BEnvScMgt	Ecologist – botanical and fauna surveys, report preparation
Rob Suansri	BSc, BEco	Geospatial consultant
Alex Cockerill	BEnvSc (Hons)	Project manager, technical input

All work was carried out under the appropriate licences, including scientific licences as required under Clause 22 of the National Parks and Wildlife Regulations 2002, Section 132C of the *National Parks and Wildlife Act 1974*, as well as animal research authorities issued by the Department of Trade Investment, Regional Infrastructure and Services.

3.3 Desktop assessment

The aim of the desktop background research was to identify threatened flora and fauna species, populations and ecological communities; Commonwealth listed Migratory species or critical habitat recorded previously or predicted to occur in the vicinity of the Modification study area.

This allowed the known habitat characteristics to be compared with those of the Modification study area to determine the likelihood of occurrence of each species or population. These results informed the identification of appropriate field survey effort to focus on the groups most likely to be present.

The desktop assessment included a review of:

- research papers, books and other published data
- aerial photographs and topography maps
- the '*A Vegetation Map for the Namoi Catchment Management Authority*' (EcoLogical Australia 2008)
- OEH Vegetation Types Database (Office of Environment and Heritage 2012c)
- database searches (refer to Table and Appendices C and D)
- existing documentation for the continuation of Boggabri Coal Mine and the surrounding area including:
  - Due Diligence Assessment – Proposed Pipeline and Power Infrastructure Alignment (2119017A-ENV-LTR-0369 RevA) (Parsons Brinckerhoff 2014b)
  - Ecological Assessment for Boggabri Coal Project Modification (Parsons Brinckerhoff 2013b)
  - Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a).
  - Boggabri Coal – Biodiversity Management Plan (Parsons Brinckerhoff 2012)
  - Preliminary vegetation mapping and survey report for Boggabri Coal lease (Parsons Brinckerhoff 2009)
  - Flora and Fauna Summary of the Boggabri Coal Project (Parsons Brinckerhoff 2005)
  - Results of Fauna survey work undertaken by the NSW National Parks and Wildlife Service within Leard State Forest (Pennay 2001)
  - Report on the botany, wildlife and ecology of the Leard State Forest. Draft Environmental Impact Statement for Amax-BHP Joint Venture Boggabri Coal Project (James B. Croft and Associates 1983)
  - Continuation of Boggabri Coal Mine – Biodiversity Offset Strategy (Parsons Brinckerhoff 2010b)
  - Continuation of Boggabri Coal Mine – Worst Case Cumulative Impact Scenario for Biodiversity (Parsons Brinckerhoff 2010c)
  - Continuation of Boggabri Coal Mine – Response to Submissions (Parsons Brinckerhoff 2011b)
  - Continuation of Boggabri Coal Mine – Matters of National Environmental Significance (Parsons Brinckerhoff 2011c).

Table 3.2 Database searches

Database	Date of search	Search area	Reference
Bionet Atlas of NSW Wildlife	10 October 2014	10 km locality search	(Office of Environment and Heritage 2014)
PlantNet Database	10 October 2014	10 km locality search around Narrabri Shire Council	(Royal Botanic Gardens 2014)
EPBC Protected Matters Search Tool	10 October 2014	10 km locality search	(Department of the Environment 2014)
NSW Fisheries Threatened and Protected Species – records viewer	10 October 2014	Namoi Catchment Management Authority	(Department of Trade & Investment Region Infrastructure and Services 2014)
Noxious Weeds Database	10 October 2014	Narrabri Shire Council	(Department of Trade and Investment Regional Infrastructure and Services 2014)

3.4 Field survey

The Modification study area (refer Figure 3.1) was inspected during daylight hours by suitably qualified ecologists on the 28 January 2014, 18 March 2014, 13 October 2014 and 24, 25 and 26 November 2014. These surveys sought to assess the extent and condition of vegetation and fauna habitat contained within the Modification study area, specifically threatened species, populations and ecological communities, and assess the impacts associated with the proposal in regards to the identified biodiversity.

3.4.1 Flora surveys

3.4.1.1 Species of plant and vegetation communities

A walk over inspection was conducted throughout the proposed Modification area with floristic composition and structure, dominant species and vegetation communities identified. The floristic diversity, possible presence of threatened species and identity of vegetation communities was assessed using quadrat and random meander surveys.

The inspections and field surveys sought primarily to provide ground-truthing of information provided by the desk-based review, particularly in relation to:

- threatened ecological communities listed under the EPBC Act, TSC Act or FM Act
- potential flora and fauna habitat
- significant habitat for threatened and migratory species or locally significant species.

The presence of threatened species was assessed during random meanders within the Modification Study Area. Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by Cropper (1993), whereby the recorder walks in a random manner recording all species observed, boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Targeted threatened flora searches for *Tylophora linearis* have been undertaken in habitat within the project area in accordance with the random meander technique described by Cropper (1993). These surveys were

undertaken within the May – November flowering period for this species. Previous targeted surveys have been undertaken within the approved Project area and these are outlined in Appendix G.

Nine (9) flora quadrat (20 X 20 m) was undertaken within the Modification study area (refer Figure 3.1) to identify the presence/absence of the native vegetation communities present. The flora quadrats were undertaken in accordance with the BioBanking Operation Manual (Seidel & Briggs 2008). Random meander transects were completed in accordance with the technique described by (Cropper 1993) whereby the recorded walks in a haphazard manner throughout the site. Attributes recorded during this random meander transects included variation in species composition and vegetation structure, the presence or absence of threatened or noxious species of plant and boundaries between vegetation communities.

3.4.1.2 Vegetation condition

The condition of vegetation was assessed using parameters such as structural intactness, native species diversity, evidence of disturbance, weed invasion and plant health. Random meander surveys were the primary method of data collection for the vegetation community identification and condition assessment.

Three categories were used to describe the condition of vegetation communities:

- **good:** vegetation still retains the species complement and structural characteristics of the pre-European equivalent. Such vegetation has usually changed very little over time and displays resilience to weed invasion due to intact groundcover, shrub and canopy layers
- **moderate:** vegetation generally still retains its structural integrity, but has been disturbed and has lost some component of its original species complement. Weed invasion can be significant in such remnants
- **poor:** vegetation that has lost most of its species and is significantly modified structurally. Often such areas have a discontinuous canopy of the original tree cover, with very few shrubs. Exotic species, such as introduced pasture grasses or weeds, replace much of the indigenous ground cover. Environmental weeds are often co dominant with the original indigenous species.

3.4.2 Fauna surveys

Fauna survey was conducted via; opportunistic surveys, hollow tree survey and habitat assessment each of the survey techniques are described in further detail in the following sections.

3.4.3 Opportunistic surveys

Opportunistic surveys consisted of random meanders across the Modification Study Area and while completing other survey techniques, including habitat assessments and hollow-bearing tree surveys. Opportunistic surveys included herpetofauna searches throughout the Modification Study Area wherever potential habitat (fallen logs, debris, drainage lines and rock outcropping) was found. Searches included turning over suitable ground shelter, such as fallen timber, sheets of iron and exposed rock, timber railway sleepers, and peeling decorticating bark where appropriate. Specimens were either identified visually, by aural recognition of calls (frogs and birds) or were collected and identified with reference to (Swan *et al.* 2004)) or (Robinson, M. 1998). All inspected ground shelter was returned to its original position.

3.4.3.1 Hollow-bearing tree survey

Hollow-bearing trees were recorded on a hand held GPS whereby the number of tree hollows were based on visual inspection.

3.4.3.2 Fauna habitat assessment

Fauna habitat assessments were undertaken to assess the likelihood of threatened species of animal (those species identified to occur within the locality from the literature and database review) occurring within the Modification study area. Fauna habitat characteristics assessed included:

- structure and floristics of the canopy, understorey and ground vegetation, including the presence of flowering and fruiting trees providing potential foraging resources
- presence of hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, birds and reptiles
- presence of the ground cover vegetation, leaf litter, rock outcrops and fallen timber and potential to provide protection for ground-dwelling mammals, reptiles and amphibians
- presence of waterways (ephemeral or permanent) and water bodies.

A general fauna habitat features traverse was undertaken throughout the Modification study area during the survey covering all major native vegetation occurrences. During the traverse, opportunistic recordings of species were made through incidental sightings, aural recognition of calls and observing indirect evidence of species presence (such as scats, feathers, hair, tracks, diggings and burrows).

3.4.3.3 Fauna habitat condition

The following criteria were used to evaluate the condition of habitat values:

- **good:** a full range of fauna habitat components are usually present (for example, old growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- **moderate:** some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- **poor:** many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

3.5 Likelihood of occurrence assessment

The likelihood of threatened and migratory species and threatened populations occurring within the Modification study area were assessed against the criteria outlined in Table 3.3.

Species subject to likelihood of occurrence assessments were those identified during the desk-top and field based investigations and/or the professional opinion of contributors to this assessment.

Table 3.3 Likelihood of occurrence assessment

Likelihood-of-occurrence	Criteria
Low	▪ have not been recorded previously in the Modification study area and surrounds which are beyond the current known geographic range ▪ are dependent on specific habitat types or resources that are not present in the Modification study area ▪ are considered extinct in the locality

Likelihood-of-occurrence	Criteria
Moderate	■ have been recorded previously in the Modification study area and surrounds infrequently (i.e. vagrant individuals) ■ use habitat types or resources that are present in the Modification study area, although generally in a poor or modified condition ■ are unlikely to maintain sedentary populations, however may seasonally utilise resources within the Modification study area opportunistically during variable seasons or migration
High	■ have been previously recorded in the Modification study area ■ are dependent on habitat types or resources that are present in the Modification study area that are abundant and/or in good condition within the Modification study area ■ are known or likely to maintain resident populations surrounding the Modification study area ■ are known or likely to visit the Modification study area or surrounds during regular seasonal movements or migration
Recorded	■ recorded in the Modification study area during current field study

3.6 Significance assessments

Significance assessments were carried out for threatened species, populations or communities listed under the *Threatened Species Conservation Act 1995* (TSC Act) or *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)* that were known or predicted to occur in the proposal locality (within a 10 km radius from the Modification study area), that had a moderate to high likelihood of occurring within the Modification study area, based on suitable habitat and that were likely to be impacted upon by the construction.

For species or communities listed under the TSC Act, significance assessments were completed by the addressing the factors of Part 5A of the *Threatened species assessment guidelines The assessment of significance* (Department of Environment and Climate Change 2007). For species or communities listed under the EPBC Act, significance assessments were completed in accordance with the *Significant Impact Guidelines 1.1 Matters of National Environmental Significance (Department of Environment 2013)*.

3.7 Limitations

No sampling technique can totally eliminate the possibility that a species is present on a site. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present on site during surveys. The conclusions in this report are based upon data acquired for the site and the environmental field surveys and are, therefore, merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of species. Also, it should be recognised that site conditions, including the presence of threatened species, can change with time.

Where surveys were conducted outside the optimal time for detecting a particular species or field surveys were of limited scope, a precautionary approach was taken and it was assumed that the species was present if suitable habitat was observed.

Targeted *Tylophora linearis* surveys where undertaken in the Modification within existing project area boundary, within potential habitat, during the species flowering period (25 and 26 November 2014) and in July 2014. *Tylophora linearis* was observed in existing project boundary during the July 2014 surveys (northern section of Site 4)). The *Tylophora linearis* observed at the reference site showed that the species had reduced in numbers since July and lost the majority of its leaves (assumed this is a result of high temperatures and lack of moisture in the soil) making it difficult to locate.

3.8 Landscape context

3.8.1 Bioregion

The Modification Study Area is located in the Brigalow Belt South bioregion. This region covers an area of approximately 27,196,933 ha encompassing the towns of Baradine, Binnaway, Coonabarabran, Dubbo, Gunnedah, Merriwa, Moree and Narrabri (NSW National Parks and Wildlife Service 2003). The region also includes a significant proportion of NSW major rivers: MacIntyre, Gwydir, Namoi, Castlereagh, Goulburn, Talbragar and Macquarie Rivers, with their catchments forming an integral part of the Murray–Darling River System (NSW National Parks and Wildlife Service 2003).

The region forms the southern extremity of the Brigalow Belt, however is not dominated by Brigalow (*Acacia harpophylla*). According to the baseline surveys that supported the Brigalow Nandewar Conservation Agreement, the signature trees that occur throughout the Brigalow Belt South bioregion are White Box, White Cypress Pines and various Ironbarks. These species also dominate the communities that occur in the approved area of impact of the Project.

Geologically the region consists of landscapes derived from both extensive basalt flows and quartz sandstones and consequently has very variable soils and vegetation depending on the local rock type or sediment source. Geologically the bioregion's bedrock comprises horizontally bedded Jurassic and Triassic quartz sandstone and shale with limited areas of conglomerate or basalts. The landscape is dominated by Quaternary sediments in the form of alluvial fans and outwash slopes composed of coarser sediment, that fan out at slightly steeper angles. The relative distribution of sediment from basalt or sandstone has a major impact on soil quality and vegetation (NSW National Parks and Wildlife Service 2003).

A number of threatened ecological communities, plants and animals are restricted to the bioregion. With over 3,190,400 ha or 60.85% of the regions vegetation being cleared, the majority of threatened species records tend to be concentrated in the major reserves and state forests. The Brigalow Belt Bioregion has only limited areas of conservation-oriented tenures: together, they occupy about 155,353 ha or 2.91% of its area (NSW National Parks and Wildlife Service 2003). These reserves are made up of nineteen National Parks and Nature Reserves. About 10.6% of the bioregion is managed as State Forests. Nine Flora Reserves, occupying 4,091 ha (0.008%) also occur in the bioregion. Several State Forests occur within the region; including Leard, Vickery, Kelvin, Kerringle, Bibblewindi and Pilliga East.

3.8.2 Brigalow and Nandewar Western Regional assessment

The Modification is located within an area that has previously been assessed at a broad scale under the Brigalow and Nandewar Western Regional Assessments (WRA). In 1999, the NSW Government initiated a regional assessment of western NSW to guide future planning and encourage partnerships to protect the environment.

The former Resource and Conservation Assessment Council (RACAC) coordinated the assessment, and involved key NSW agencies representing forests, conservation, planning, Aboriginal interests, minerals and natural resources. The assessment included detailed scientific analysis and consultation with timber operators, conservation groups, Aboriginal stakeholders, minerals and gas industries, local communities and local government.

The aims of the Brigalow and Nandewar assessments were to deliver:

- adequate and complete core data layers to inform regional land use planning, conservation and resource management
- enhanced partnerships between core agencies and interest groups concerned with natural resources and ecological sustainability, to increase sharing of information and to reduce duplication

- the identification of a comprehensive, adequate and representative network of protected and managed areas.

Informed by the information collected during the WRAs, NSW Government's decision in 2005 to conserve 350,000 ha of woodlands in the Brigalow and Nandewar bioregions through the *Brigalow and Nandewar Community Conservation Area Act 2005* provided a regional approach to the protection of important conservation values with an aim of long-term sustainability of the region's important timber, gas, minerals and apiary sectors.

The Boggabri Coal Project is largely restricted to Leard State Forest, which was not identified for conservation in the regional assessments.

3.9 Vegetation communities

The field survey and desktop assessment identified that the vegetation within the Modification Boundary and Project Boundary was comprised of seven (7) native vegetation community previously described by (Parsons Brinckerhoff 2009), the distribution of which are related to geological, topographical, and geomorphological characteristics and previous land use (refer to Table 3.4 and Figure 3.1). In addition, one (1) non-native vegetation community was recorded. The vegetation communities identified in the Modification Boundary and Project Boundary included:

- Pilliga Box – Poplar Box – White Cypress Pine grassy woodland
- River Red Gum riparian woodlands and forests
- White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest
- Narrow-leaved Ironbark – White Cypress Pine shrubby open forest
- Yellow Box – Blakely's Red Gum grassy woodland
- White Box White Cypress Pine grassy woodlands
- Derived native grassland
- Exotic grassland with scattered trees.

Table 3.4 Identified vegetation communities

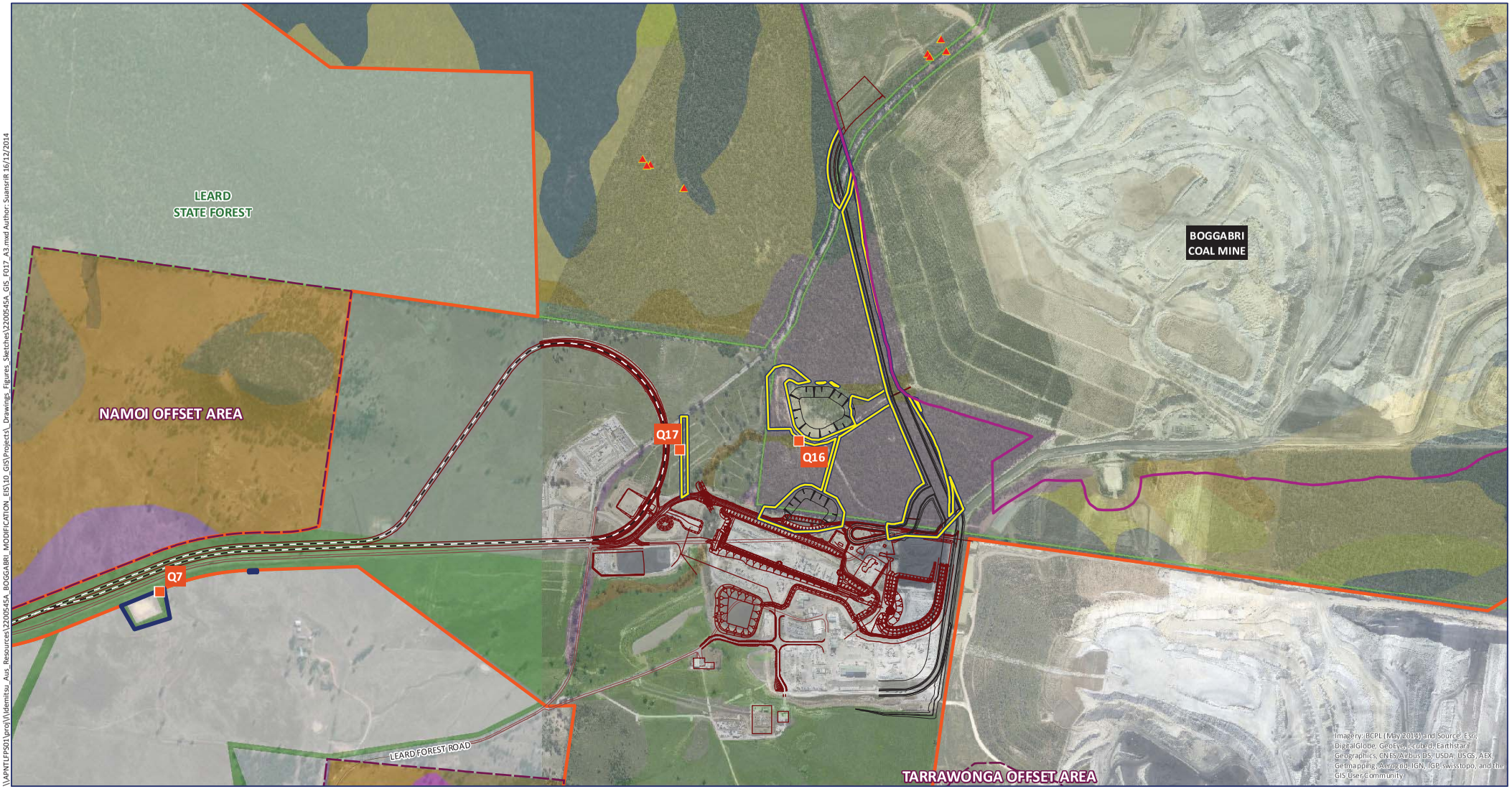
Existing vegetation mapping community equivalent (Parsons Brinckerhoff 2009)	Field Verified Vegetation community(Office of Environment and Heritage 2012c)	Threatened ecological community[1]	OEH Vegetation class (Gibbons *et al.* 2008)	OEH Vegetation formation class (Gibbons *et al.* 2008)
Pilliga Box – Poplar Box – White Cypress Pine grassy woodland	NA179: Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland on alluvial loams mainly of the temperate (hot summer) climate zone	-	Dry Sclerophyll Forests (Shrub/grass subformation)	Pilliga Outwash Dry Sclerophyll Forests
River Red Gum riparian woodlands and forests	NA193: River Red Gum riverine woodlands and forests in the Nandewar and Brigalow Belt South Bioregions	-	Forested Wetlands	Inland Riverine Forests
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	NA225: White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	-	Dry Sclerophyll Forests (Shrub/grass subformation)	North-west Slopes Dry Sclerophyll Woodlands

Existing vegetation mapping community equivalent (Parsons Brinckerhoff 2009)	Field Verified Vegetation community(Office of Environment and Heritage 2012c)	Threatened ecological community[1]	OEH Vegetation class (Gibbons *et al.* 2008)	OEH Vegetation formation class (Gibbons *et al.* 2008)
Narrow - leaved Ironbark - White Cypress Pine shrubby open forest	NA134: Cypress pine - Bulloak shrubby woodland of northern Brigalow Belt South Bioregion	-	Grassy Woodlands	Western Slopes Grassy Woodlands
Yellow Box – Blakely's Red Gum grassy woodland	NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	E, CE	Grassy Woodlands	Western Slopes Grassy Woodlands
White Box White Cypress Pine Grassy Woodland[2]	NA225: White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	E	Grassy Woodlands	Western Slopes Grassy Woodlands
Derived native grassland	NA179: Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland on alluvial loams mainly of the temperate (hot summer) climate zone	-	Dry Sclerophyll Forests (Shrub/grass subformation)	Pilliga Outwash Dry Sclerophyll Forests
Exotic grassland with scattered trees	-	-	-	-

(1) E = Endangered ecological community, White Box Yellow Box Blakely's Red Gum Woodland (TSC Act)
CE = Critically Endangered Ecological Community White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland as listed on the EPBC Act.

(2) This community generally occurred as native grassland with scattered trees.

Detailed summaries of these communities including structure and dominant species recorded and vegetation habitat assessments are provided below. Copies of the field data sheets for the nine biobanking quadrats and transects is provided in Appendix F.



Endangered ecological communities
- White Box - Narrow-leaved Ironbark - White Cypress Pine grassy open forest
- White Box - White Cypress Pine grassy woodland
- Yellow Box - Blakelys Red Gum grassy woodland

All other communities
- Derived native grassland
- Exotic grassland
- Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- Pilliga Box - Poplar Box - White Cypress Pine grassy open woodland
- Regrowth - White Cypress Pine
- White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- White Pine - Narrow-leaved Ironbark Shrub - Grass Open Forest SW

- Quadrat
- *Tylophora linearis* location
- Proposed mine infrastructure
- Existing mine infrastructure
- Proposed rail
- Road
- Proposed new project area
- Modification within existing project area
- Boggabri Project Approval Area
- Namoi offset area
- EPBC approval boundary
- Leard State Forest

0 0.25 0.5 0.75 km

Figure 3.1c
Vegetation communities and survey effort within the Modification Area

3.9.1 Pilliga Box – Poplar Box – White Cyprus Pine grassy Woodland

Pilliga Box – Poplar Box – White Cyprus Pine grassy Woodland is a native open woodland vegetation community that was recorded as isolated patches of remnant trees within a heavily disturbed landscape as a result of agricultural activities. This community occurred as scattered isolated patches of remnant vegetation throughout Sites 2-9 within the Modification study area mostly adjacent to areas of exotic grassland (refer to Figure 3.1).

The majority of this community is dominated by a combination of native and exotic grasses and forbs however, retains a native canopy cover characteristic of the Pilliga Box – Poplar Box – White Cyprus Pine grassy woodland.

Pilliga Box – Poplar Box – White Cyprus Pine grassy Woodland			
Description			
Conservation significance	Not consistent with any endangered ecological communities.		
Condition	**Low - Moderate.** This community is subject to high disturbance from previous and current land use including agricultural activities, vegetation clearing, edge effects and weed invasion. This community contains a sparse canopy of remnant and occasional planted species such as *Eucalyptus pilligaensis* and *Eucalyptus populnea* subsp. *bimbil.* The ground layer was generally dominated by exotic and native groundcover species including numerous perennial grasses and herbs.		
Strata	**Height range (m)**	**Foliage cover (%)**	**Dominant species**
Canopy	4-20	0-30	*Eucalyptus pilligaensis* and *Eucalyptus populnea subsp. bimbil.*
Shrub layer	0.4-2	0-15	Occasional exotic shrub species such as *Sclerolaena birchilli** and *Vachellia farnesiana**
Ground cover	0.1-1.6	0-100	*Austrostipa aristiglumis, Chloris truncata, Panicum queenslandicum, Bothriochloa decipiens, Dichanthium sericeum,* and exotic pasture grasses and herbaceous weeds including *Sida rhombifolia**, *Hypochaeris radicata**, *Cirsium vulgare**, *Brassica spp.**, *Silybum marianum**, *Lolium perenne**, *Echium plantagineum**, *Avena fatua**, *Chloris gayana**, *Plantago lanceolata**, *Centaurea calcitrapa** and *Bidens pilosa**.

Pilliga Box – Poplar Box – White Cyprus Pine grassy Woodland

3.9.2 River Red Gum riparian woodlands and forests

The River Red Gum riparian woodlands and forests vegetation community that was recorded within the proposed Modification area occurred at Site 2 on the floodplain depressions throughout the proposed Modification area (refer to Figure 3.1). This community has been heavily disturbed as a result of agricultural activities such as grazing, cropping and vegetation clearance. This community generally occurred adjacent to exotic grassland.

The majority of this community is dominated by a combination of native and exotic grasses and forb however retains a native canopy cover characteristic of the River Red Gum riparian woodlands and forest.

River Red Gum riparian woodlands and forests			
Description			
Conservation significance	Not consistent with any endangered ecological communities.		
Condition	**Low.** This community is subject to high disturbance from previous and current land use including agricultural activities, vegetation clearing, edge effects and weed invasion. This community contained a sparse canopy of remnant *Eucalyptus camaldulensis* and the occasional *Eucalyptus melliodora*. The ground layer was dominated by exotic groundcover species as a result of pasture grassing including numerous perennial grasses and herbs such as *Vicia sativa* subsp. *nigra*, Hypochaeris radicata*, Cirsium vulgare*, Sonchus olearus** and *Bidens pilosa**.		
Strata	**Height range (m)**	**Foliage cover (%)**	**Dominant species**
Canopy	4-22	0-25%	*Eucalyptus camaldulensis* and the occasional *Eucalyptus melliodora.*
Shrub layer	0.4-2	0-10	Occasional exotic shrub species such as *Sclerolaena birchii** and *Vichellia farnesiana**
Ground cover	0.1-1	50-90	*Hypochaeris radicata*, Cirsium vulgare*, Brassica spp.*, Silybum marianum*, Lolium perenne*, Echium plantagineum*, Avenua fatua*, Trifolium arvensis*, Vulpia myuros*, Rumex crispix*, Anagallis arvensis*, Trifolium sativa*, Chloris gayana*, Plantago lanceolata*, Centaurea calcitrapa** and *Bidens pilosa**. The community also comprised the occasional native plant species such as *Austrostipa aristiglumis, Chloris truncate, Carex appressa* and *Cyperus spp.*

Note: Photo of River Red Gum riparian woodlands and forests from within the Project Area Boundary

3.9.3 White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest

The White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest vegetation community was recorded within Site 1 immediately adjacent to the coal stockpile and a crusher south of the Rocklea offset property (refer to Figure 3.1). Within the proposed Modification area the community occurred on the mid-upper slopes on skeletal soils over conglomerate. This community generally occurred adjacent to exotic grassland.

The majority of this community was in moderate condition with a moderate native species diversity and low weed density. However this community had been subjected to disturbance as a result of vegetation clearing, edge effects, adjacent roads and agriculture activities.

White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest			
Description			
Conservation significance	Not consistent with any endangered ecological communities. The community contained a number of characteristic species of the critically endangered Box – Gum Woodlands community and the endangered Box – Gum Woodlands listed under the TSC Act. However, was excluded from the classification due to the following reasons: ■ It contained a continuous shrub layer with greater than 30% foliage cover comprising a mixture of non-pioneer shrub species (i.e. it was not grassy) (Gibbons & Boak 2000). ■ It was restricted to steep, skeletal, rocky soils of low fertility.		
Condition	**Moderate.** This community is subject to moderate disturbance from previous and current land use including agricultural activities, vegetation clearing, edge effects and weed invasion. This community contained a sparse canopy of remnant *Eucalyptus crebra* and the occasional *Eucalyptus albens*. The ground layer was dominated by native and exotic groundcover species such as perennial grasses, forbs and sedges.		
Strata	**Height range (m)**	**Foliage cover (%)**	**Dominant species**
Canopy	16-20	30-35	*Eucalyptus albens* and *Eucalyptus crebra*.
Sub-canopy	3-8	0-30	*Callitris glaucophylla*
Shrub layer	0.4-2	40-65	*Notelaea microcarpa* var. *macrocarpa, Olearia elliptica, Geijera parviflora, Dodonaea viscosa subsp. angustifolia Bursaria spinosa* subsp. *spinosa, Pimelea neo-anglica, Beyeria viscosa, Cassinia* spp and *Acacia* spp.
Ground cover	0.1-1	40-60	*Austrostipa scabra, Cyperus gracilis, Austrodanthonia racemosa, Desmodium brachypodum, Aristida ramosa, Calotis spp., Vittadinia spp., Cymbopogon refractus, Cheilanthes distans* and *Rostellularia adscendens ssp adscendens var pogonanthera and exotic species such as Echium plantagineum** and *Centaurea calcitrapa**.

White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest

Note: Photo of White Box – Narrow –leaved Ironbark – White Cypress Pine shrubby woodland from within the Project Area Boundary

3.9.4 Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

The Narrow-leaved Ironbark – White Cypress Pine shrubby open forest vegetation community was recorded within Sites 4-9 within the Haul Road construction area (refer to Figure 3.1).

The community was generally in good condition with high native species diversity and low weed density. However the majority of the community has been subjected to forest operations in the past, while minor clearing associated with existing access tracks was also observed. The edge effects along the adjoining roads were the main source of disturbance.

Narrow - leaved Ironbark - White Cypress Pine shrubby open forest			
Description			
Conservation significance	Not consistent with any endangered ecological communities.		
Condition	**Good.** This community has been subjected to forest operations in the past, while minor clearing associated with existing access tracks was also observed. The edge effects along the adjoining roads were the main source of disturbance. This community contained a sparse canopy of *Eucalyptus crebra* and *Corymbia trachyphloia* subsp. *amphistomatica* with occasional *Eucalyptus dwyeri.* The ground layer was dominated by a diverse range of grasses intermingled with a range of forbs and sedges.		
Strata	**Height range (m)**	**Foliage cover (%)**	**Dominant species**
Canopy	16-20	30-40	Dominated by *Eucalyptus crebra* and *Corymbia trachyphloia* subsp. *amphistomatica* with occasional *E. dwyeri*
Sub-canopy	3-8	0-30	*Callitris glaucophylla*
Shrub layer	0.4-3	0-20	*Melichrus urceolatus, Notelaea microcarpa var. macrocarpa, Pultenaea sp. and Hovea lanceolata.*
Ground cover	0.1-1	0-60	*Joycea pallida Dichelachne micrantha Austrostipa scabra, , Austrodanthonia racemosa, Aristida ramosa, Calotis spp., Lepidosperma laterale, Goodenia hederacea subsp. hederacea and Cheilanthes sieberi subsp. sieberi.*

Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

Note: Narrow-leaved Ironbark – Brown Bloodwood – White Cypress Pine shrubby open forest within the Project Area Boundary

3.9.5 Yellow Box – Blakely's Red Gum grassy woodland

The Yellow Box – Blakely's Red Gum grassy woodland vegetation community was recorded within the Haul Road upgrades area (Sites 4-9). The community was typically associated with minor ephemeral creek lines and fertile soils on lower slopes and plains (refer to Figure 3.1).

The majority of this community was in moderate condition with a moderate density of native species diversity. However, this community is subject to a moderate weed density having been subjected to low disturbance as a result of minor clearing associated with existing access tracks and the construction of Boggabri Coal Mines clean water diversion drain. Areas of this community within the predominantly cleared paddocks south of Leard State Forest have been subjected to a wide range of agricultural disturbances, including, clearing, grazing, pasture improvements, construction of agricultural infrastructure and exotic weed infestations. The edge effects along the Leard State Forest road were also a source of disturbance.

Yellow Box – Blakely's Red Gum grassy woodland			
Description			
Conservation significance	Yes. Is consistent with White Box Yellow Box Blakely's Red Gum Woodland community listed as an Endangered Ecological Community under the TSC Act and with White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands, which are listed as Critically Endangered under the EPBC Act.		
Condition	**Moderate.** This community is subject to moderate disturbance from previous and current land use including agricultural activities, vegetation clearing, edge effects and weed invasion. This community contained a sparse to dense canopy of remnant *E. blakelyi* and the occasional *E. melliodora* and *E. albens.* The ground layer was dominated by native with the occasional exotic groundcover species such as perennial grasses, forbs and sedges.		
Strata	**Height range (m)**	**Foliage cover (%)**	**Dominant species**
Canopy	16-25	0-25	Dominated by *E. blakelyi* and occasionally *E. melliodora* and *E. albens.*
Shrub layer	1-3	20-30	*Acacia decora* and *Dodonaea spp.*
Ground cover	0.1-1	40-80	*Chloris truncata, Bothriochloa macra, Microlaena stipoides var. stipoides, Lomandra longifolia, Austrostipa verticillata.*

Note: Yellow Box – Blakely's Red Gum grassy woodland within the Project Boundary

3.9.6 White Box White Cypress Pine grassy woodland

This vegetation community was recorded as isolated remnants within the Modification area (Sites 2-9). This grassy woodland was highly modified from the woodland that is likely to have occurred in pre-European times and currently occurs as derived grassland with scattered trees. Very few large hollow-bearing trees were recorded. The characteristics of this community are summarised below. Impacts to this community are detailed in Section 6 of this report.

White Box Cypress Pine grassy woodland			
Description			
Conservation status	Yes. Is consistent with White Box Yellow Box Blakely's Red Gum Woodland community listed as an Endangered Ecological Community under the TSC Act.		
Condition	**Moderate.** This community is subject to moderate to high disturbance from previous and current land use including agricultural activities edge effects and weed invasion. This community contained scattered canopy of remnant *E. albens*. The shrub layer was sparse and the ground layer was dominated by native grasses with the occasional exotic groundcover species.		
Strata	**Height range (m)**	**Foliage cover (%)**	**Dominant species**
Canopy	16-20	0-15	Scattered occurrences of *E. albens.*
Shrub layer	1-3	15-25	Scattered occurrences of *Acacia decora* and *Geijera parviflora*
Ground cover	0.1-1	50-60	*Cyperus gracilis, Austrodanthonia racemosa, Bothriochloa macra, Desmodium brachypodum, Aristida ramosa, Calotis cuneifolia, Brunoniella australis, Austrostipa spp. Vittadinia cuneata, Dichondra repens and Lomandra multiflora.*

3.9.7 Derived native grassland

The derived native grassland is a highly modified native vegetation community that occurs immediately adjacent the Pilliga Box – Poplar Box – White Cypress Pine grassy woodland. Specifically the community occurs in the southern sections of the Project area and along the majority of the Haul Road (Sites 4-9). The community is associated with areas of recent clearing for agricultural land uses and Boggabri Coal Mine. Given the floristic composition and presence of regrowth Poplar Box – White Cypress Pine it is considered likely that this community would have comprised the Pilliga Box – Poplar Box – White Cypress Pine grassy woodland prior to the clearing.

The majority of this community was dominated by a variety of exotic and cultivated native pasture grasses and exotic herbs. The majority of the canopy and shrub layer within this community had been previously cleared and its condition class was considered to be poor. Isolated paddock trees of *Eucalyptus populnea subsp. bimbil* were scattered throughout this community.

Derived native grassland			
Description			
Conservation significance	Not consistent with any endangered ecological communities.		
Condition	**Low to moderate.** This community is subject to high disturbance from previous and current land use including vegetation clearing, infrastructure, edge effects and weed invasion. This community generally did not contain a canopy or shrub layer aside from the occasional planted or remnant plant species (*Eucalyptus populnea* subsp. *bimbil)*. The ground layer was dominated by native and exotic groundcover species including numerous perennial grasses (including crops) and herbs.		
Strata	**Height range (m)**	**Foliage cover (%)**	**Dominant species**
Canopy	4-18	0-30	Isolated paddock trees of *Eucalyptus populnea* subsp. *bimbil*
Shrub layer	0.4-1	0-20	Occasional *Sclerolaena birchii**
Ground cover	0.1-1.8	80-100	*Enchylaena tomentosa, Einadia nutans* subsp. *linifolia, Austrostipa scabra subsp. scabra, Austrostipa verticillata, Calotis cuneifolia, Vittadinia cervicularis var. cervicularis.*

3.9.8 Exotic grassland with scattered trees

The exotic grassland with scattered trees is a highly disturbed vegetation community that occurs throughout the proposed Modification area, southern sections of the Project area and along the majority of the Haul Road (Sites 1-3). The community is associated with areas that have been impacted by a history of agricultural activities and no longer resembles any local native remnant vegetation communities (refer to Figure 3.1). The majority of this vegetation community was dominated by a variety of exotic and cultivated native pasture grasses and exotic herbs.

Exotic grassland with scattered trees			
Description			
Conservation significance	Not consistent with any native vegetation communities or endangered ecological communities.		
Condition	**Low.** This community is subject to high disturbance from previous and current land use including vegetation clearing, infrastructure, edge effects and weed invasion. This community generally did not contain a canopy or shrub layer aside from the occasional planted or remnant plant species such as *Eucalyptus pilligaensis* and *Eucalyptus populnea* subsp. *bimbil*. The ground layer was dominated by exotic groundcover species including numerous perennial grasses (including crops) and herbs.		
Strata	**Height range (m)**	**Foliage cover (%)**	**Dominant species**
Canopy	4-18	0-30	Occasional remnant or planted *Eucalyptus populnea* and *Eucalyptus pilligaensis.*
Shrub layer	0.4-1	0-20	Occasional *Sclerolaena birchii**
Ground cover	0.1-1.8	80-100	*Hypochaeris radicata**, *Cirsium vulgare**, *Brassica spp.**, *Silybum marianum**, *Lolium perenne**, *Echium plantagineum**, *Avenua fatua**, *Trifolium arvensis**, *Vulpia myuros**, *Rumex crispix**, *Anagallis arvensis**, *Trifolium sativa**, *Chloris gayana**, *Plantago lanceolata**, *Centaurea calcitrapa**, *Medicago polymorpha**, *Triticum aestivum** and *Bidens pilosa**.

3.9.9 Species of plant

A total of 114 species of plant were recorded within the proposed Modification area (Appendix A). Of these species, 76 (67%) were native. The most diverse plant families were the Poaceae (grasses) and Asteraceae.

One threatened species *Tylophora linearis* has previously been recorded within the modification area (Appendix G) adjoining the northern portion of the proposed haul road.

Three (3) weed species (Fireweed, Galvanised Burr and Prickly Pear) recorded within the Modification study area are declared as noxious under the *Noxious Weeds Act 1993* for the Narrabri Shire Council weed control area (refer to Table 3.5). These weeds are classifies as Class 4 weeds under the *Noxious Weeds Act 1993* and must be managed in accordance with the control class measures specified as outlined under the Act. Fireweed is also listed as Weeds of National Significance and should be appropriately managed as it has high potential to invade and spread.

Table 3.5 Noxious weeds and Weeds of National Significance identified on the site

Scientific Name	Common Name	Noxious Weeds Act 1993[1]	Weed of National Significance
*Opuntia stricta**	Prickly Pear	4	-
*Senecio madagascariensis**	Fireweed	4	Yes
*Sclerolaena birchii**	Galvanised Burr	4	-

Note:

(1) Control Categories under the *Noxious Weeds Act 1993* for the Narrabri Shire Council: Class 4: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority (Department of Trade and Investment Regional Infrastructure and Services 2014).

3.10 Fauna habitat

The quality of vertebrate fauna habitats is typically correlated with the patch size, configuration, structure, species composition and connectivity of the vegetation communities present at a given site and the presence of non-biological features such as rock outcrops and water bodies. Therefore, the fauna habitats present in the Modification study area varied from low condition in highly modified areas (exotic grassland with scattered trees) and moderate condition in the highly disturbed open woodland.

The Modification study area consisted on three (3) fauna habitat types: grasslands (exotic and derived native), grassy woodland on fertile soils and aquatic habitat.

3.10.1 Grasslands

This habitat type consisted of all exotic grassland with scattered trees and derived native grassland vegetation communities that were recorded throughout the proposed Modification area.

The grassland areas have been subject to heavy disturbance (vegetation clearing, edge effects and weed invasion) as a result of agricultural and mining activities. This habitat is almost entirely devoid of trees and shrubs, consisting primarily of exotic and native grasses and herbaceous weeds with the occasional tree. The grassland habitat generally lacked a range of habitat features, such as tree hollows, fallen timber, rock outcrops, diverse native groundcover or deep leaf litter providing limited foraging resources and refuge sites for native animals. As this habitat lacked structural complexity it provided limited habitat suitable only for transient ground dwelling native species or highly mobile disturbance tolerant species (such as birds and bats) and is unlikely to be used on a permanent basis by most threatened fauna. This habitat does provide foraging and marginal roosting habitat for a number of threatened birds of prey including the Little Eagle, Square-tailed Kite and Spotted Harrier.

3.10.1.1 Grassy woodland on fertile soils

This habitat type included the Pilliga Box – Poplar Box – White Cypress Pine grassy woodland, River Red Gum riparian woodlands and forests, Silver-leaved Ironbark shrubby woodland, White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest, Narrow-leaved Ironbark – White Cypress Pine shrubby open forest and Yellow Box – Blakely's Red Gum grassy woodland vegetation communities. This habitat type occurred as moderately disturbed and isolated patches of native remnant vegetation within the proposed Modification area.

This area contained an intact native canopy cover, generally lacked a native shrub layer with a combined native and exotic groundcover (often dominated by exotic pasture grasses and herbaceous weeds). This habitat contained numerous hollows suitable for bird species however lacked other habitat features such as fallen timber, rock outcrops and leaf litter. This habitat does provide foraging and roosting habitat for a number of disturbance tolerated species of animal including threatened bat and bird species.

3.10.1.2 Aquatic habitat

Three (3) artificial dams were recorded within the Modification study area. These dams were generally in low condition almost completely devoid of vegetation. There were however, areas within these dams that may be used by disturbance tolerant bird species such as the Australian Wood Duck. The dams varied in depth, width (20-50m) and turbidity which all fluctuate in accordance with rainfall patterns.

Field observations of the artificial dams revealed that they were in a low habitat condition. The aquatic habitat within the proposed Modification area has been subject to high levels of disturbance (e.g. weed invasion and sedimentation) as a result of land use (i.e. agricultural and mining activities). Although, the habitat has been degraded, it still retained some aquatic fauna habitat features such as vegetation and foraging habitat. The artificial dams are likely to provide marginal foraging habitat for a number of aquatic and terrestrial species including amphibians, reptiles (turtles), mammals (microbats) and birds which are tolerant to poor water quality and disturbance.

The aquatic habitat identified within the Modification study area is unlikely to provide habitat for any threatened species listed under the *Fisheries Management Act 1994* (FM Act) due to the degraded condition of habitat and regular disturbance regime currently impacting the site.

3.10.2 Species of animal

A total of 19 species of animal were recorded in the proposed Modification area (Appendix B), of which, 16 (84%) were native. Birds accounted for 17 species (89%) while reptiles accounted for two (2) (11%) species.

No threatened animal species were recorded during the opportunistic fauna survey. Most of the species recorded are associated commonly with disturbed environments within a modified landscape.

4. Biodiversity of conservational concern

4.1 Endangered ecological communities

One (1) threatened ecological community (TEC) listed under the TSC Act and EPBC Act was recorded within the Modification study area:

- *White Box Yellow Box Blakely's Red Gum Woodland* listed as endangered under the TSC Act (Sites 2, 3 and Sites 4-9) (1.9 ha).
- *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* listed as critically endangered under the EPBC Act (Sites 4-9) (1.2 ha).

A small area (1.9 ha consistent with endangered TSC Act listed community and of this 1.2 ha consistent with critically endangered EPBC Act listed community) of this community was recorded within the Modification study area. Of this area 1.2 ha of this community TSC Act listed and EPBC Act listed community will be within the Modification within project area (Sites 4-9). Works proposed within these areas would involve removal of vegetation for the construction increased sediment dams and haul road adjustments and associated infrastructure. See Section 5.1.1 and 5.1.2 for the determination processes used in determining presence of the White Box, Yellow Box, Blakely's Red Gum Woodland communities listed under the TSC Act and EPBC Act. Control measures have been provided in Section 6 to mitigate any potential impacts associated with the proposal, such as erosion and sediment control. Figure 4-1 shows the extent of the threatened ecological communities within the proposed modification area.

None of the communities identified within the Modification study area correspond with TEC listed under the FM Act.

Table 4.1 Threatened ecological communities with potential to occur within the proposed Modification study area

Ecological community name TSC Act (EPBC Act)	Conservational status			Recorded within the proposed Modification study area
	TSC Act[1]	EPBC Act[2]	FM Act[3]	
Coolibah – Black Box Woodlands of the Northern Riverine Plains in the Darling Riverine Plains and the Brigalow Belt South Bioregions (Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions)	E	E	-	No. Not identified within the proposed Modification study area.
Inland Grey Box Woodland in the Riverina: NSW South Western Slopes: Cobar Peneplain: Nandewar and Brigalow Belt South Bioregions (Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grassland of South-eastern Australia)	E	E	-	No. Not identified within the proposed Modification study area.

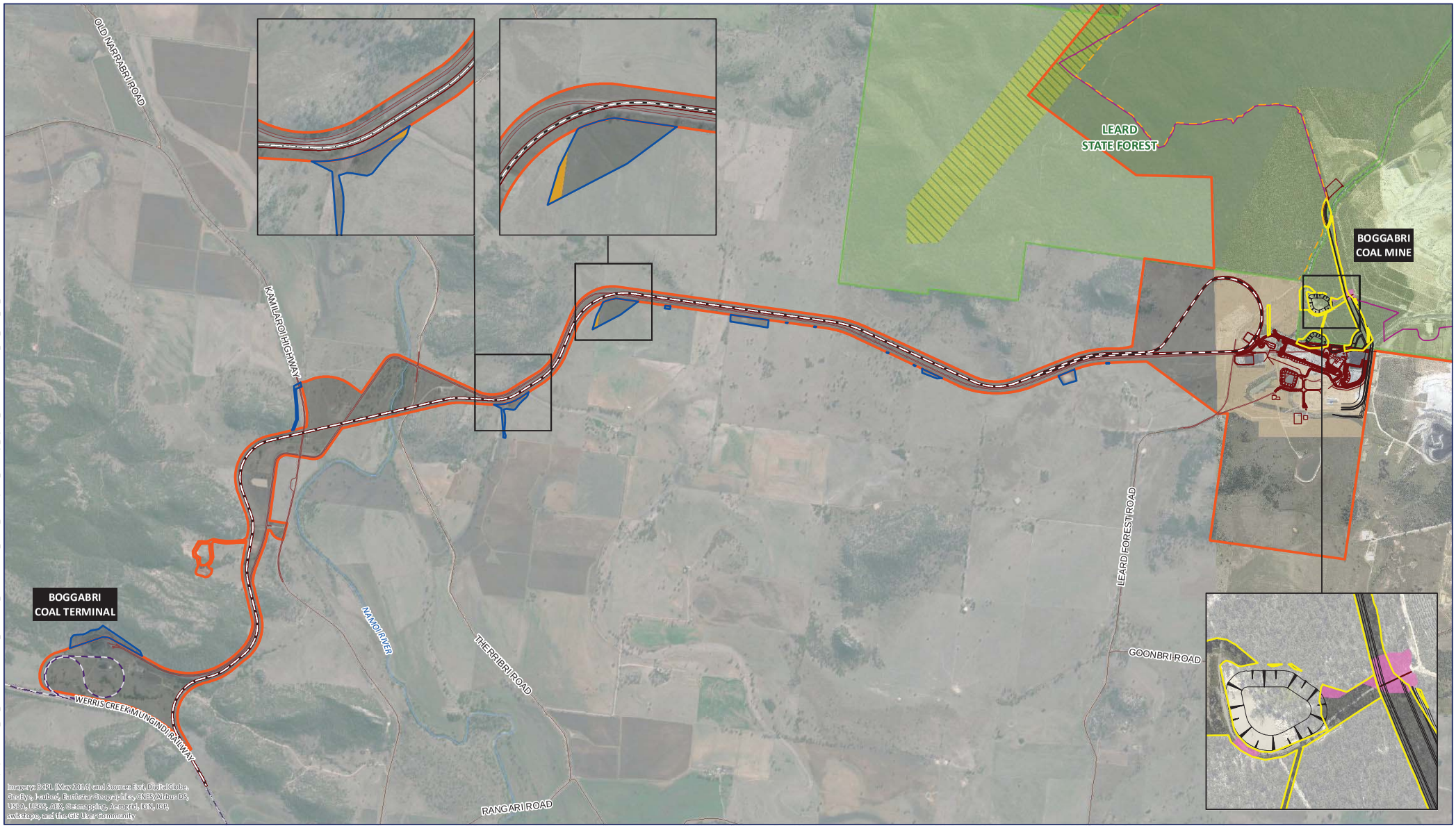
Ecological community name TSC Act (EPBC Act)	Conservational status			Recorded within the proposed Modification study area
	TSC Act[1]	EPBC Act[2]	FM Act[3]	
Native Vegetation on cracking Clay Soils of the Liverpool Plains (Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland)	E	CE	-	No. Not identified within the proposed Modification study area.
New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands		CE	-	No. Not identified within the proposed Modification study area.
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregion (Weeping Myall Woodlands)	E	E	-	No. Not identified within the proposed Modification study area.
White Box Yellow Box Blakely's Red Gum Woodland **(White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland)**	**E**	**CE**	**-**	**Yes. The Box – Gum Woodland within the Modification study area was consistent with the TSC Act listing (1.9ha) and the EPBC Act (1.2ha).**
Semi-evergreen Vine thicket in the Brigalow Belt South and Nandewar Bioregions (Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions)	E	E	-	No. Not identified within the proposed Modification study area.
Brigalow within the Brigalow Belt South, Nadewar and Darling Riverine Plains Bioregions (Brigalow (*Acacia harpophylla* dominant and co-dominant)	E	E	-	No. Not identified within the proposed Modification study area.
Carabeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	E	-	-	No. Not identified within the proposed Modification study area.
Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	E	-	-	No. Not identified within the proposed Modification study area.
Inland Grey box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia)	E	E	-	No. Not identified within the proposed Modification study area.
Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South Bioregions	E	-	-	No. Not identified within the proposed Modification study area.

Note:

(1) TSC Act – *Threatened Species Conservation act 1995,* V=Vulnerable, E= Endangered

(2) EPBC Act – *Environment Protection and Biodiversity Conservation Act*1999, E= Endangered, CE = Critically Endangered

(3) Consistent with the White box yellow box Blakely's red gum woodland community listed as endangered under the TSC Act and critically endangered under the EPBC Act.



- Proposed security fence
- Proposed mine infrastructure
- Existing mine infrastructure
- Existing/operational rail
- Proposed rail

Threatened ecological community

- White Box - White Cypress Pine grassy woodland (Derived grassland) (TSC Act)
- Yellow Box - Blakelys Red Gum grassy woodland (TSC and EPBC Act)

- Proposed new project area
- Modification impact area
- EPBC Approval boundary
- Boggabri Project Approval Area

- Mine infrastructure area
- Biodiversity offset corridor
- Leard State Forest

0 0.5 1 1.5 km

Figure 4.1
Identification of threatened ecological communities

4.1.1 Commonwealth listed White Box Yellow Box Blakely's Red Gum Woodland and derived native grasslands

White Box - Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: *Eucalyptus albens*, *E. melliodora* and *E. blakelyi*. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. Intact stands that contain diverse upper and mid-storeys and groundlayers are rare. Modified sites include the following:

- areas where the main tree species are present, ranging from an open woodland formation to a forest structure, and the groundlayer is predominantly composed of exotic species
- sites where the trees have been removed and only the grassy groundlayer and some herbs remain.

To be considered part of the EPBC listed ecological community remnant areas must:

- have one or more of the most common Box Gum Woodland tree species
- have a predominately native understorey (i.e. more than 50% of the perennial vegetative groundlayer must comprise native species)
- be 0.1 hectare (ha) or greater in size and contain 12 or more native understorey species (excluding grasses), including one or more identified important species
- be 2 ha or greater in size and have either natural regeneration of the overstorey species or an average of 20 or more mature trees per ha.

Three vegetation communities and associated derived native grasslands within the proposed Modification Area have some of the characteristics of the federally listed White Box Yellow Box Blakely's Red Gum grassy woodland and Derived Native Grassland:

- White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest – This community had White box as dominant canopy species, however had a dense shrub layer.
- Yellow Box – Blakely's Red Gum grassy woodland – This community was dominated by Yellow box and Blakely's Red gum and generally has a grassy understorey with diverse native species.
- White Box White Cypress Pine grassy woodland – This community generally occurred as native grassland with isolated white box individuals present in the canopy.

Shrub layer

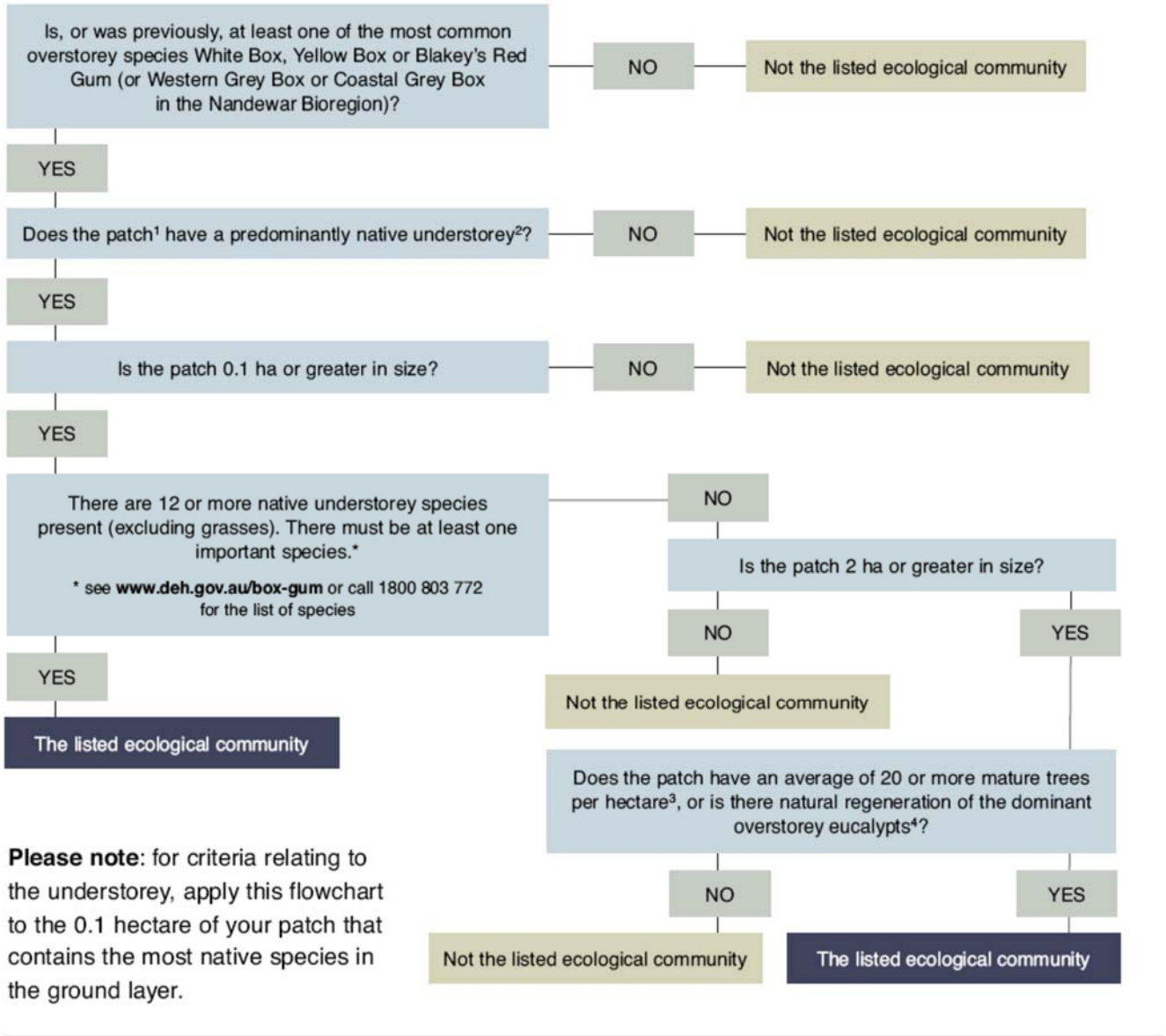
In determining the presence of Box-Gum Woodlands, any areas of White Box woodlands with greater than 30% cover in the shrub layers are not included within the listed Threatened community (Department of the Environment and Heritage 2006).

White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest shrub layer density is high (generally greater than 35%) and as such is not consistent with the sparse open shrub layer of the EPBC Act community. Therefore this community **is not** consistent with the EPBC Act criteria for Box-gum woodland.

An identification guide for the EPBC Act listed community is provided in Figure 4.2 with a summary of the assessment for the two remaining potential Box-gum communities is provided in Table 4.2.

In conclusion, the assessment in Table 4.2 found one vegetation assemblage meets the EPBC Act criteria for Box-gum Woodlands. This community is Yellow Box – Blakely's Red Gum grassy woodland. Approximately

1.2 ha of this community will be impacted upon by the current modification and will require assessment as part of this report.



[1] Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and is not, included within any individual patch. The patch is the larger of:

- an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
- the area over which the understorey is predominantly native.

Patches must be assessed at a scale of 0.1 ha (1000m^2) or greater.

[2] A predominantly native ground layer is one where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species. The best time of the year to determine this is late autumn when the annual species have died back and have not yet started to regrow. (At other times of the year, you can determine whether something is perennial or not is if it is difficult to pull out of the soil. Annual species pull out very easily.)

[3] Mature trees are trees with a circumference of at least 125 cm at 130 cm above the ground.

[4] Natural regeneration of the dominant overstorey eucalypts when there are mature trees plus regenerating trees of at least 15 cm circumference at 130 cm above the ground.

Figure 4.2 Identification of EPBC listed Box - Gum Woodland

Table 4.2 Summary table of EPBC determination of White Box Yellow Box Blakely's Red Gum Woodland

Step	EPBC Criteria for determining Box-Gum Woodlands	Yellow Box – Blakely's Red Gum grassy woodland	White Box White Cypress Pine grassy woodland
1	**Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum?**	This community had Yellow Box and Blakely's Red Gum species present in the all of patches (Plot 16).	There was no regeneration of eucalypts evident within areas mapped as derived grassland. However, based on adjacent woodland vegetation, derived grassland within the study area may have previously contained White Box.
2	**Does the patch have a predominantly native understorey?**[1]	All areas mapped as this community were dominated by native understorey of native grasses.	All areas mapped as White Box White Cypress Pine grassy woodland were dominated by native understorey. Areas of grassland not dominated by native understorey were mapped as exotic vegetation.
3	**Is the patch 0.1 ha or greater in size?**	Yes, all areas of this community are greater than 0.1 ha.	Yes. All areas of White Box White Cypress Pine grassy woodland are greater than 0.1 ha
4	**Are there 12 or more native understorey species present (excluding grasses), with at least one important species?**	Quadrat data showed that the community included 12 or more native understorey species with at least one important species. This included plot 16.	None of the patches of White Box White Cypress Pine grassy woodland had 12 or more native species (excluding grasses) and an important species
5	**Is the patch 2 ha or greater in size?**	The majority of patches are greater than 2 ha.	No. the patches of White Box White Cypress Pine grassy woodland were not greater than 2 ha.
6	**Does the patch have an average of 20 or more mature trees per ha, or is there natural regeneration of the dominant overstorey eucalypts?**	Yes. The majority of patches greater than 2 ha have more than 20 mature trees per hectare and/or have natural regeneration of eucalypts.	No. White Box White Cypress Pine grassy woodland generally occurred as native grassland
END	**Does patch meet final determination of the listed community (Department of the Environment and Heritage 2006)?**	Yes, the patches that occur within Sites 4 to 9 of the Modification Area meet the criteria for the federal listing of Box-Gum Woodland.	No. The White Box White Cypress Pine grassy woodland did not have 12 or more native species (excluding grasses), and patches were less than 2 ha in size and lacked regeneration of dominant eucalypt overstorey.

Notes 1) The EPBC Act Policy Statement (Department of the Environment and Heritage 2006) indicates that a predominantly native ground layer exists where at least 50% of the perennial vegetation cover in the ground layer is made up of native species. Results have been extrapolated from randomly placed 400 square metre quadrats and transects not necessarily located in the 0.1 hectare of each patch containing the highest quality of native vegetation. In some cases the dominance of native species observed during random transects was used to assess dominance of native perennial groundcover.

4.1.2 TSC Act White Box Yellow Box Blakely's Red Gum Woodland

White Box, Yellow Box, Blakely's Red Gum Woodland is listed as an Endangered Ecological Community under the TSC Act.

The final determination for this community under the TSC Act is broad, with five main features defining whether a patch is consistent with the community determination:

- whether the site is within the area defined in the determination
- whether the characteristic trees of the site are (or are likely to have been) White Box, Yellow Box or Blakely's Red Gum
- whether the site is mainly grassy
- whether any of the listed characteristic species occur (including as part of the seedbank in the soil)
- if the site is degraded, whether there is potential for assisted natural regeneration of the overstorey or understorey (NSW National Parks and Wildlife Service 2002a).

The White Box White Cypress Pine grassy Woodland and Yellow Box Blakely's Red Gum grassy Woodland vegetation communities (1.9 ha) mapped within the Modification Study Area meets the one or more of the above TSC Act criteria.

Degraded remnants and scattered trees may be included in the definition of the community if sufficient natural soil and seedbank remain, so that under appropriate management, assisted natural regeneration of the overstorey or understorey could occur (NSW National Parks and Wildlife Service 2002c).

To determine the potential for assisted regeneration within each patch, an assessment according to one of the five condition criteria identified by the Box-Gum identification guidelines was completed (Table 4.3). This assessment was based on the results of the sampled plot with the greatest native diversity and cover for each patch.

Some of the small remnants of woodland and scattered trees (e.g. all of the east west ridgelines) assessed were in poor condition with little or no native shrub or groundcover species, or were dominated by exotic species (pasture improvement species and weeds as in Sites 2 and 3). However, all of the patches sampled contained areas with some native groundcover species and potential for regeneration.

All patches mapped as White Box White Cypress Pine grassy Woodland and Yellow Box Blakely's Red Gum grassy Woodland within the Modification Study Area are considered to be consistent with the state listed White Box, Yellow Box, Blakely's Red Gum Woodland endangered ecological community.

Of these two communities 1.2 ha of Yellow box Blakely's Red Gum Grassy Woodland that occurs within the Modification within existing project area is being removed that has not been previously assessed as part of previous approvals. Therefore 1.2 ha of Box-gum woodland that meets the TSC Act criteria will be assessed as part of this report.

Table 4.3 Summary table of TSC Act Condition Criteria for determination of White Box, Yellow Box, Blakely's Red Gum Woodlands

TSC Act condition criteria for determining White Box, Yellow Box, Blakely's Red Gum Woodland	General comment	Vegetation Community	
		Yellow Box Blakely's Red Gum grassy Woodland	White Box White Cypress Pine grassy woodland
Multi-aged overstorey with a grassy, herb-rich understorey (Condition class one).	Remnants in this condition are very scarce and are generally confined to travelling stock reserves, roadside vegetation, cemeteries, some national parks and the occasional private property.	No	No
Partially cleared/thinned stands with a mixture of native and exotic understorey species (Condition class two).	This condition is far more common than the above; however, its long-term future is often insecure due to inadequate regeneration of overstorey species. Often current management (e.g. set-stocking) is inconsistent with tree regeneration.	**Yes (within Sites 4-9 only)**	No
Stands where White Box, Yellow Box or Blakely's Red Gum have been killed and other species dominate the canopy (Condition class three).	This condition occurs in woodlands where the characteristic trees occur in conjunction with White Cypress Pine. The understorey is often in reasonable to very good condition.	No	No
Grasslands (secondary or derived grasslands), where the tree overstorey has been removed and only the Box-Gum Woodland understorey is present (Condition class four).	This condition is likely to be reasonably common in some areas and is likely to be relatively easy to rehabilitate if appropriate management strategies are implemented.	No	**Yes White Box White Cypress Pine grassy woodland community mapped within the Modification Study Area.**
Degraded remnants that have few, if any, native species in the understorey: (Condition class five).	This condition is typical of Box-Gum Woodland where agricultural practices have been more intensive (e.g. pasture improvement over long periods).	No	No
Does patch meet one of the five condition criteria for classification of the vegetation as the listed community?		**Yes** sites 4-9 meets class two condition	**Yes** meets class four condition

4.2 Endangered populations

Results of the desktop assessment indicated that three endangered populations listed under the EPBC Act and FM Act have been previously recorded, or has the potential to occur within the locality (10 km buffer) of the proposal. None of these endangered populations are considered likely to occur within the proposed Modification study area. These included:

- *Tandanus tandanus* – Eel tailed catfish in the Murray/Darling Basin - This species was not recorded within the Modification study area, no suitable habitat was recorded during the recent field survey and the Modification study area is not within the Murray/Darling Basin, therefore it is considered unlikely that the species or population would occur within the Modification study area.
- Australian brush-turkey population, Nandewar and Brigalow Belt South bioregions – This species was not recorded within the Modification study area and no suitable habitat was recorded during the recent field survey, therefore it is considered unlikely that the species or population would occur within the Modification study area.
- White-fronted Chat population in the Sydney Metropolitan Catchment Management Area – This species was not recorded within the Modification study area, no suitable habitat was recorded during the recent field survey and the Modification study area is not within the Sydney Metropolitan Bioregion, therefore it is considered unlikely that the species or population would occur within the Modification study area.

4.3 Threatened plants

Results of the desktop assessment indicated that 20 species of plant listed under the TSC Act and/or EPBC Act have been previously recorded, or could potentially occur within the locality (10 km buffer) of the proposed Modification area. Of these 20 species, the Modification study area contained potential habitat for four (4) threatened flora species (refer to Table 5.4). No threatened plant species were recorded within the Modification study area during current surveys, however one threatened plant species *Tylophora linearis* has previously been recorded within the approved project boundary in July 2014 (refer to Appendix G and Section 5.3.1 below).

Table 4.4 Threatened species of plant

Species name	Common name	TSC Act[1]	EPBC Act[2]	Recorded?
Digitaria porrecta	Finger Panic Grass	E	-	N
Diuris tricolor	Pine Donkey Orchid	V	-	N
Prasophyllum sp. Wybong (C. Phelps ORG 5269)	A leek orchid	-	CE	N
Tylophora linearis[3]	**-**	**V**	**E**	**Y**

(1) TSC Act – *Threatened Species Conservation act 1995,* V=Vulnerable, E= Endangered

(2) EPBC Act – *Environment Protection and Biodiversity Conservation Act*1999, E= Endangered, CE = Critically Endangered

(3) This species was recorded in the previously approved project boundary.

The remaining 16 threatened flora species known of predicted to occur are considered to have a low likelihood of occurrence based on the availability of habitat in the Modification study area (i.e. cleared land and remnant vegetation with a shrub and ground layer completely dominated by exotic species). Full details of the species requirements and reasons for not further considering impacts of the proposal for these threatened plants are provided in Appendix C.

4.3.1 *Tylophora linearis*

In January 2013 a previously unrecorded small population (approx. 6 plants) of this species was recorded within the north west corner of the Leard State Forest, in an areas proposed for the development of the Maules Creek Coal Project. The previously nearest known population of *Tylophora linearis* was in the Pilliga State Forest approximately 20km to the west from the Leard State Forest.

Subsequent targeted surveys for this species as part of the pre clearing surveys works for the Maules Creek Coal Project between April and June 2014 identified further populations of *Tylophora linearis* within the Leard State Forest (Personal Comms Dan Martin June 2014).

To determine if the *Tylophora linearis* population extent within the Leard State Forest includes areas of the Boggabri Coal Expansion Project (BCEP) exploration lease and Project Boundary, targeted surveys within the approved Project Boundary were undertaken in July 2014 (refer to Appendix G). During these surveys 22 individuals of *Tylophora linearis* were recorded within the Project Boundary to the north east of Site 4 adjoining the proposed haul road (refer Figure 3.1). This area is currently within the previously approved Project Boundary (approval PA 09_0182), with the vegetation to be removed as part of the previous approval.

Potential habitat within the modification within existing project area was identified and would be impacted by the current modification. Therefore, an additional targeted survey for *Tylophora linearis* was conducted in November 2014 (within the species flowering period) in the southern portion of Site 4 (Modification within existing project area) not surveyed in July 2014 No further individuals of *Tylophora linearis* individuals were recorded. As potential habitat for this species was recorded in the modification within existing project area asignificance assessment for this species was conducted and is provided in Appendix E.

4.4 Threatened fauna

Results of the desktop assessment indicated that 63 fauna species listed under the TSC Act, EPBC Act and/or FM Act have been previously recorded, or could potentially occur within the locality (10 km buffer) of the proposed modification area. Of these 63 species, the Modification study area contained potential habitat for 25 threatened fauna species (refer to Table 4.5). No threatened fauna species were identified within the Modification study area during the field survey.

The remaining 38 threatened fauna species known or predicted to occur are considered to have low likelihood of occurrence based on the availability of habitat within the Modification study area. Full details of the species requirements and reasons for not further considering impacts of the proposed Modification for these threatened fauna species are provided in Appendix D.

Table 4.5 Threatened species of animal with suitable habitat in the Modification study area

Scientific name	Common name	TSC Act[1]	EPBC Act[2]
Birds of prey			
Circus assimilis	Spotted Harrier	V	–
Hieraaetus morphnoides	Little Eagle	V	–
Lophoictinia isura	Square-tailed Kite	V	–
Hollow dependent microchiropteran bats			
Nyctophilus timoriensis	Greater Long-eared Bat – south eastern form	V	V

Scientific name	Common name	TSC Act[1]	EPBC Act[2]
Chalinolobus dwyeri	Large-eared Pied-bat	V	V
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	–
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	–
Woodland birds			
Climacteris picumnus	Brown Treecreeper	V	–
Melanodryas cucullata	Hooded Robin	V	–
Melithreptus gularis	Black-chinned Honeyeater	V	–
Grantiella picta	Painted Honeyeater	V	–
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	–
Pyrrholaemus sagittatus	Speckled Warbler	V	–
Stagonopleura guttata	Diamond Firetail	V	–
Daphoenositta chrysoptera	Varied Sittella	V	–
Birds – opportunistic blossom nomads			
Glossopsitta pusilla	Little Lorikeet	V	–
Neophema pulchella	Turquoise Parrot	V	–
Lathamus discolor	Swift Parrot	E	E
Polytelis swainsonii	Superb Parrot	V	V
Tyto novaehollandiae	Masked Owl	V	–
Ninox connivens	Barking Owl	V	–
Xanthomyza phrygia	Regent Honeyeater	CE	E, M
Arboreal Mammals			
Phascolarctos cinereus	Koala	V	V
Petaurus norfolcensis	Squirrel glider	V	–
Reptiles			
Hoplocephalus bitorquatus	Pale-headed Snake	V	–

(1) TSC Act – *Threatened Species Conservation act 1995,* V=Vulnerable, E= Endangered, CE= Critically Endangered.
(2) EPBC Act – *Environment Protection and Biodiversity Conservation Act*1999, E= Endangered; M= Migratory

4.5 Migratory species

Migratory species are protected under international agreements to which Australia are a signatory, including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), the Republic of Korea Australia Migratory Bird Agreement (RoKAMBA) and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered to comprise 'Matters of National Environmental Significance' and are protected under the EPBC Act.

Based on the findings of the desktop assessment, a total of 12 Migratory species have been recorded or have the potential to occur in the Proposal locality. No Migratory species were recorded during field surveys, however, potential habitat was observed for the Fork-tailed Swift, Eastern Great Egret, Cattle Egret, White-throated Needletail, and Rainbow Bee-eater.

While terrestrial Migratory species of bird may potentially use the area, the site would not be classed as 'important habitat' as defined *Matters of National Environmental Significance, Significant Impact Guidelines 1.1 EPBC Act* (Department of Environment 2013) as the site does not contain:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat utilised by a migratory species which is at the limit of the species range
- habitat within an area where the species is declining.

As such, it is not likely that the proposed activity would significantly affect Migratory species and this group is not considered further.

4.6 State Environmental Planning Policy 44 – Koala Habitat Protection

The proposed Modification area is located in the Narrabri Shire Local Government Area, which is listed as an area under which SEPP 44 applies, and is further positioned in the Western Slopes and Plains Koala Management Area (Department of Environment and Climate Change 2008b). The proposed Modification area contained two Koala feed trees, as listed under Schedule 1 of SEPP 44 (NSW Government 2000) and the Western Slopes and Plains Koala Management Area (NSW Government 2000). The suite of Koala feed trees available is the most important factor influencing Koala habitat and occurrence (NSW National Parks and Wildlife Service 2002b). Primary feed trees are those tree species that exhibit a level of use that is significantly higher than that of other *Eucalyptus* species, independent of tree density, and make up the bulk of a Koala's diet (NSW National Parks and Wildlife Service 2002b). Secondary or supplementary feed trees are species that provide a seasonal or supplementary dietary resource (NSW National Parks and Wildlife Service 2002b).

One primary feed tree species (*Eucalyptus camaldulensis*) was recorded in the proposed Modification area. In addition, two secondary feed trees, *Eucalyptus populnea* and *E. albens*, were recorded therein (Table 4.6) The koala feed trees occurred as scattered trees throughout the proposed Modification area in the Pilliga Box – Poplar Box White Cypress Pine grassy open forest , White Box White Cypress Pine grassy woodland , River Red Gum riparian woodlands and forests, White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest as well as scattered trees in the exotic grasslands.

Impacts of the proposed Modification on Koala have also been assessed under the TSC Act and EPBC Act threatened species significance assessment, refer to Section 5.10. The significance assessment determined that neither the proposed Modification nor Project Approval would significantly impact upon the Koala (refer Table 8.1).

Table 4.6 Koala feed tree species recorded in the proposed Modification area

Scientific name	PB verified vegetation community[1]	>15% of the total number of trees	SEPP 44[2]	Approved koala recovery plan[3]
Eucalyptus camaldulensis	Yes. Occurred in River Red Gum riparian woodlands and forests	Yes	Yes	Yes (P)
Eucalyptus	Yes. White Box – Narrow-leaved	Yes	Yes	Yes (S)

Scientific name	PB verified vegetation community[1]	>15% of the total number of trees	SEPP 44[2]	Approved koala recovery plan[3]
populnea	Ironbark - White Cypress Pine grassy woodland as well as scattered in exotic grassland.			
Eucalyptus albens	Yes. White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest, White Box – Narrow-leaved Ironbark - White Cypress Pine grassy woodland as well as scattered in exotic grassland.	Yes	Yes	Yes (S)

(1) Vegetation type based on surveys in the proposed Modification area.
(2) SEPP 44 – State Environmental Planning Policy No. 44 – Koala Habitat Protection.
(3) Approved Koala Recovery Plan (Department of Environment and Climate Change 2008b). P – Primary, S – Secondary food tree species

Habitat in the proposed Modification area is considered 'core habitat' due to:

- koala observations within the locality, and specifically along the Kamilaroi Highway
- feed tree species occurring at a density greater than 15% of the total number of trees in a vegetation community (Poplar Box Woodland and White box grassy woodland).

Furthermore, the habitat within the proposed Modification area represents remnant trees within an otherwise largely cleared landscape. This habitat is a corridor allowing koalas to move throughout the landscape.

4.7 Critical habitat

Critical habitat is listed under both the TSC Act and the EPBC Act. Critical habitat is the whole or any part or parts of an area or areas of land comprising habitat critical to the survival of an endangered species, population or community.

There is no listed critical habitat in the proposed Modification and not is likely to be affected by the proposed Modification. The area to be impacted by the proposed Modification is not considered likely to constitute critical habitat listed under either the TSC Act or the EPBC Act, or be critical to the survival of an endangered species, population or community.

5. Potential impacts

The potential impacts on biodiversity due to construction and operation of the proposed Modification are summarised in Table 5.1 and described in detail below.

Mitigation measures to ameliorate these impacts are discussed in Section 6 and assessments of significance for threatened biodiversity that occur or have potential habitat within the proposed Modification area (discussed in Section 4) are provided in Appendix E and summarised in Section 5.10.

Table 5.1 Potential impacts associated with the Project

Potential impact	Potential phase of impact	
	Construction	Operation
Loss of vegetation (including threatened ecological communities/animal habitats)	●	
Loss of vegetation within a secured offset area	●	
Direct loss of animals and plants	●	●
Habitat fragmentation and barrier effects	●	●
Weed invasion and dispersal	●	●
Erosion and sedimentation	●	●
Potential environmental impact of noise on wildlife	●	●
Changed hydrology	●	●

5.1 Loss of vegetation

Clearing of native vegetation is listed as a Key Threatening Process under both the NSW TSC Act and the Commonwealth EPBC Act. The construction phase of the proposed Modification will require the removal of 22.7 ha of native vegetation and of which approximately 1.2 ha of vegetation listed under the TSC Act and EPBC Act as a threatened ecological community (refer to Table 5.2). Measures to minimise impacts to threatened biodiversity affected by the loss of vegetation and associated habitat are described in Section 6.

An area of 12.9 ha of predominately disturbed and exotic vegetation is within the biodiversity offsets as described in the Boggabri Coal Mine biodiversity offsets strategy (Parsons Brinckerhoff 2010b). These areas are associated with Project Boundary adjustments to accommodate existing infrastructure and therefore will not require new impact assessments as part of the Modification.

Table 5.2 Potential loss of native vegetation within the Modification Study area

Vegetation community	TSC Act listing[1]	EPBC Act listing[2]	Total Modification Study Area (ha)[3]	Area not previously assessed (Modification within existing project area) (ha)[4]	Area within offsets for project boundary adjustment (ha)[5]
Exotic grassland with scattered trees	–	-	15.5	-	8.4
Derived native grassland	-	-	0.8	0.8	-
Pilliga Box – Poplar Box White Cypress Pine grassy open forest	–	-	19.0	17.2	1.7
White Box White Cypress Pine grassy woodland[6]	E	-	0.7	-	0.7
River Red Gum riparian woodlands and forests	–	-	0.9	-	0.9
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	–	-	1.2	-	1.2
Yellow Box-Blakely's Red Gum grassy woodland[7]	E	CE	1.2	1.2	-
Narrow - leaved Ironbark - White Cypress Pine shrubby open forest	-	-	3.5	3.5	-
Total clearing for Modification			**42.8**	**22.7**	**12.9**
Total Native Vegetation clearing for Modification			**27.3**	**22.7**	**4.5**
Total TSC Act EEC clearing for Modification			**1.9**	**1.2**	**0.7**
Total EPBC Act EEC clearing for Modification			**1.2**	**1.2**	**-**

(1) TSC Act, E = Endangered
(2) EPBC Act, CE = Critically Endangered.
(3) For the purpose of this report, Total Modification Area (ha) = all sites assessed within this report (Sites 1 – 9) including adjustments of project boundaries, existing infrastructure and those areas not previously assessed.
(4) For the purpose of this report, Area not previously assessed (ha) = all sites for which new impacts (Sites 4-9 only) to biodiversity has not yet been assessed within the existing EA (PA 09_0182) (impact assessments in Appendix E)
(5) For the purpose of this report, Area within offsets = Area (ha) within Namoi River Offsets associated with the proposed Project Boundary adjustments for existing disturbances and not subject to new impacts.
(6) This community generally occurred as native grassland and meets TSC Act criteria for Box-gum woodland only
(7) This community meets both the EPBC Act criteria and the TSC Act criteria for Box-gum woodland

Loss of vegetation and habitats result in a range of direct and indirect impacts to vegetation communities and species of plant and animal including:

- Loss of 22 individuals of the threatened flora species, *Tylophora linearis* (in the existing project boundary)
- reduction in the extent of vegetation communities and associated habitats
- loss of local populations of species
- fragmentation of remnants of vegetation communities or local populations of individual species
- increased edge effects and habitat for invasive species

- reduction in the viability of ecological communities resulting from loss or disruption of ecological functions (e.g. increased desiccation, light penetration, herbivore, weed invasion, predation, and parasitism)
- destruction of flora and fauna habitat and associated loss of biological diversity (habitat removal may include removal of hollow bearing trees, loss of leaf litter layer, and resultant changes to soil biota)
- soil exposure and altered water flow patterns resulting in increased erosion and sedimentation.

The proposed Modification will have an impact on fauna habitats with the removal or modification of an additional 22.7 ha of native vegetation that is outside of the EA Project Boundary.

The impact assessments confirm that the removal of 22.7 ha of native vegetation is unlikely to have a significant impact upon any threatened species, populations or communities.

5.2 Modification areas within offsets

The proposed Modification includes areas within previously identified offsets, as described in the Continuation of Boggabri Coal Mine - Biodiversity Offset Strategy (Parsons Brinckerhoff 2010b). These areas (defined as proposed new project area) are associated with Project Boundary adjustments to accommodate existing infrastructure and therefore will not require new impact assessments as part of the Modification.

The exclusion of the proposed new project area adjustments will however incorporate 4.5 ha of native vegetation as identified in the Continuation of Boggabri Coal Mine - Biodiversity Offset Strategy (Parsons Brinckerhoff 2010b) and as such these areas, will require an alternative replacement. The extent of the proposed new project area adjustments on these offsets is presented in Table 5.3.

Table 5.3 Vegetation clearing within existing offsets

Vegetation community	TSC Act listing[1]	EPBC Act listing[2]	Area within offsets (ha)[3]
Exotic grassland with scattered trees	–	-	8.4
Pilliga Box – Poplar Box White Cypress Pine grassy open forest	–	–	1.7
White Box White Cypress Pine grassy woodland[1]	E	-	0.7
River Red Gum riparian woodlands and forests	–	-	0.9
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	–	-	1.2
Total area of Modification within offsets			**12.9**
Total Native Vegetation within offsets			**4.5**
Total area of TSC Act CEEC within Modification offsets			**0.7**
Total area of EPBC Act CEEC within Modification offsets			**-**

(1) TSC Act, E = Endangered.
(2) EPBC Act, CE = Critically Endangered.
(3) For the purpose of this report, Area within offsets = Total Modification Study Area (ha) within Namoi River Offsets associated with the proposed Project Boundary adjustments for existing disturbances and not subject to new impacts.

Native vegetation and species habitat occurs within the both the proposed new project area adjustments and the proposed modification within existing project area, including habitat for the threatened flora species

Tylophora linearis. Therefore, it is recommended that targeted surveys should be undertaken across the existing offset properties to identify the presence of this threatened flora species.

5.3 Direct loss of animals and plants

Fauna injury or death could occur as a result of the proposed activities during the construction phase, particularly when vegetation and habitats are being cleared. The risk of vehicle collision is also present during the operation phase of the proposed Modification.

While some mobile species, such as birds, have the potential to move away from the path of clearing, other species that are less mobile, or those that are nocturnal and restricted to tree hollows, may have difficulty moving over relatively large distances. Species of animal that may be affected by vegetation clearing include small terrestrial and arboreal mammals, microchiropteran bats, reptiles and frogs. Although the relatively small patch of woodland habitat in the proposed Modification area is effectively isolated from other such areas, the senescent nature of many individual *Eucalyptus populnea, Eucalyptus pilligaensis* and *Eucalyptus camaldulensis* provided numerous tree hollows, which potentially provide roosting habitat or nesting dens for species of animal. In order to limit potential for animals to be injured during vegetation removal, the procedures and strategies developed for the Boggabri Coal, Biodiversity Management Plan (Parsons Brinckerhoff 2012) should be adhered to. A summary of these measures is provided in Table 6.1.

Vehicle strike during construction, operation and maintenance works is not considered to be significant and is not likely to significantly increase as a result of the proposed Modification.

Measures would be in place to minimise the likelihood of death or injury of wildlife, however, these cannot prevent such losses. The impact of such losses in relation to threatened species was considered in the assessments of significance (Appendix E).

5.4 Habitat fragmentation, barrier effects and edge effects

Habitat fragmentation is the division of a single area of habitat into two or more smaller areas, with the occurrence of a new habitat type in the area between the fragments. This new dividing habitat type is often artificial and inhospitable to the species remaining within the fragments (Bennett 1990, 1993; Johnson *et al.* 2007).

In addition to the loss of total habitat area, the process of fragmentation can affect species within the newly created fragments in a number of ways, including barrier effects, genetic isolation, and edge effects. The degree to which these potential impacts affect the flora and fauna within the newly created fragments depends on a number of variables, including distance between the fragments, local environmental conditions, the species present and any proposed mitigation measures. Some of the potential impacts are summarised below.

5.4.1 Barrier effects

Barrier effects occur where particular species are either unable or are unwilling to move between suitable areas of fragmented habitat due to the imposition of a ‘barrier’ (e.g. a newly created inhospitable habitat type). This could result in either a complete halt to species movement or a reduced level of species movement between fragments. Species most vulnerable to barrier effects include rare species (where even a small reduction in movements can reduce genetic continuity within a population, hence reducing the effective population size), smaller ground-dwelling species and relatively sessile species with low mobility. Species least vulnerable to barrier effects tend to be those that are highly mobile (e.g. birds), although even these species can vary in their response to barriers.

Genetic isolation occurs where individuals from a population within one fragment are unable to interbreed with individuals from populations in adjoining fragments. Genetic isolation can lead to problems with inbreeding and genetic drift for populations isolated within a fragment. This may lead to reduced fitness (in the form of inbreeding depression resulting from expression of deleterious recessive genes in offspring) and consequently reduced viability of populations that are isolated in habitat fragments as a result of the proposed activity.

Vegetation in the proposed Modification area generally occur as fragmented and isolated remnants resulting from extensive agricultural and mining developments in the locality. In general, the habitat is already in a fragmented state, and exists as scattered trees within an otherwise disturbed landscape and therefore the proposed Modification is not considered likely to significantly impact animal movements or impede the dispersal of plant seeds.

The barrier effects associated with the proposed Modification are not considered likely to have a significant impact upon any species, population or community listed under the TSC Act or EPBC Act.

5.4.2 Edge effects

Edge effects are zones of changed environmental conditions (e.g. altered light levels, wind speed, temperature) occurring along the edges of habitat fragments. These new environmental conditions along the edges can promote the growth of different vegetation types (including weeds), promote invasion by pest animals specialising in edge habitats, or change the behaviour of resident animals (Moenting & Morris 2006). Edge zones can be subject to higher levels of predation by introduced mammalian and native avian predators. The distance of edge effects influence can vary, with edge effects in roads having been recorded greater than 1 km (Forman *et al.* 2000) and as little as 50 m away (Bali 2000, 2005).

Vegetation and fauna habitats in the proposed Modification area are fragmented and isolated by existing linear infrastructure and extensive agricultural developments, and as a result is already subject to edge effects.

Furthermore, given the highly modified nature of the surrounding landscape, the proposed Modifications are not likely to increase edge effects on vegetation and habitats remaining post construction. As such, edge effects as a result of the proposed Modification are not considered likely to have a significant impact upon any threatened species, populations or communities.

5.5 Weed invasion and dispersal

The construction phase of the proposed Modification has the potential to disperse weeds into areas where weed species do not currently occur. The most likely causes of weed dispersal associated with the proposed Modification would include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery. This may, in turn, reduce the habitat quality of the sites for threatened species, such as woodland species of bird (Robinson, D. *et al.* 2001). Dispersal of weeds during the operation phase would relate generally to maintenance activities.

The invasion of exotic perennial grasses, such as *Chloris gayana** and *Lolium perenne** which was recorded abundantly within the Modification Study Area, is recognised as a Key Threatening Process under the TSC Act. The proposed Modification has the potential to result in further spread of these species.

Given the high level of weed invasion, and the presence of three noxious weeds, construction and to a lesser extent, operation phase, has the potential to spread weeds from the proposed Modification area to other sites. Therefore mitigation measures relating to weed control have been outlined in Section 7 of this report.

5.6 Erosion and sedimentation

Excavation and earthworks undertaken during the construction phase would expose soils that have the potential to enter surrounding areas of vegetation and waterways, possibly resulting in sedimentation and dispersal of weeds. Erosion during the operation stage relates to maintenance activities and is likely to be minor. Section 6 of this memo provides a number of mitigation measures, and if properly adhered to, the impacts associated with the proposed Modification are not considered significant.

5.7 Noise

Many animals detect and depend on sound to communicate, navigate, evade danger and find food, but human-made noise can alter the behaviour of animals or interfere with their normal functioning (Bowles 1997). In some cases it can harm their health, reproduction, survivorship, habitat use, distribution, abundance, or genetic composition (Forman *et al.* 2000).However, variation in ambient noise, such as from wind or other animals, is part of the natural environment (Eve 1991) and many animals display behavioural adaptations to this variation. For example, certain species of frogs avoid vocalising during loud calling by cicadas (Paez *et al.* 1993) or other frogs (Matsui *et al.* 1993), and some species will time their calls during brief periods of silence (Schwartz & Henderson 1991).

During construction, noise levels will increase in the proposed Modification area and surrounds due to ground disturbance, machinery operation and vehicle movements and vegetation clearing. This may cause disturbance for some fauna. A number of factors are thought to influence the reaction of animals to noise including the volume, the frequency and the characteristic of the noise (e.g. short and percussive versus long and constant).

The proposed Modification area is already affected by noise levels associated with the approved mine operations, existing haul road and vehicle movements on the surrounding public road network. How fauna occupying the local area will respond to increased noise is not known, but given the degree of current noise levels, it is not likely to be significant.

5.8 Changed hydrology

Excavation and earthworks undertaken during the construction phase will remove vegetation and change the landscape, potentially influencing surface water flow. During operation the access roads and paved areas will generate minor increases in runoff while changing the hydrological flow of surface water if not properly managed. Proper drainage within the design should result in the negative impacts associated with changed hydrology being managed, and therefore the impacts are likely to be minor. The management and mitigation measures in Section 6 should be adhered to.

5.9 Key threatening processes

Key Threatening Processes (KTPs) are listed under Schedule 3 of the NSW TSC Act and Commonwealth EPBC Act. A process is defined as a KTP if it threatens or may threaten the survival, abundance, or evolutionary development of a native species or ecological community. A process can be listed as a KTP if it could cause a native species or ecological community to become eligible for adding to a threatened list (other than conservation dependant), or cause an already listed threatened species or community to become more endangered, or if it adversely affects two or more listed threatened species or ecological communities.

The proposed Modification has the potential to contribute to the following threatening processes:

- TSC Act Key Threatening Processes:
  - clearing of native vegetation (refer Section 5.1)
  - invasion of native plant communities by exotic perennial grasses (refer to Section 5.5).
  - loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (refer to Section 5.5)
- EPBC Act Key Threatening Processes:
  - land clearance (refer to Section 5.1)
  - loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (refer to Section 5.5).

The proposed Modification will result in the loss of native vegetation (removal of hollow bearing trees is not required) and thus contribute to one key threatening processes, clearing of native vegetation and land clearance. The proposed Modification is not likely to significantly increase the introduction or spread of exotic weed species, if undertaken in accordance with mitigation measures provided in Section 6.

6. Mitigation measures

This section identifies appropriate management and mitigation measures that build upon the strategies currently employed as part of the Boggabri Coal Biodiversity Management Plan. The relevant management and mitigation measures previously identified in Section 6 of the Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a) should also be followed for works associated with the proposed Modification.

The general principle to minimise impacts to biodiversity, should in order of consideration, endeavour to:

- avoid impacts on habitat, through the planning process
- minimise impacts on habitat, through the planning process
- mitigate impacts on habitat, though the use of a range of mitigation measures including securing offset areas.

6.1 Detailed mitigation measures

Detailed mitigation measures for the BCEP Project are shown in Table 6.1. These are applicable for the proposed Modification. The mitigation measures are presented for both the construction and operational phases of the Project. Mitigation measures should be incorporated into the mine operational plan and existing measures that have produced favourable outcomes incorporated where possible. This biodiversity management plan should be an important document for the environmental field supervisor or ecologist in enacting the 'avoid and mitigate' principles during the construction phase. The biodiversity management plan should include detailed information such as protocols for vegetation clearing, feral animal and pest control, rehabilitation objectives, monitoring activities and further detailed design measures Table 6.1.

Table 6.1 Detailed mitigation measures as described in the Boggabri Coal - Biodiversity Management Plan (Parsons Brinckerhoff 2012)

Impact	Mitigation
Pre-construction	
Targeted *Tylophora linearis* surveys	▪ Pre-clearing surveys to be undertaken along with other ecological pre-clearance surveys during the May – November flowering period for *Tylophora linearis* before any vegetation clearing is to begin.
Construction	
Vegetation and habitat loss	▪ limit disturbance of vegetation to the minimum necessary for each stage of the clearing ▪ implement a two stage clearing protocol for all hollow-bearing tree clearing. ▪ Mark all hollow-bearing trees to be felled and catalogue their species and approximate dimensions so that hollows or nest boxes can be affixed to similar standing trees ▪ attach salvaged sections of hollows or nest boxes to trees in a way that allows for tree expansion and does not poison the tree. Hollows or nest boxes should be attached to trees with consideration of aspect, height and location appropriate for the target fauna species. The location of each relocated hollow or nest box should be recorded using GIS equipment during installation ▪ collect native seed prior to clearing, for use in the revegetation of disturbed

Impact	Mitigation
	areas ■ landscaping should include: ▸ planting of a range of native shrubs, trees and groundcover plants ▸ incorporation of existing natural vegetation where possible ▸ linking of bushland remnants ▸ maintenance of plantings through a landscaping plan. ■ mark the limits of clearing and install fencing around the construction footprint area prior to construction activities commencing to avoid unnecessary vegetation and habitat removal ■ restrict equipment and stockpiling of resources to designated areas in cleared land to minimise the overall impact of the construction ■ place transportable habitat features such as large logs and boulders, in adjacent retained areas where possible to allow their continuation as potential fauna refuge sites ■ progressively revegetate disturbed areas ■ locate sediment ponds in existing cleared areas where possible to minimise the loss of habitat
Weeds	■ a weed management plan should be developed to manage weeds during the construction phase ■ undertake ongoing management and monitoring of weed invasion through the weed management plan
Habitat fragmentation and barrier effects	■ maintain where possible linkages and or crossing zones between isolated vegetation remnant patches within Leard State Forest
Changed hydrology	■ design and construct Namoi River crossings in accordance with the I & I NSW *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull & Witheridge 2003) ■ prepare a progressive erosion and sediment control plan following best practice. Design temporary scour protection and energy dissipation measures to protect receiving environment from erosion ■ revegetate riparian zones affected by the Project with native species
Success of mitigation	■ undertake monitoring in line with current monitoring programs
Cumulative loss of habitat	■ offset any residual biodiversity impacts
Operation	
Weeds	■ undertake ongoing management and monitoring of weed invasion within the Project Boundary during the life of the Projects operation
Ecological Monitoring	■ a flora and fauna monitoring program for the Project should be developed and implemented aimed at achieving a better understanding of impacts and rehabilitation actions to flora and fauna throughout the Project Boundary ■ the monitoring plan should consider and develop the existing monitoring plan in place as part of the MOP for existing operations ■ monitoring should also include exotic weeds and feral animals. The plan should be adaptive and identify trigger points and responses for ongoing impacts to flora and fauna ■ the monitoring should include consideration of the observed microbat roost site in close proximity to the haul route

Impact	Mitigation
Rehabilitation	■ areas not required for mining purposes or activities should be revegetated following a revegetation/rehabilitation plan. This plan should include ■ planting of a range of locally occurring native shrubs, trees and groundcover plants, in keeping with the former vegetation types present. Choice of species should be in consultation with the relevant regulators NSW and should include Acacia, Eucalyptus species to compensate for any impacts to habitat of the koalas and hollow dependent species ■ incorporating existing natural vegetation where possible ■ linking vegetation remnants ■ focusing on riparian vegetation to protect waterways ■ excluding stock from areas rehabilitated for nature conservation objectives
Vehicle strike and direct mortality	■ locate revegetation works to increase fauna habitat linkages ■ design drainage structures to incorporate fauna movement ■ reduce the median width to the minimum necessary for safe operation of the road in fauna crossing zones
Changed water quality	■ plant macrophytes along the stream banks of the Namoi River to filter flow and enhance bank stability ■ all water discharge into streams should be guided by the ANZECC Water Quality Guidelines (ANZECC 2000)

7. Biodiversity offsets

7.1 Background

Whilst the majority of the impacts associated with the proposed Modification can be mitigated, the loss of vegetation cannot be adequately ameliorated in the absence of a biodiversity offset strategy. Boggabri Coal has developed a robust Biodiversity Offset Strategy (BOS) for the Continuation of Boggabri Coal Mine Project (Boggabri EA Offset Strategy) (Parsons Brinckerhoff 2010b, 2011d). Impacts associated with the proposed Modification, were not considered in the development of the Biodiversity Offset Strategy for the Continuation of Boggabri Coal Mine Project (Boggabri EA Offset Strategy) (Parsons Brinckerhoff 2010b, 2011d).

Boggabri Coal is currently refining the approved BOS in accordance with PA 09_0182 Condition 43 and in consultation with the Commonwealth Department of Environment (DoE). The final offset package including refined vegetation mapping resulting from the Modification EA field surveys, independent field validation and BMP baseline monitoring will be incorporated into a revised BOS and BMP.

Boggabri coal is committed to the approved BOS development in accordance with the consolidated PA 09_0182. This commitment includes revisions to the BOS resulting from the refined vegetation mapping identified after the development of the BOS.

Boggabri Coal is committed to providing offsets for the Modification in accordance with the quantum (ratio) and principles of the existing BOS.

7.1.1 NSW Biodiversity Offsets Policy for Major Projects (2014)

In March 2014, the Draft NSW Biodiversity Offsets Policy for Major Projects (Draft Policy) was released for public exhibition. The Draft Policy has now been finalised (Offset Policy 2014) and will be implemented from 1 October 2014 when it will be mandatory for all SSD and SSI projects.

The Offset Policy 2014 reduced the number of offset principles to six and introduced the use of a new assessment methodology, the Framework for Biodiversity Assessment (FBA). While Boggabri Coal is committed to providing offsets for the Modification in accordance with its current BOS, consideration to the principles outlined in the recent NSW (Offset Policy 2014) policy is provided below:

- Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.

  Given the location and nature of the Project and its context with regard to existing infrastructure and coal resource, there is limited scope for using alternative locations to entirely avoid impacts on biodiversity. The proposed impacts are associated with increasing capacity of existing dams, design of water infrastructure and widening of existing haul roads for safety and design changes. Where possible details design changes associated with the modification have considered “minimising impacts to native vegetation” and utilised exiting disturbance areas.
- Offset requirements should be based on a reliable and transparent assessment of losses and gains.

  The proposed offsets for the Modification are based on the existing approved Boggabri Coal BOS, and will be based on comparison of offset site values with the residual impacts on biodiversity. This BOS incorporated a transparent, targeted and quantifiable assessment of losses and gains in consultation

with DP&E and OEH and will result in a net improvement over time in both size and scale, providing a ratio (offset: clearing) of approximately 5.6:1.

- Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

  The proposed offset for the Modification will be targeted to contain the specific species, habitat and vegetation requirements as impacted by the Project. The proposed offset sites generally contain vegetation types of similar or greater conservation value, located in the same IBRA subregion, contain similar habitat values for threatened species and threatened ecological communities listed on the TSC Act.

- Offsets must be additional to other legal requirements.

  The proposed offsets for the Modification will be in addition to the existing offset requirements for the PA 09_0182 and consistent with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (Department of Sustainability Environment Water Population and Communities 2012).

- Offsets must be enduring, enforceable and auditable.

  The additional offset areas will be protected by an agreement that will place legal restrictions on the future use and management of the land that would exist within the title for the land in perpetuity. This will ensure that the offsets are enduring and that they will offset the impact of the development for the period that the impact occurs.

- Supplementary measures can be used in lieu of offsets.

  The offsets for the Modification will be direct land based and not require supplementary measures.

7.2 Changes to existing offset areas in BOS

The proposed Modification includes areas within previously identified offsets, as described in the Continuation of Boggabri Coal Mine - Biodiversity Offset Strategy (Parsons Brinckerhoff 2010b). These areas are associated with Project Boundary adjustments to accommodate existing infrastructure and therefore will not require new impact assessments as part of the Modification. The extent of the Modifications impact on the Namoi River Offset Area is presented in Table 7.1.

The BOS will be amended to ensure the lands previously identified within the Namoi River Offset Area and subsequently excised for the proposed Project Boundary adjustments of the Modification will be replaced by an alternative offset. It is considered that the quantum of this transfer will comprise up to 4.5 ha of native vegetation and threatened species habitat.

7.3 Proposed Modification biodiversity offsets

As noted above, the BOS is currently undergoing an independent verification process and will be subject to further revisions following the implementation of the regional offset strategy and the identification and provision of an additional 1,103 ha residual offset requirements (as per Condition 39 of PA 09_0182).

The relatively minor changes to the Namoi River Offset Area resulting from this Modification and associated refined vegetation mapping will be incorporated into the final amended BOS and BMP.

Boggabri Coal considers the relatively minor impacts described in the Modification EA to be adequately offset by the substantial BOS approved as part of PA 09_0182. The minor modifications are considered part of the Boggabri Coal Project's detailed design and Project refinement and are to be expected for a Project of this scale and significance.

Nevertheless, Boggabri Coal is currently securing additional offsets to meet its residual offset commitment of 1,103 ha. In combination with this additional offset commitment, Boggabri Coal will provide an additional offset for the impacts of the Modification. This offset will be consistent with the final ratio of 5.6.1 specified in the approved BOS which has been developed in accordance with the *OEH Principles for Biodiversity Offsets* and consideration of the recent NSW Biodiversity Offsets Policy for Major Projects (2014).

A summary of the total offset requirements for the new impacts associated with the Modification are provided below in Table 7.1.

Table 7.1 Offset requirements for impacts associated within the modification

Vegetation community	TSC Act listing[1]	EPBC Act listing[2]	Area not previously assessed (ha)[3]	Offsets requirement (ha)[4]
Derived native grassland	-	-	0.8	4.5
Pilliga Box – Poplar Box White Cypress Pine grassy open forest	–	-	17.2	96.3
White Box White Cypress Pine grassy woodland[1]	E	-	-	-
River Red Gum riparian woodlands and forests	–	-	-	-
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	–	-	-	-
Yellow Box-Blakely's Red Gum grassy woodland[1,2]	E	CE	1.2	6.7
Narrow - leaved Ironbark - White Cypress Pine shrubby open forest	-	-	3.5	19.6
Total Native Vegetation offset for Modification			**22.7**	**127.1**
Total TSC Act EEC offset for Modification			**1.2**	**6.7**
Total EPBC Act EEC offset for Modification			**1.2**	**6.7**

(1) TSC Act, E = Endangered.
(2) EPBC Act, CE = Critically Endangered.
(3) For the purpose of this report, Area not previously assessed (ha) = all sites for which new impacts to biodiversity has not yet been assessed within the existing EA (PA 09_0182) (impact assessments in Appendix E)
(4) For the purpose of this report, Offset requirements = Application of the final ratio of 5.6.1 specified in the approved BOS to all Area not previously assessed.

The proposed additional offset for the Modification impacts will therefore incorporate a minimum of 127.1 ha of native vegetation and threatened species habitat.

8. Significance assessments

The Continuation of Boggabri Coal Mine - Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a) and Ecological Assessment for Boggabri Coal Project Modification (Parsons Brinckerhoff 2013a) completed significant assessments for the affected threatened biodiversity within the Boggabri EA Project Boundary and proposed modifications. These reports provided a lists of the threatened biodiversity that have been recorded and/or have potential habitat within the Project Boundary. The findings of the Continuation of Boggabri Coal Mine - Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a) significance assessments, found that Box Gum Woodland, woodland birds, hollow-dependent microchiropteran bats and the Regent Honeyeater would be significantly affected as a result of the Continuation of Boggabri Coal Mine Project. The findings of the Ecological Assessment for Boggabri Coal Project Modification (Parsons Brinckerhoff 2013a) significance assessments found that that the additional incremental impacts are unlikely to alter the previous significance assessment findings reported in the Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a).

The previous assessments of the Project Boundary do not include the proposed Modification area assessed in this report. Therefore, additional significance assessments have been completed to consider cumulative impacts of works associated with the proposed Modification. In addition, a small area of one threatened ecological community (Box Gum Woodland) and potential habitat for a further four threatened species of plant and 25 species of animal, including six listed under the EPBC Act was identified therein. One threatened species of plant *Tylophora linearis* (22 individual stems) has been previously recorded within the approved Project Boundary.

The threatened ecological communities and threatened species listed in Table 8.1 have had assessments of significance completed for this report. These assessments consider cumulative impacts from the incremental addition of vegetation and habitat loss associated with the construction and operation of the proposed Modification. The findings of the significance assessments completed for this proposed Modification are that whilst the additional incremental impacts will add incrementally to the loss of vegetation and habitat loss for threatened biodiversity, it is unlikely to be a significant impact such that any of the assessment threatened biodiversity will be placed at risk of extinction. The significance assessments are included as Appendix E.

Table 8.1 Significant impact assessments completed

Threatened biodiversity	Potential habitat in the proposed Modification area	Recorded in the proposed Modification area	Recorded in Approved Project Boundary	TSC Act[1]	EPBC Act[2]	Likely significant impact (Boggabri EA)	Likely significant impact (Boggabri Modification 2013)	Likely to be significantly affected by proposed Modification
Endangered ecological community								
White box yellow box Blakely's red gum woodland	Yes	Yes	Yes	E	CE	Yes	No	No
Threatened plants								
Digitaria porrecta[3]	Yes	No	No	E	-	No	No	No
Diuris tricolor[4]	Yes	No	No	V	-	No	No	No
Prasophyllum sp. Wybong (C. Phelps ORG 5269)	Yes	No	No	-	CE	N/A	N/A	No
Tylophora linearis[5]	Yes	Yes	Yes	V	E	No	No	No
Birds of prey								
Spotted Harrier	Yes	No	Yes	V	-	No	No	No
Little Eagle	Yes	No	Yes	V	-	No	No	No
Square-tailed Kite	Yes	No	No	V	-	No	No	No
Hollow-dependent microchiropteran bats								
Greater Long-eared Bat – south eastern form	Yes	No	Yes	V	V	Yes	No	No
Large-eared Pied Bat	Yes	No	Potentially	V	V	No	No	No

Threatened biodiversity	Potential habitat in the proposed Modification area	Recorded in the proposed Modification area	Recorded in Approved Project Boundary	TSC Act[1]	EPBC Act[2]	Likely significant impact (Boggabri EA)	Likely significant impact (Boggabri Modification 2013)	Likely to be significantly affected by proposed Modification
Yellow-bellied Sheathtail -Bat	Yes	No	Yes	V	-	Yes	No	No
Eastern False Pipistrelle	Yes	No	Yes	V	-	Yes	No	No
Woodland birds								
Brown Treecreeper	Yes	No	Yes	V	-	Yes	No	No
Grey-crowned Babbler	Yes	No	Yes	V	-	Yes	No	No
Hooded Robin	Yes	No	Yes	V	-	Yes	No	No
Speckled Warbler	Yes	No	Yes	V	-	Yes	No	No
Diamond Firetail	Yes	No	Yes	V	-	Yes	No	No
Painted honeyeater	Yes	No	Yes	V	-	Yes	No	No
Black-chinned Honeyeater	Yes	No	No	V	-	Yes	No	No
Varied Sitella	Yes	No	Yes	V	-	Yes	No	No
Opportunistic blossom nomad birds								
Little Lorikeet	Yes	No	Yes	V	-	No	No	No
Turquoise Parrot	Yes	No	Yes	V	-	No	No	No
Swift Parrot	Yes	No	Yes	E	E	No	No	No
Masked Owl	Yes	No	Yes	V	-	No	No	No
Barking Owl	Yes	No	Yes	V	-	No	No	No

Threatened biodiversity	Potential habitat in the proposed Modification area	Recorded in the proposed Modification area	Recorded in Approved Project Boundary	TSC Act[1]	EPBC Act[2]	Likely significant impact (Boggabri EA)	Likely significant impact (Boggabri Modification 2013)	Likely to be significantly affected by proposed Modification
Superb Parrot	Yes	No	No	V	V	No	No	No
Regent Honeyeater	Yes	No	Yes	CE	E,M	Yes	No	No
Arboreal mammals								
Koala	Yes	No	Yes	V	V	No	No	No
Squirrel Glider	Yes	No	Yes	V	-	No	No	No
Reptiles								
Pale-headed Snake	Yes	No	Yes	V	-	No	No	No

Notes:

(1) TSC Act V = vulnerable, E = endangered. CE = critically endangered,
(2) EPBC Act,V = vulnerable, E = endangered, CE = critically endangered, M = migratory
(3) *Digitaria porrecta* delisted from the EPBC Act on 14 December 2013.
(4) *Diuris tricolor* delisted from the EPBC Act on 19 August 2011
(5) *Tylophora linearis* was listed from Endangered to vulnerable under the TSC Act

9. Likely Impacts on Matters of National Environmental Significance under the EPBC Act

The likely broad potential impacts of the Modification on Matters of National Environmental Significance include:

- impacts on 22.7 ha of known and/or potential habitat for Threatened and/or Migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

The greatest impact by the Modification will be the loss of vegetation and habitat for Matters of National Environmental Significance. This clearing will result in a total of 22.7 ha of native vegetation and habitat for Matters of National Environmental Significance being removed.

9.1 The significance of the impacts

Impacts on Threatened and/or Migratory species and communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* are required to be assessed following the *Significant Impact Guidelines* (Department of the Environment Heritage water and the Arts 2009). Significance Assessments for species listed under the *Environment Protection and Biodiversity Conservation Act 1999* that have a moderate or high likelihood of occurrence within the Modification are presented in full in Appendix E.

The findings of the whole of the BCEP project (Parsons Brinckerhoff 2010a, 2013a), significance assessments, found that Box Gum Woodland, woodland birds, hollow-dependent microchiropteran bats and the Regent Honeyeater would be significantly affected as a result of the Continuation of Boggabri Coal Mine Project.

The findings of the significance assessments completed for the this modification are that the additional incremental impacts will add incrementally to the loss of vegetation and habitat loss for threatened biodiversity, however it is unlikely to be a significant impact such that any of the assessment threatened biodiversity will be placed at risk of extinction.

10. Conclusions

This report assessed the ecological impacts associated with proposed Modification to the Boggabri Coal Project Approval (09_0182). Specifically the proposed Modification includes those areas as outlined in the Environmental Assessment of the proposed Modification.

The proposed Modification includes impacts to areas outside of the previous Project Approval (09_0182) and will result in new impacts to 22.7 ha of native vegetation and habitat, of which 1.2 ha is listed as a threatened ecological community under the TSC Act and EPBC Act.

The native vegetation proposed to be removed as part of this modification is considered potential habitat for four threatened plants and 25 threatened animals, including six species listed under the EPBC Act and would add to the cumulative removal of vegetation for the expansion of Boggabri Mine.

Significance assessments have been completed in accordance with TSC Act and EPBC guidelines for the threatened biodiversity with potential to occur within, or utilise the proposed Modification area. The significance assessments concluded that the incremental increase in habitat loss associated with the proposed Modification is unlikely to impact significantly upon threatened biodiversity within the Modification area.

Whilst the majority of impacts associated with the proposal are able to be ameliorated, amendment of the existing BOS will be required. The BOS will be amended to ensure the lands previously identified within the Namoi River Offset Area and subsequently removed as part of the proposed Project Boundary adjustments of the Modification will be replaced by an alternative offset. It is considered that the quantum of this transfer will comprise up to 4.5 ha of native vegetation and threatened species habitat to replace the existing offsets areas. In addition, the proposed Modification impacts not previously assessed will also be offset in accordance with the final ratio of 5.6:1 specified in the approved BOS and therefore incorporate a minimum of 127.1 ha of native vegetation and threatened species habitat.

In consideration of the ecological and significance assessments completed, it is concluded that, if the relevant management and mitigation measures identified in Section 6 of the Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment (Parsons Brinckerhoff 2010a, 2013a) and the additional measures outlined in Section 7 of this report are adhered to, significant impact upon any threatened community, population or species as a result of the proposed Modification is unlikely.

11. References

ABRS 2009, *Australian Faunal Directory*

Australian Biological Resources Study, Canberra, http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/index.html, Viewed 08 April 2011,

ANZECC 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

Bali, R 2000, *Discussion paper - Compensating for Edge Effects*, Biosis Research for the Roads and Traffic Authority, Sydney.

Bali, R 2005, *Discussion Paper - Compensating for Edge Effects*, Ecosense Consulting for the NSW Roads and Traffic Authority, Sydney.

Bennett, AF 1990, *Habitat corridors: Their role in wildlife management and conservation*, Arthur Rylah Institute for Environmental Research, Melbourne.

Bennett, AF 1993, 'Fauna Conservation in Box and Ironbark Forests: A Landscape Approach', *Victorian Naturalist*, vol. 110, no. 1, pp. 15-23.

Bowles, AE 1997, 'Responses of wildlife to noise', in RL Knight & KJ Gutzwiller (eds), *Wildlife and Recreationists: Coexistence through Management and Research*, Island Press, Washington D.C.

Cropper, SC 1993, *Management of Endangered Plants*, CSIRO Australia, Melbourne.

Department of Environment 2013, *Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia, Canberra, ACT,

Department of Environment and Climate Change 2007, *Threatened species assessment guidelines. The assessment of significance*, Department of Environment and Climate Change, Hurstville.

Department of Environment and Climate Change 2008a, *Principles for the use of Biodiversity Offsets in NSW*,

Department of Environment and Climate Change 2008b, *Recovery Plan for the Koala (Phascolarctos cinereus) (Approved)*, Department of Environment and Climate Change, Sydney.

Department of Environment and Conservation 2004, *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)*, Department of Environment and Conservation, Hurstville.

Department of Environment and Conservation 2005, *Draft guidelines for Threatened species assessment under Part 3A*, Department of Environment and Conservation, Hurstville.

Department of Environment Climate Change 2009, *BioBanking Assessment Methodology and Credit Calculator Operational Manual*.

Department of Sustainability Environment Water Population and Communities 2012, *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*, Department of Sustainability Environment Water Population and Communities, Canberra.

Department of the Environment 2014, *EPBC Protected Matters Search Tool*, Department of the Environment 2014, <http://www.environment.gov.au/epbc/pmst/>.

Department of the Environment and Heritage 2006, *EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands* Department of the Environment and Heritage, Canberra.

Department of the Environment Heritage water and the Arts 2009, *EPBC Act Policy Statement 1.2 Significant Impact Guidelines - Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies*, Department of the Environment and Heritage, Canberra.

Department of the Environment Water Heritage and the Arts 2009, *EPBC Act Policy Statement 1.1 Matters of National Environmental Significance, Significant Impact Guidelines*, Department of the Environment Water Heritage and the Arts, Canberra.

Department of Trade & Investment Region Infrastructure and Services 2014, *Threatened & protected species - records viewer*, <http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer>.

Department of Trade and Investment Regional Infrastructure and Services 2014, *Noxious Weeds Declaration Page*, viewed 19 March 2014, <http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed/noxious-app-application>.

EcoLogical Australia 2008, *A Vegetation Map for the Namoi Catchment Management Authority*, An unpublished report prepared for Namoi Catchment Management Authority, Coffs Harbour, NSW.

Ensbey, R & Johnson, A 2009, *Noxious and Environmental Weed Control Handbook, A Guide to Weed Control in Non-crop, Aquatic and Bushland Situations. 4th Edition*, NSW Department of Primary Industries.

Eve, R 1991, 'The sound environment of a tropical forest bird community - order or chaos', *Revue D Ecologie La Terre Et La Vie*, vol. 46, pp. 191-220.

Forman, RTT, Sperling, D, Bissonette, JA, Clevenger, AP, Cutshall, CD, Dale, VH, Fahrig, L, France, R, Goldman, CR, Heanue, K, Jones, JA, Swamson, FJ, Turrentine, T & Winter, TC 2000, *Road Ecology. Science and Solutions.*, Island Press, Washington.

Gibbons, P, Ayers, D, Seddon, J, Doyle, S & Briggs, S 2008, *BioMetric 2.0. A terrestrial biodiversity assessment tool for the NSW Native Vegetation Assessment Tool* NSW Department of Environment and Climate Change, Canberra.

Gibbons, P & Boak, M 2000, *The importance of paddock trees for regional conservation in agricultural landscapes.* , NSW National Parks and Wildlife Service.

Harden, G 1992, *Flora of New South Wales Volume 3*, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, *Flora of New South Wales Volume 4*, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, *Flora of New South Wales Volume 1 (Revised Edition)*, University of New South Wales Press Ltd., Kensington.

Harden, G 2002, *Flora of New South Wales Volume 2 (Revised Edition)*, 2nd edn, vol. 2, University of New South Wales Press Ltd., Kensington.

James B. Croft and Associates 1983, *Report on the botany, wildlife and ecology of the Leard State Forest. Draft Environmental Impact Statement for Amax-BHP Joint Venture Boggabri Coal Project, Appendix 1.* .

Johnson, M, Reich, P & Mac Nally, R 2007, 'Bird assemblages of a fragmented agricultural landscape and the relative importance of vegetation structure and landscape pattern', *Wildlife Research*, vol. 34, no. 3, pp. 185-93.

Matsui, M, Wu, GF & Yong, HS 1993, 'Acoustic characteristics of 3 species of the genus *Amolops (amphibia anura, ranidae)*', *Zoological Science*, vol. 10, pp. 691-5.

Moenting, AE & Morris, DW 2006, 'Disturbance and habitat use: is edge more important than area?', *Oikos*, vol. 115, no. 1, pp. 23-32.

NSW Government 2000, 'State Environmental Planning Policy No 44 - Koala Habitat Protection'.

NSW National Parks and Wildlife Service 2002a, *Identification guidelines for endangered ecological communities: White box - Yellow box - Blakely's red gum (box gum) woodland*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002b, *Koala Draft Recovery Plan*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002c, *White Box Yellow Box Blakely's Red Gum (Box-Gum) woodland: fact-sheet for NSW*, NSW National Parks and Wildlife Service, Hurstville,

NSW National Parks and Wildlife Service 2003, *The Bioregions of New South Wales: their biodiversity, conservation and history*, NSW National Parks and Wildlife Service, Hurstville.

Office of Environment and Heritage 2012a, *BioNet the Atlas of NSW Wildlife Database Search*, <http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx>.

Office of Environment and Heritage 2012b, *Cymbidium canaliculatum R. Br. - endangered population listing*, Office of Environment and Heritage, viewed 10/06/2012 <http://www.environment.nsw.gov.au/determinations/CymbidiumCanaliculatumEndSpListing.htm>.

Office of Environment and Heritage 2012c, *Vegetation Types Database*, <http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm>.

Office of Environment and Heritage 2014, *NSW Bionet Atlas of NSW Wildlife*, viewed 19 March 2014, <http://www.bionet.nsw.gov.au/>.

Paez, VP, Bock, BC & Rand, AS 1993, 'Inhibition of evoked calling of *Dendrobates pumilio* due to acoustic interference from cicada calling', *Biotropica*, vol. 25, pp. 242-5.

Parsons Brinckerhoff 2005, *Flora and Fauna Summary of the Boggabri Coal Project*, Parsons Brinckerhoff, Sydney.

Parsons Brinckerhoff 2009, ' Preliminary vegetation mapping and survey report for Boggabri Coal lease'.

Parsons Brinckerhoff 2010a, *Continuation of Boggabri Coal Mine - Biodiversity Impact Assessment*, A report prepared by Parsons Brinckerhoff for Hanson Bailey Pty Ltd, Newcastle, NSW.

Parsons Brinckerhoff 2010b, *Continuation of Boggabri Coal Mine - Biodiversity Offset Strategy*, A report prepared by Parsons Brinckerhoff for Hanson Bailey Pty Ltd, Newcastle, NSW.

Parsons Brinckerhoff 2010c, *Continuation of Boggabri Coal Mine - Worst Case Cumulative Impact Scenario for Biodiversity*, A report prepared by Parsons Brinckerhoff for Hansen Bailey, Newcastle, NSW, October 2010, Newcastle, NSW.

Parsons Brinckerhoff 2011a, 'Boggabri Coal - Biodiversity Monitoring, February 2006 - May 2010 '.

Parsons Brinckerhoff 2011b, *Boggabri Coal Mine Environmental Assessment - Response to Submissions*, A report prepared by Parsons Brinckerhoff for Hanson Bailey Pty Ltd, Newcastle, NSW, March 2011.

Parsons Brinckerhoff 2011c, *Continuation of Boggabri Coal Mine - Matters of National Environmental Significance*, A report prepared by Parsons Brinckerhoff for Hanson Bailey Pty Ltd, Newcastle, NSW, April 2011.

Parsons Brinckerhoff 2011d, *Continuation of Boggabri Coal Mine - Revised Residual Matters Report*, A report prepared by Parsons Brinckerhoff for Hanson Bailey Pty Ltd, Newcastle, NSW, July 2011, Newcastle, NSW.

Parsons Brinckerhoff 2012, *Boggabri Coal - Biodiversity Management Plan (BMP)*, Newcastle.

Parsons Brinckerhoff 2013a, *Booggabri Coal Expansion Project - Ecological Assessment for Boggabri Coal Project Modification* Newcastle.

Parsons Brinckerhoff 2013b, *Ecological Assessment for Boggbri Coal Project Modification*, Newcastle.

Parsons Brinckerhoff 2014a, *Boggabri Coal Tree Clearing Report - December 2013 to March 2014*, An unpublished Report prepared for Idemitsu Boggabri Coal Pty Ltd.

Parsons Brinckerhoff 2014b, *Due Diligence Assessment - Proposed Pipeline and Power Infrastructure Alignment*, Newcastle.

Pennay, M 2001, *Results of Fauna survey work undertaken by the NSW National Parks and Wildlife Service within Leard State Forest*, Sydney NSW.

Robinson, D, Davidson, I & Tzaros, C 2001, *Biology and conservation of the Grey-crowned Babbler in Victoria*, Department of Natural Resources and Environment, East Melbourne.

Robinson, M 1998, *A field guide to frogs of Australia*, Second edition edn, Reed New Holland, Sydney.

Royal Botanic Gardens 2014, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, Sydney, < <http://plantnet.rbgsyd.nsw.gov.au/search/spatial.htm>>.

Schwartz, A & Henderson, RW 1991, *Amphibians and Reptiles of the West Indies: descriptions, distributions and natural history*, University of Florida Press, Gainesville, Florida.

Seidel, J & Briggs, S 2008, *Biobanking Operation Manual* NSW Department of Environment and Climate Change, Sydney.

Swan, G, Shea, G & Sadlier, R 2004, *A Field Guide to Reptiles of New South Wales*, Reed New Holland, Sydney.

Thackway, R & Cresswell, ID 1995, *An Interim Biogeographic Regionalisation of Australia*, Australian Nature Conservation Agency, Canberra.

Weeds Australia 2011, *Weeds of National Significance*, <http://www.weeds.org.au/WoNS/>.

Woinarski, JCZ, Brock, C, Armstrong, M, Hempel, C, Cheal, D & Brennan, K 2000, 'Bird distribution in riparian vegetation in the extensive natural landscape of Australia's tropical savanna: a broad-scale survey and analysis of a distributional data base.', *Journal of Biogeography*, vol. 27, pp. 843-68.

Appendix A

Plant species recorded

Appendix A – Plant species recorded

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Adiantaceae	*Cheilanthes distans*	Bristly Cloak Fern			Y
Adiantaceae	*Cheilanthes sieberi*	Mulga Fern			Y
Anthericaceae	*Arthropodium minus*	Small Vanilla Lily			Y
Apiaceae	*Cyclospermum leptophyllum*	Slender Celery			N
Apiaceae	*Daucus glochidiatus*	Native Carrot			Y
Apocynaceae	*Parsonsia eucalyptophylla*	Gargaloo			Y
Asteraceae	*Bidens pilosa*	Cobblers Pegs			N
Asteraceae	*Calotis cuneifolia*	Purple Burr-Daisy			Y
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy			Y
Asteraceae	*Carduus pycnocephalus*	Slender Thistle			N
Asteraceae	*Carthamus lanatus*	Saffron Thistle			N
Asteraceae	*Centaurea calcitrapa*	Star Thistle			N
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting			Y
Asteraceae	*Cirsium vulgare*	Spear Thistle			N
Asteraceae	*Conyza sp.*				N
Asteraceae	*Euchiton sp.*				Y
Asteraceae	*Hypochaeris radicata*	Catsear			N
Asteraceae	*Rhodanthe diffusa subsp. leucactina*				Y
Asteraceae	*Senecio madagascariensis*	Fireweed			N
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed			Y
Asteraceae	*Silybum marianum*	Variegated Thistle			N
Asteraceae	*Sonchus oleraceus*	Common Sowthistle			N
Asteraceae	*Vittadinia cuneata*	Fuzzweed			Y
Asteraceae	*Vittadinia pustulata*				Y
Asteraceae	*Vittadinia sp.*				Y
Asteraceae	*Xerochrysum bracteatum*	Golden Everlasting			Y
Boraginaceae	*Echium plantagineum*	Pattersons Curse			N
Boraginaceae	*Echium vulgare*	Vipers Bugloss			N
Brassicaceae	*Brassica rapa*	White Turnip			N
Brassicaceae	*Brassica sp.*				N
Brassicaceae	*Lepidium africanum*	Common Peppercress			N
Brassicaceae	*Sisymbrium irio*	London Rocket			Y
Cactaceae	*Opuntia stricta*	Prickly Pear			N
Campanulaceae	*Wahlenbergia sp.*	Bluebell			Y
Caryophyllaceae	*Petrorhagia dubia*	Velvety Pink			
Casuarinaceae	*Casuarina cristata*	Belah			Y

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Chenopodiaceae	*Einadia polygonoides*				Y
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush			Y
Chenopodiaceae	*Maireana microphylla*	Small-leaf Bluebush			Y
Chenopodiaceae	*Sclerolaena birchii*	Galvinized Burr			Y
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort			Y
Convolvulaceae	*Convolvulus erubescens*				Y
Convolvulaceae	*Dichondra repens*	Kidney Weed			Y
Crassulaceae	*Crassula colorata*	Dense Crassula			Y
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine			Y
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge			Y
Cyperaceae	*Eleocharis pusilla*	Small Spike-sedge			Y
Euphorbiaceae	*Chamaesyce drummondii*	Caustic Weed			Y
Fabaceae (Faboideae)	*Glycine tabacina*				Y
Fabaceae (Faboideae)	*Medicago polymorpha*	Burr Medic			N
Fabaceae (Faboideae)	*Medicago sativa*	Lucerne			N
Fabaceae (Faboideae)	*Trifolium arvense*	Haresfoot Clover			N
Fabaceae (Mimosoideae)	*Acacia dealbata*	Silver Wattle			Y
Fabaceae (Mimosoideae)	*Acacia decora*	Western Golden Wattle			Y
Fabaceae (Mimosoideae)	*Vachellia farnesiana*	Mimosa Bush			Y
Geraniaceae	*Erodium crinitum*	Blue Storksbill			Y
Juncaceae	*Juncus usitatus*	Billabong Rush			Y
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush			Y
Lomandraceae	*Lomandra multiflora*				Y
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush			Y
Loranthaceae	*Amyema pendulum*				Y
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow			N
Malvaceae	*Sida corrugata*	Corrugated Sida, Variable Sida			Y
Malvaceae	*Sida rhombifolia*	Paddys Lucerne			N
Malvaceae	*Sida sp.*				Y
Myoporaceae	*Eremophila debilis*	Amulla			Y
Myrtaceae	*Eucalyptus albens*	White Box			Y

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Myrtaceae	*Eucalyptus blakelyi*	Blakelys Red Gum			Y
Myrtaceae	*Eucalyptus pilligaensis*	Narrow-leaved Grey Box			Y
Myrtaceae	*Eucalyptus populnea*	Bimble Box			Y
Nyctaginaceae	*Boerhavia dominii*	Tarvine			Y
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis			N
Plantaginaceae	*Plantago debilis*	Shade Plantain			Y
Plantaginaceae	*Plantago lanceolata*	Lambs Tongues			N
Poaceae	*Aristida ramosa*	Cane Wire-grass			Y
Poaceae	*Aristida sp.*				Y
Poaceae	*Aristida vagans*	Threeawn Speargrass			Y
Poaceae	*Austrostipa aristiglumis*	Plains Grass			Y
Poaceae	*Austrostipa scabra*	Speargrass			Y
Poaceae	*Austrostipa verticillata*				Y
Poaceae	*Avena fatua*	Wild Oats			N
Poaceae	*Bothriochloa decipiens*	Red Grass			Y
Poaceae	*Bromus arenarius*	Sand Brome			Y
Poaceae	*Bromus molliformis*				N
Poaceae	*Chloris divaricata*				Y
Poaceae	*Chloris gayana*	Rhodes Grass			N
Poaceae	*Chloris truncata*	Windmill Grass			Y
Poaceae	*Chloris ventricosa*	Tall Chloris			Y
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass			Y
Poaceae	*Cynodon dactylon*	Common Couch			Y
Poaceae	*Dichanthium sericeum*	Queensland Bluegrass			Y
Poaceae	*Digitaria breviglumis*				Y
Poaceae	*Elymus scaber*				Y
Poaceae	*Elymus scabrus*				Y
Poaceae	*Enteropogon acicularis*	Spider Grass			Y
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass			Y
Poaceae	*Lolium perenne*	Perennial Ryegrass			N
Poaceae	*Panicum queenslandicum*	Yadbil Grass			Y
Poaceae	*Panicum sp.*				Y
Poaceae	*Paspalum dilatatum*	Paspalum			N
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass			N
Poaceae	*Rytidosperma sp.*				Y
Poaceae	*Setaria gracilis*	Slender Pigeon Grass			N

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Poaceae	*Sporobolus creber*	Slender Rats Tail Grass			Y
Poaceae	*Triticum aestivum*	Wheat			N
Poaceae	*Vulpia myuros*	Rats Tail Fescue			N
Polygonaceae	*Rumex crispus*	Curled Dock			N
Primulaceae	*Anagallis arvensis*	Scarlet/Blue Pimpernel			N
Rubiaceae	*Richardia stellaris*				N
Rutaceae	*Geijera parviflora*	Wilga			Y
Sapindaceae	*Dodonaea viscosa*	Sticky Hop-bush			Y
Sapindaceae	*Dodonaea viscosa subsp. angustifolia*				Y
Solanaceae	*Solanum nigrum*	Black-berry Nightshade			N
Solanaceae	*Solanum parvifolium*				Y
Verbenaceae	*Verbena officinalis*	Common Verbena			N

Appendix B

Animal species recorded

Appendix B – Animal species recorded

Family Name	Scientific Name	Common Name	Observation type	Native
Birds				
Artamidae	*Gymnorhina tibicen*	Australian Magpie	O	Yes
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	O	Yes
Cacatuidae	*Cacatua roseicapilla*	Galah	O	Yes
Cacatuidae	*Cacatua sanguinea*	Little Corella	O	Yes
Charadriidae	*Vanellus miles*	Masked Lapwing	O	Yes
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	O	Yes
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	O	Yes
Corcoracidae	*Struthidea cinerea*	Apostlebird	O	Yes
Corvidae	*Corvus coronoides*	Australian Raven	O	Yes
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	O	Yes
Falconidae	*Falco berigora*	Brown Falcon	O	Yes
Falconidae	*Falco cenchroides*	Nankeen Kestrel	O	Yes
Meliphagidae	*Manorina melanocephala*	Noisy Miner	O	Yes
Muscicapidae	*Turdus merula*	Common Blackbird	O	Yes
Petroicidae	*Microeca fascinans*	Jacky Winter	O	Yes
Psittacidae	*Platycercus eximius*	Eastern Rosella	O	Yes
Sturnidae	*Acridotheres tristis*	Common Myna	O	No
Mammals				
Bovidae	*Bos taurus*	Cattle (feral)	O	No
Suidae	*Sus scrofa*	Pig (feral)	O	No

Notes: O = Observed

Appendix C

Threatened species of plant

Appendix C - Threatened species of plant known or predicted to occur within the Study Area

Family Name	Species Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data Source[3]	Likelihood of occurrence[4]	Impact assessment required?
Asclepiadaceae	*Tylophora linearis*		E	E1	Grows in dry scrub in the Barraba, Mendooran, Temora and West Wyalong districts, in the NWS, CWS botanical subdivisions (Royal Botanic Gardens 2005). Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, E. sideroxylon, E. albens, Callitris endlicheri, C. glaucophylla* and *Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides, A. lineata, Myoporum* species and *Casuarina* species (Department of Environment and Conservation 2005). This species has recently been recorded within Leard State Forest near Boggabri NSW (Pers. Obs.).	EPBC, PlantNet, Namoi CMA	**Recorded -** This species has been recorded within Leard State Forest and within the modification area.	**Yes** – this species was recorded and will be impacted upon by the proposed modification an impact assessment has been undertaken in Appendix E.
Brassicaceae	*Lepidium aschersonii*	Spiny Peppercress	V	V	Not widespread, occurring in the marginal central-western slopes and north-western plains regions of NSW (and potentially the south western plains). A recent survey has located several populations at Narrabri, from where the species had last been recorded in 1899. Also known from the West Wyalong, Barmedman and Temora areas, although most records are old. Approximately 50% of the total *Lepidium aschersonii* recorded for Australia occurs in NSW. Found on ridges of gilgai clays dominated by Brigalow (*Acacia harpophylla*), with *Austrodanthonia* and/or *Austrostipa* species in the understorey. The species grows as a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense Brigalow, with sparse grassy understorey and occasional heavy litter. Flowers from spring to autumn. Recorded population sizes vary from 10 to 2000+ plants. Plant numbers decrease with increasing overstorey density, and plants were not found where the Brigalow canopy cover exceeded about 60%. The species is often described as a “weed” where it dominates paddocks (Royal Botanic Gardens 2007).	PlantNet, Namoi CMA	Low - No suitable habitat was recorded within the study area.	No.

Family Name	Species Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data Source[3]	Likelihood of occurrence[4]	Impact assessment required?
Brassicaceae	*Lepidium monoplocoides*	Winged Peppercress	E	E1	Widespread in the semi-arid western plains regions of NSW. Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by *Allocasuarina luehmannii* (Bulloak) and/or eucalypts, particularly *E. largiflorens* (Black Box) or *E. populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. Recorded in a wetland-grassland community comprising *Eragrostis australasicus, Agrostis avenacea, Austrodanthonia duttoniana, Homopholis proluta, Myriophyllum crispatum, Utricularia dichotoma* and *Pycnosorus globosus*, on waterlogged grey-brown clay. Also recorded from a *Maireana pyramidata* shrubland. The species is highly dependent on seasonal conditions. Occurs in periodically flooded and waterlogged habitats and does not tolerate grazing disturbance. The number of plants at each site varies greatly with seasonal conditions, but sites tend to be small in area with local concentrations of the plant. Has been recorded as uncommon to locally common with hundreds of plants at sites (Department of Environment and Conservation 2005).	PlantNet	Low - No suitable habitat was recorded within the study area.	No.

Family Name	Species Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data Source[3]	Likelihood of occurrence[4]	Impact assessment required?
Cyperaceae	*Cyperus conicus*	-		E1	Occurs rarely in the Pilliga area of NSW and is also found in Victoria, Qld, the NT and WA. It grows in open woodland on sandy soil. In central Australia, the species grows near waterholes and on the banks of streams in sandy soils. In Qld the species usually found on heavy soils. Recorded from Callitris forest in the Pilliga area, growing in sandy soil with *Cyperus gracilis, C. squarrosus* and *C. fulvus*. Often associated with other sedge species including *C. victoriensis, C. difformis, C. iria, C. compressus, C. nervulosus, C. dactylotes, Fimbristylis* and *Eleocharis* species. *Cyperus conicus* has been recorded as very rare and occasional, to common and abundant in populations. Interstate habitats include floodplains, creek beds and banks, swamps, run-on areas and various watercourses, near or in dams and bores, and in vegetation communities such as Melaleuca swamps, open Box woodland and sedgelands. Soils are usually sandy or silty and damp to wet (Department of Environment and Conservation 2005).	PlantNet	Low - No suitable habitat was recorded within the study area.	No.
Eriocaulaceae	*Eriocaulon australasicum*		E	E1	Occurs within habitat typically described as 'wet places along the Murray towards the junction of Murrumbidgee' such as within swamps and sedgelands (Department of Environment and Conservation 2006).	PlantNet	Low - No suitable habitat was recorded within the study area.	No.
Euphorbiaceae	*Bertya opponens (syn. Bertya sp. A Cobar-Coolabah)*		V	V	It occurs in a range of habitats which makes the identification of critical habitat difficult. The species grows predominantly in shallow soil on stony mallee ridges and cypress pine forest on the red soils in the west, to coastal cliff edges in open eucalypt forests in the east (Briggs & Leigh 1996).(Harden 2000).	PlantNet	Low –suitable habitat was recorded within the study area.	No.

Family Name	Species Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data Source[3]	Likelihood of occurrence[4]	Impact assessment required?
Fabaceae (Faboideae)	*Swainsona murrayana*	Slender Darling Pea	V	V	Often grows with Maireana species on heavy soils, especially in depression (Royal Botanic Gardens 2005). Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. It grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated (Department of Environment and Conservation 2005).	EPBC, PlantNet, Namoi CMA	Low - No suitable habitat was recorded within the study area.	No.
Haloragaceae	*Myriophyllum implicatum*			CE	It occurs in moist microhabitats adjacent to fresh water (Callaghan *et al.* 2002; Orchard 1985; Thompson, D. & Sharp 2003a; Thompson, E. & Sharp 2003b). Previously presumed extinct in NSW it was rediscovered in 2008 in open inundated gilgai depression on cracking clays in an area dominated by open forest/woodland. In QLD t is located in the Moreton Bay area, sporadically along the east coast to Townsville and inland to the Desert Uplands.	PlantNet	Low - No suitable habitat was recorded within the study area.	No.

Family Name	Species Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data Source[3]	Likelihood of occurrence[4]	Impact assessment required?
Orchidaceae	*Diuris tricolor*	Donkey Orchid		V	Grows in sclerophyll forest among grass, often with Callitris (Royal Botanic Gardens 2005). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Soils include gritty orange-brown loam on granite, shallow red loamy sand on stony porphyry, skeletal lateritic soil and alluvial grey silty loam. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats(Department of Environment and Conservation 2005). Within the Upper Hunter it is known to occur in *Eucalyptus albens/Eucalyptus crebra/Eucalyptus blakelyi/Corymbia maculata* woodland complexes and grasslands (Parsons Brinckerhoff 2004).	Atlas of NSW	**Moderate -** Suitable habitat was recorded in within the derived native grassland within the study area.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Orchidaceae	*Prasophyllum sp. Wybong (C. Phelps ORG 5269)*	a leek orchid	CE		*Prasophyllum* sp. Wybong (C. Phelps ORG 5269) is known from seven populations in open eucalypt woodland and grassland in NSW. The species' area of occupancy is estimated to be 1.5 km2 with an estimated population size based on surveys in 2006 of 460 mature individuals. This species occurs within the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes IBRA Bioregions and the Border Rivers-Gwydir, Namoi, Hunter-Central Rivers and Central West Natural Resource Management Regions. The distribution of this species overlaps with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland EPBC Act-listed threatened ecological community (Department of Sustainability Environment Water Population and Communities 2011)	EPBC	**Moderate -** Suitable habitat was recorded in within the derived native grassland within the study area.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Family Name	Species Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data Source[3]	Likelihood of occurrence[4]	Impact assessment required?
Orchidaceae	*Pterostylis cobarensis*		V	V	Grows among rocks on low hills and on slopes above streams; chiefly from Nyngan to Bourke district (Royal Botanic Gardens 2005). Western plains of NSW, chiefly in Nyngan - Cobar - Bourke region; favours stony ridges, often growing under *Eucalyptus morisii* (Grey Mallee) (Bishop 2000). Habitats are eucalypt woodlands, open mallee or *Callitris* shrublands on low stony ridges and slopes in skeletal sandy-loam soils. It has been recorded from ridge tops as well as steep exposed slopes and sheltered east slopes. Soils include shallow red clay-loam, skeletal red loam on metaquartzite, shallow sandy-loam on conglomerate and sandstone, and skeletal gritty organic loam on microgranite. Associated species include *Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna* spp. and *Eremophila* spp. (Department of Environment and Conservation 2005).	PlantNet	Low - No suitable habitat was recorded within the study area.	No.
Poaceae	*Dichanthium setosum*	Bluegrass	V	V	Grows in woodland and grassland (Harden 1993). On the New England Tablelands and North West Slopes it grows on stony red-brown hard-setting soils over basalt, or on black soil (Department of Environment and Conservation 2007).	PlantNet, Namoi CMA	Low - No suitable habitat was recorded within the study area.	No.
Poaceae	*Digitaria porrecta*	Finger Panic Grass	E	E1	In NSW it occurs in north western slopes and north western plains subdivisions (Royal Botanic Gardens 2004) where it grows in native grassland, woodlands or open forest with a grassy understorey, on richer soils. It is often found along roadsides and travelling stock routes where there is light grazing and occasional fire (Department of Environment and Conservation 2006).	PlantNet, Namoi CMA	**Moderate -** Suitable habitat was recorded in within the derived native grassland within the study area.	**Yes** – as potential habitat was recorded and impact assessment has been undertaken in Appendix E.
Poaceae	*Homopholis belsonii*		V		Occurs north from the Warialda district. It grows in dry woodland on poor soils such as belah (Department of Environment and Conservation 2006; Royal Botanic Gardens 2005)	EPBC, Namoi CMA	Low - No suitable habitat was recorded within the study area.	No.

Family Name	Species Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data Source[3]	Likelihood of occurrence[4]	Impact assessment required?
Polygalaceae	*Polygala linariifolia*			E1	Grows in dry sclerophyll communities from Warialda area to Weebah gate on the Qld border (Royal Botanic Gardens 2005).	PlantNet	Low - No suitable habitat was recorded within the study area.	No.
Rhamnaceae	*Pomaderris queenslandica*	Scant Pomaderris		E1	Widely scattered but not common in north-east NSW and in Queensland. It is only known from a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolatai, and also from several locations on the NSW north coast (Department of Environment and Conservation 2005). It grows in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks (Department of Environment and Conservation 2005).	PlantNet, Namoi CMA	Low - No suitable habitat was recorded within the study area.	No.
Philotheca ericifolia	Rutaceae	-	V		Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies, in the upper Hunter Valley and Pilliga to Peak Hill district (Royal Botanic Gardens 2004). It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include Melaleuca uncinata, Eucalyptus crebra, E. rossii, E. punctata, Corymbia trachyphloia, Acacia triptera, A. burrowii, Beyeria viscosa, Philotheca australis, Leucopogon muticus and Calytrix tetragona. Noted as being a moisture-loving plant, with plants common on the sides of a particular spur of the Hervey Ranges where soakage from the high background provides sufficient moisture for the plants (Department of Environment and Conservation 2005).	Namoi CMA	Low - No suitable habitat was recorded within the study area.	No.
Santalaceae	*Thesium australe*	Austral Toadflax	V	V	Grows in grassland or woodland often in damp sites. It is a semi-parasitic herb and hosts are likely to be *Themeda australis* and *Poa* spp. (Department of Environment and Climate Change 2008; Harden 1992).	EPBC, Namoi CMA	Low - No suitable habitat was recorded within the study area.	No.

Family Name	Species Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data Source[3]	Likelihood of occurrence[4]	Impact assessment required?
Scrophulariaceae	*Euphrasia orthocheila* subsp. *orthocheila*			E1	Grows in moist open situations such as swamps north from Walcha districts and west to Mt Kaputar N.P., also at Orange and possibly in Sydney area.	PlantNet	Low – No suitable habitat was recorded within the study area.	No.
Surianaceae	*Cadellia pentastylis*	Ooline	V	V	Occurs west from near Tenterfield and north from Terry Hie Hie (Royal Botanic Gardens 2005). Grows mainly in vine thickets or dry rainforest, and more rarely occurs in woodlands. It is a relict rainforest species and tends to favour upper and mid slope positions, often with a northerly aspect. It commonly occurs on sandy-loam to clay soils of low to medium fertility. It can occur in pure stands or in a mixed community on the slopes of residual sandstone ranges and scarps (Department of Environment and Conservation 2006).	EPBC, PlantNet	Low - No suitable habitat was recorded within the study area.	No.

Notes:

1. Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the EPBC Act.
2. Listed as an Endangered Population (EP), Vulnerable (V), Endangered (E1), Critically Endangered (CE) or Extinct (E4) under the TSC Act.
3. EPBC = EPBC Act Protected Matters Search Tool Report
   Atlas of NSW Wildlife = Office of Environment and Heritage Bionet Atlas – 10 km buffer of study area
   PlantNet = The Royal Botanic Gardens PlantNet database – 25 km buffer of study area
   Namoi CMA = OEH Namoi CMA Liverpool Range (Part B) regional search
4. Refer to Section 4 of the main report

References

Bishop, T 2000, *Field guide to the orchids of New South Wales and Victoria*, Second edn, University of New South Wales Press Pty. Ltd., Sydney.

Briggs, JD & Leigh, JH 1996, *Rare or Threatened Australian Plants*, CSIRO, Canberra.

Callaghan, J, Curran, T, Thompson, J & Floyd, R 2002, *Greater Taree City Council Draft Comprehensive Koala Plan of Management*, Prepared by the Australian Koala Foundation on behalf of Greater Taree City Council.

Department of Environment and Climate Change 2008, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2008, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2005, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2006, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2007, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Sustainability Environment Water Population and Communities 2011, *Species Profile and Threats Database*, Department of Sustainability, Environment, Water, Population and Communities, <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.

Harden, G 1992, *Flora of New South Wales Volume 3*, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, *Flora of New South Wales Volume 4*, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, *Flora of New South Wales Volume 1 (Revised Edition)*, University of New South Wales Press Ltd., Kensington.

Orchard, AE 1985, 'Myriophyllum (Haloragaceae) in Australasia. II. The Australian Species,' *Brunonia*, vol. 8, pp. 173-291.

Parsons Brinckerhoff 2004, *Woodland Ridge Estate Diuris tricolor Significance Assessment*, Parsons Brinckerhoff, Rhodes.

Royal Botanic Gardens 2004, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, Sydney,

Royal Botanic Gardens 2005, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, Sydney,

Royal Botanic Gardens 2007, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, <http://plantnet.rbgsyd.nsw.gov.au/>.

Thompson, D & Sharp, D 2003a, *Regional ecosystems of the Desert Uplands: 10.3.15 Grasslands, sedgelands, ephemeral herblands and open-woodlands in depressions on sand plains*, Queensland Environmental Protection Agency.

Thompson, E & Sharp, D 2003b, *Regional ecosystems of the Desert Uplands: 10.3.14 River red gum and/or coolabah open-woodland along channels and on floodplains*, Queensland Environmental Protection Agency.

Appendix D

Threatened species of animal

Appendix D - Threatened species of animal known or predicted to occur within the Study Area

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Amphibians							
Litoria booroolongensis	Booroolong Frog	E	E1	Confined to mountain streams of the Great Dividing Range (Cogger 2000). Usually found on or under boulders and debris in and beside the rocky beds of mountain streams; breeds in summer (Anstis 2002).	EPBC, Namoi CMA	Low – No preferred habitat recorded.	No.
Birds							
Botaurus poiciloptilus	Australasian Bittern	E	E1	Occurs in shallow, vegetated freshwater or brackish swamps. Requires permanent wetlands with tall dense vegetation, particularly bulrushes and spikerushes. When breeding, pairs are found in areas with a mixture of tall and short sedges but will also feed in more open territory. (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 2002a).	Namoi CMA	Low – No preferred habitat recorded.	No.
Alectura lathami	Australian Brush-turkey		E2	Has a largely coastal distribution from Cape York south as far as the Illawarra in NSW (Barrett, G.W. *et al.* 2003; Marchant & Higgins 1993). It occurs in forested and wooded areas of tropical and warm-temperate districts, particularly above 300 m to at least 1200 m altitude. The species is commonly associated with closed forest, including rainforest and vine thickets, as well as dense woodland habitats. More open dry woodland habitats are also used including open woodland dominated by Spotted Gum, *Corymbia maculata, Brigalow, Acacia harpophylla*, and Belah, *Casuarina cristata* (Marchant & Higgins 1993). In NSW the inland vegetation type preferred by the Australian Brush-turkey is a dry rainforest community that is found within the Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions Endangered Ecological Community (NSW Scientific Committee 2005). The population in the Nandewar and Brigalow Belt South bioregions of NSW is listed as an Endangered population.	Namoi CMA	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Ardeotis australis	Australian Bustard		E1	The ground-dwelling bird mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams. Breeds on bare ground on low sandy ridges or stony rises in ecotones between grassland and protective shrubland cover; roosts on ground among shrubs and long grasses or under trees. Forages on insects, young birds, lizards, mice, leaves, seeds and fruit. Dispersive, with irregular widespread movements over long distances; movements are thought to be in response to habitat and climatic conditions; known to converge on areas with high mice numbers and in recently burnt areas (Marchant & Higgins 1993).	Namoi CMA	Low – No preferred habitat recorded.	No.
Rostratula australis (syn. R. benghalensis)	Australian Painted Snipe (Painted Snipe)	VM	E1	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as *Eucalyptus camaldulensis* (River Red Gum), *E. populnea* (Poplar Box) or shrubs such as *Muehlenbeckia florulenta* (Lignum) or *Sarcocornia quinqueflora* (Samphire). Feeds at the water's edge and on mudlflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett & Crowley 2000).	EPBC, Namoi CMA	Low – No preferred habitat recorded.	No.
Ninox connivens	Barking Owl		V	Occurs in dry sclerophyll woodland. In the south west it is often associated with riparian vegetation while in the south east it generally occurs on forest edges. It nests in large hollows in live eucalypts, often near open country. It feeds on insects in the non-breeding season and on birds and mammals in the breeding season (Garnett & Crowley 2000).	Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Hamirostra melanosternon	Black-breasted Buzzard		V	Distributed throughout most of inland Australia and prefers arid scrubland, and open woodlands. Feeds on small mammals and birds (Garnett & Crowley 2000).	Namoi CMA	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)		V	Occurs within areas of annual rainfall between 400-700 mm. Feed on insects, nectar and lerps (Garnett & Crowley 2000). It occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, Blakely's Red Gum and Forest Red Gum. Also inhabits open forests of smooth-barked gums, stringybarks, river sheoaks (nesting habitat) and tea-trees. Feeding territories are large making the species locally nomadic. It tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares (Office of Environment and Heritage 2012b).	Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Ephippiorhynchus asiaticus	Black-necked Stork		E1	Feed in shallow water up to 0.5 m deep on fish, reptiles and frogs. Build nests in trees close to feeding sites (Garnett & Crowley 2000).	Namoi CMA	Low – No preferred habitat recorded.	No.
Limosa limosa	Black-tailed Godwit	M	V	A coastal species found on tidal mudflats, swamps, shallow river margins and sewage farms. Also found inland on larger shallow fresh or brackish waters. A migratory species visiting Australia between September and May (Pizzey & Knight 2007).	Namoi CMA	Low – No preferred habitat recorded.	No.
Oxyura australis	Blue-billed Duck		V	Relatively sparse throughout species range. Regularly found breeding in south-east Queensland, north-east South Australia and throughout New South Wales. Found on temperate, fresh to saline, terrestrial wetlands, and occupies artificial wetlands. Prefers deep permanent open water, within or near dense vegetation. Nest in rushes, sedge, Lignum Muehlenbeckia cunninghamii and paperbark Melaleuca (Garnett & Crowley 2000).	Namoi CMA	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Grus rubicunda	Brolga		V	Occurs in well vegetated shallow freshwater wetlands, small isolated swamps in eucalypt forests, floodplains, grasslands, paddocks, ploughed fields, irrigated pastures, stubbles, crops, desert claypans, bore drains, tidal areas, mangroves, beach wastes. Roosts in shallow, bare swamps and nests on small islands in wetland or standing in shallow water, eggs are occasionally laid on bare ground {Pizzey, 1997 #24}.	Namoi CMA	Low – No preferred habitat recorded.	No.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)		V	Found in eucalypt woodlands and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly in habits woodlands dominated by stringybarks or other rough-barked eucalypts. Nesting occurs in tree hollows (Department of Environment and Conservation 2005a).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Burhinus grallarius	Bush Stone-curlew		E1	Inland habitat consists of open forest and woodlands with few, if any, shrubs, and short, sparse grasses of less than 15cm in height, with scattered fallen timber, leaf litter and bare ground present (Department of Environment and Conservation 2006a). In coastal areas, structurally similar elements of tidal and estuarine communities (Casuarina woodlands, saltmarsh and mangroves) provide suitable habitat (Price 2004). Nesting sites are frequently located in relatively open areas, where ground cover is extremely low and/or sparse including native vegetation and mown lawns, ploughed paddocks and paddocks cut for hay, dirt and gravel roads, seaweed on sand beach, playing fields, vacant lots (Department of Environment and Conservation 2006b).	Namoi CMA	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Ardea ibis	Cattle Egret	M		Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands and very rarely in arid and semi-arid regions. High numbers may occur in moist, poorly drained pastures with high grass; it avoids low grass pastures but has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. It is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora (Marchant & Higgins 1990; Morton *et al.* 1989).	EPBC	**Moderate –** preferred habitat recorded.	**Yes –** impact assessment conducted in Section 4.5 of the main report.
Stagonopleura guttata	Diamond Firetail		V	Distributed through central and eastern NSW, extending north into southern and central Queensland and south through Victoria to the Eyre Peninsula, South Australia. In NSW, the species occurs predominantly west of the Great Dividing Range, although populations are known from drier coastal areas (Blakers *et al.* 1984; Schodde & Mason 1999). Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range (Garnett & Crowley 2000). Firetails nest in trees and bushes, and forage on the ground, largely for grass seeds and other plant material, but also for insects (Blakers *et al.* 1984; Read 1994).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Ardea modesta	Eastern Great Egret	M		Great Egrets occur throughout most of the world. They are common throughout Australia, with the exception of the most arid areas. Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups. In Australia, the breeding season of the Great Egret is normally October to December in the south and March to May in the north. This species breeds in colonies, and often in association with cormorants, ibises and other egrets. (Australian Museum 2003).	EPBC	**Moderate –** preferred habitat recorded.	**Yes –** impact assessment conducted in Section 4.5 of the main report.
Petroica phoenicea	Flame Robin		V	In NSW the Flame Robin breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats (Higgins & Peter 2002). The Flame Robin forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other woody debris. The robin builds an open cup nest of plant fibres and cobweb, which is often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank (Department of Environment Climate Change and Water 2010a).	Namoi CMA	Low – No preferred habitat recorded.	No.
Apus pacificus	Fork-tailed Swift	M		Breeds in the northern hemisphere, wintering south to Australia. It is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground. It mostly occurs over inland plains but sometimes above foothills or in coastal areas over cliffs, beaches, islands and well out to sea. It also occurs over towns and cities. It mostly occurs over dry and/or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, grassland, spinifex sandplains, farmland and sand-dunes. It sometimes occurs above forests. It probably roosts aerially, but has occasionally been observed to land (Higgins 1999).	EPBC	**Moderate –** preferred habitat recorded.	**Yes –** impact assessment conducted in Section 4.5 of the main report.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Stictonetta naevosa	Freckled Duck		V	In most years this species appear to be nomadic between ephemeral inland wetlands. In dry years they congregate on permanent wetlands while in wet years they breed prolifically and disperse widely, generally towards the coast. In inland eastern Australia, they generally occur in brackish to hyposaline wetlands that are densely vegetated with Lignum (*Muehlenbeckia cunninghamii*) within which they build their nests (Garnett & Crowley 2000).	Namoi CMA	Low – No preferred habitat recorded.	No.
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	Occurs in eucalypt woodland and forest with Casuarina/Allocasuarina spp. Characteristically inhabits forests on sites with low soil nutrient status, reflecting the distribution of key Allocasuarina species. The drier forest types with intact and less rugged landscapes are preferred by the species. Nests in tree hollows (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 1999a).	Namoi CMA	Low – No preferred habitat recorded.	No.
Falco hypoleucos	Grey Falcon		E1	Generally centred on inland drainage systems where the average rainfall is less than 500 millimetres. It is found in timbered lowland plains that are crossed by tree-lined water courses. Nests in the old nests of other birds, particularly raptors (Garnett & Crowley 2000).	Namoi CMA	Low – No preferred habitat recorded.	No.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern)		V	Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. This is one of a suite of species that has declined in woodland areas in south-eastern Australia (Garnett & Crowley 2000; Traill & Duncan 2000). The species appears unable to survive in remnants smaller than 100-200ha (NSW Scientifc Committee 2001).	Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Pomatostomus temporalis temporalis	Grey-Crowned Babbler (Eastern subspecies)		V	The eastern form of the species formerly ranged throughout eastern Australia from South Australia, through Victoria and broadly through NSW and central Queensland but is now extinct in South Australia, coastal Victoria and the ACT. In NSW, it occurs on the western slopes and plains but is less common at the higher altitudes of the tablelands. Isolated populations are known from coastal woodlands on the North Coast, in the Hunter Valley and from the South Coast near Nowra (Blakers *et al.* 1984; Schodde & Mason 1999).Grey-crowned Babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. The species builds conspicuous dome-shaped nests and breeds co-operatively in sedentary family groups of 2-13 birds (Davidson & Robinson 1992).Grey-crowned Babblers are insectivorous and forage in leaf litter and on bark of trees (NSW Scientific Committee 2001a).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat was recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Gallinago hardwickii	Latham's Snipe	M		Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed (Garnett & Crowley 2000).	EPBC	Low – No preferred habitat recorded.	No.
Hieraaetus morphnoides	Little Eagle		V	The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet (Marchant & Higgins 1993).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Glossopsitta pusilla	Little Lorikeet		V	The Little Lorikeet is a small green lorikeet with black bill and red patch on forehead and throat. The underside is yellow-green. Immatures are duller with less red on face and brown bill. Found in forests, woodland, treed areas along watercourses and roads. Forages mainly on flowers, nectar and fruit. Found along coastal east Australia from Cape York in Queensland down east coast and round to South Australia. Uncommon in southern Victoria (Higgins 1999).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Anseranas semipalmata	Magpie Goose		V	Occurs in shallow wetlands such as large swamps and dams, especially with dense growth of rushes or sedges, and with permanent lagoons and grassland nearby. Feeds on seeds, tubers and green grass. Form large nesting colonies during the wet season. During the dry season this species migrates hundreds of kilometres to perennial swamps (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 2002a).	Namoi CMA	Low – No preferred habitat recorded.	No.
Leipoa ocellata	Malleefowl	VM	E1	Ground-dwelling bird found in mallee woodland and other dry scrub in the semi-arid zone of inland Australia. Restricted to semi-arid rangelands and small habitat remnants in the dryland cropping zone of the southwest and centre of NSW. Prefers well drained, light sandy or loamy soils. Habitat usually contains dense but discontinuous canopy which provides abundant leaf litter and dense, varied shrub and herb layers containing food plants, particularly Acacia, Cassia, Bossiaea, Beyeria and some open ground for ease of movement (NSW National Parks and Wildlife Service 1999c).	EPBC, Namoi CMA	Low – No preferred habitat recorded.	No.
Tyto novaehollandiae novaehollandiae	Masked Owl (southern mainland)		V	Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known to occasionally roost and nest in caves (Garnett & Crowley 2000).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Grantiella picta	Painted Honeyeater		V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Ninox strenua	Powerful Owl		V	A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, Casuarina or Callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands (Garnett & Crowley 2000).	Namoi CMA	Low – No preferred habitat recorded.	No.
Merops ornatus	Rainbow Bee-eater	M		Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings (Higgins 1999).	Atlas of NSW, EPBC	**Moderate –** preferred habitat recorded.	**Yes –** impact assessment conducted in Section 4.5 of the main report.
Anthochaera phrygia (syn. Xanthomyza phrygia)	Regent Honeyeater	EM	CE	Occurs mostly in box-ironbark forests and woodland and prefers wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with Casuarina cunninghamiana and Amyema cambagei are important for feeding and breeding. Spotted Gum and Swamp Mahogany forests are also important feeding areas in coastal areas. Important food trees include Eucalyptus sideroxylon (Mugga Ironbark), E. albens (White Box), E. melliodora (Yellow Box) and E. leucoxylon (Yellow Gum) (Garnett & Crowley 2000).	EPBC, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Myiagra cyanoleuca	Satin Flycatcher	M		Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens (Pizzey & Knight 2007).	EPBC	Low – No preferred habitat recorded.	No.
Petroica boodang	Scarlet Robin		V	In NSW, the Scarlet Robin occupies open forests and woodlands from the coast to the inland slopes. Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. It prefers an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris (Department of Environment Climate Change and Water 2010b; Higgins & Peter 2002). The species has been found to be absent from remnants surrounded by cereal cropping, less common in isolated patches of 30 ha or less (where there was no tree cover within 200 m and less than 20% cover within 1 km), less common in sites surrounded by cattle grazing and more common in sites with native versus exotic grasses if ungrazed for more than 10 years (Barrett, G.W. *et al.* 2003).	Namoi CMA	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Chthonicola sagittata (syn. Pyrrholaemus sagittatus)	Speckled Warbler		V	Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett & Crowley 2000). The species has been shown to decrease in abundance as woodland area decreased, and it appears to be extinct in districts where no fragments larger than 100ha remain (Barrett, G.W *et al.* 1994). Isolation of Speckled Warbler populations in small remnants increases their vulnerability to local extinction as a result of stochastic events and decreases their genetic viability in the long term (NSW Scientific Committee 2001b).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Circus assimilis	Spotted Harrier		V	The Spotted Harrier occurs throughout the Australian mainland in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods) (Marchant & Higgins 1993). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. The diet of the Spotted Harrier includes terrestrial mammals, birds and reptiles, occasionally large insects and rarely carrion (Department of Environment Climate Change and Water 2010b).	Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Lophoictinia isura	Square-tailed Kite		V	This species hunts primarily over open forest, woodland and mallee communities as well as over adjacent heaths and other low scrubby habitats in wooded towns. It feeds on small birds, their eggs and nestlings as well as insects. Seems to prefer structurally diverse landscapes (Garnett & Crowley 2000).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Polytelis swainsonii	Superb Parrot	V	V	Mainly found in the Riverina where they nest in loose colonies in riparian woodland on River Red Gum. On the inland slopes, Superb Parrots both forage and feed within box woodland, mostly nesting in dead trees (Garnett & Crowley 2000).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Lathamus discolor	Swift Parrot	E	E1	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering Acacia pycnantha, is indicated. Sites used vary from year to year. (Garnett & Crowley 2000),(Swift Parrot Recovery Team 2001).	EPBC, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Neophema pulchella	Turquoise Parrot		V	The Turquoise Parrot inhabits eucalypt and cypress-pine open forests and woodlands (commonly box or box-ironbark) with native grasses, sometimes with a low shrubby understorey, often in undulating or rugged country, or on footslopes. It also lives in open woodland or riparian gum woodland, and often near ecotones between woodland and grassland, or coastal forest and heath. The Turquoise Parrot requires live or dead trees, stumps and logs for nesting, trees and shrubs for shelter, and seeding grasses and forbs (often beneath trees) for food. The Turquoise Parrot's nest is a cavity in a live or dead tree, stump or log, or even fence post often within 1-2 m of the ground. Hollows average about 0.5 m deep, with an entrance hole of 10 x 7 cm, and a nest chamber 12 x 9 cm in diameter (Garnett & Crowley 2000; Higgins 1999).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Daphoenositta chrysoptera	Varied Sittella		V	The Varied Sittella inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years (Department of Environment Climate Change and Water 2010b).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Haliaeetus leucogaster	White-bellied Sea-Eagle	M		Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs (Pizzey & Knight 2007).	EPBC	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Epthianura albifrons	White-fronted Chat		E2	The White-fronted Chat occupies foothills and lowlands below 1000 m above sea level (North 1904; Higgins et al. 2001; Barrett et al. 2003). In New South Wales the White-fronted Chat occurs mostly in the southern half of the state, occurring in damp open habitats along the coast, and near waterways in the western part of the state (Higgins et al. 2001). Along the coastline, White-fronted Chats are found predominantly in saltmarsh vegetation although they are also observed in open grasslands and sometimes in low shrubs bordering wetland areas. (North 1904; Higgins et al. 2001; Barrett et al. 2003). The population in the Sydney Metropolitan Catchment Management Authority region is listed as Endangered (Office of Environment and Heritage 2012).	Namoi CMA	Low – No preferred habitat recorded.	No.
Hirundapus caudacutus	White-throated Needletail	M		Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey & Knight 2007).	Atlas of NSW, EPBC	**Moderate –** preferred habitat recorded.	**Yes –** impact assessment conducted in Section 4.5 of the main report.
Fish							
Tandanus tandanus	Eel-tailed Catfish		E2	Occupies a wide range of habitats including rivers, creeks, lakes, billabongs and lagoons. It inhabits flowing streams but prefers slow and still waters and can be found in clear or turbid water over substrates including mud, gravel and rock (NSW Fisheries Scientific Committee 2008).	Fisheries	Low – No preferred habitat recorded.	No.
Maccullochella peelii	Murray Cod	V		The Murray Cod occurs in lower reaches of the Murray-Darling Basin, where the water temperature is warm. The diverse range of habitats frequented by the Murray Cod includes slow moving rivers, murky billabongs and clear, rocky rivers (Threatened Species Scientific Committee 2011).	EPBC, Fisheries	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Craterocephalus fluviatilis	Murray Hardyhead	V	CE	Murray hardyhead live along the edges of slow-flowing lowland rivers, as well as in lakes, billabongs and backwaters. They are often found amongst aquatic weeds, in both fresh and quite saline waters. They were once widespread and abundant in the Murray and Murrumbidgee river systems in southern NSW and northern Victoria; however, they have suffered a serious population decline, and now seem to be limited to a few sites, mainly in northern Victoria. Since 2000, only one individual has been collected in extensive surveys in NSW (NSW Fisheries Scientific Committee 2008).	Fisheries	Low – No preferred habitat recorded.	No.
Bidyanus bidyanus	Silver Perch		V	The most abundant remaining natural population occurs in the central Murray River downstream of Yarrawonga Weir as well as several of its anabranches and tributaries (including the Edward River, an anabranch of the Murray which flows through Deniliquin, and the Murrumbidgee River). The central Murray population is considered secure and self-sustaining. There have also been reports of self-sustaining populations in other rivers, including the MacIntyre and Macquarie Rivers in northern NSW and the Warrego River in Queensland, mostly from recreational anglers. Little is currently known about the status of these populations (Department of Trade and Investment Regional Infrastructure and Services 2011).	EPBC, Fisheries	Low – No preferred habitat recorded.	No.
Mammals							
Macropus dorsalis	Black-striped Wallaby		E1	The preferred habitats for the species is forested country with a dense shrub layer including rainforest margins; Brigalow scrub, particularly in a phase of regrowth; open forest with a thick acacia or other shrub understorey; and lantana thickets (Strahan 1995).	Namoi CMA	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Phascogale tapoatafa	Brush-tailed Phascogale		V	Largely arboreal it occurs in a range of habitats which have reliable rainfall (500-2000mm), but has preference for open dry sclerophyll forest on ridges (up to 600 m alt) with little/sparse ground cover. It nests in tree hollows and feeds at dusk on arthropods and small vertebrates (Strahan 1995).	Namoi CMA	Low – No preferred habitat recorded.	No.
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E1	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It has a preference for rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or "colonies" each usually separated by hundreds of metres (NSW National Parks and Wildlife Service 2003a).	Namoi CMA	Low – No preferred habitat recorded.	No.
Vespadelus troughtoni	Eastern Cave Bat		V	A cave-dwelling species found in eastern Australia from Cape York to NSW. They inhabit tropical mixed woodland and wet sclerophyll forests on the coast and the dividing range, but extend into drier forests on the western slopes (Churchill 1998). Breeding habitat includes caves, rocky outcrops, cliffs, scarps and old mine workings. Roosting habitat includes breeding habitat types and very small crevices in rocky areas or boulder piles or old mine workings and Fairy martin nests. Foraging habitat includes suitable native vegetation within 5km of breeding habitat (Office of Environment and Heritage 2011b).	Namoi CMA	Low – No preferred habitat recorded.	No.
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 metres high (Churchill 2008)	Previous assessment	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Cercartetus nanus	Eastern Pygmy-possum		V	Found in a range of habitats from rainforest through sclerophyll forest to tree heath. It feeds largely on the nectar and pollen of banksias, eucalypts and bottlebrushes and sometimes soft fruits. It nests in very small tree holes, between the wood and bark of a tree, abandoned birds' nests and shredded bark in the fork of trees (Turner & Ward 1995).	Namoi CMA	Low – No preferred habitat recorded.	No.
Phascolarctos cinereus	Koala (NSW, ACT & QLD - excluding SE QLD)	V	V	Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Forest Red Gum *Eucalyptus tereticornis*, Grey Gum *E. punctata,* Monkey Gum *E. cypellocarpa* and Ribbon Gum *E. viminalis*. In coastal areas, Tallowwood *E. microcorys* and Swamp Mahogany *E. robusta* are important food species, while in inland areas White Box *E. albens,* Bimble Box *E. populnea* and River Red Gum *E. camaldulensis* are favoured (NSW National Parks and Wildlife Service 1999b, 2003b). Hawks Nest and Tea Gardens Population and population in the Pittwater LGA listed as Endangered under the NSW TSC Act.	Atlas of NSW, EPBC, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs in moderately wooded habitats, mainly in areas with extensive cliffs and caves and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins (Churchill 1998; Office of Environment and Heritage 2011b). Breeding habitat (maternity roosts) is located in roof domes in sandstone caves (Office of Environment and Heritage 2011b). Thought to forage below the forest canopy for small flying insects (Churchill 1998).	Atlas of NSW, EPBC, Namoi CMA	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Chalinolobus picatus	Little Pied Bat		V	The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria and has been recorded in dry open forest, open woodland, Mulga woodlands, chenopod shrublands, Callitris forest and mallee (Churchill 1998; Office of Environment and Heritage 2011a). The species roosts and breeds in tree hollows, fissures or cracks, buildings, powerpoles, fenceposts, caves, cliff crevices, mine shafts and tunnels. Roost sites in caves are usually warm and dry but the species can tolerate roost temperatures of more than 40 degrees Celsius (Office of Environment and Heritage 2011a).	Namoi CMA	Low – No preferred habitat recorded.	No.
Pseudomys pilligaensis	Pilliga Mouse	V	V	Restricted to unique habitat known as Pilliga scrub, which occurs on deep, low nutrient sand in the Pilliga region of NSW (south of Narrabri). Specifically, Pilliga mouse has been found in areas dominated by broombush, or with Acacia burrowii shrub layer and Corymbia trachyphloia overstory. Both of these habitats had relatively high species richness with moist groundcover and medium to high shrub cover. An additional habitat for the Pilliga Mouse is recently burnt moist gullies with high cover of low grasses and sedges, yet low cover of shrubs (Department of Environment and Climate Change 2007).	Namoi CMA	Low – No preferred habitat recorded.	No.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Aepyprymnus rufescens	Rufous Bettong		V	Distribution: From Cooktown in north Queensland, to north-east NSW, where it occurs east of the Dividing Range. In Queensland, it still occurs on both sides of the Great Divide. Macrohabitat: Found in a variety of forest types from wet sclerophyll to dry open woodland, where grass tussocks or fallen timber are present. Also known to occupy a mosaic of open forest and grasslands. Microhabitat: It appears to prefer a more open forest structure, with an sparse shrub layer and a diverse ground cover. Builds nests in grass tussocks and under logs. Strongly associated with dry sclerophyll forest particularly those dominated by Spotted Gum (NSW National Parks and Wildlife Service 1999f).	Namoi CMA	Low – No preferred habitat recorded.	No.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs in moderately wooded habitats, mainly in areas with extensive cliffs and caves and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins (Churchill 1998; Office of Environment and Heritage 2011b). Breeding habitat (maternity roosts) is located in roof domes in sandstone caves (Office of Environment and Heritage 2011b). Thought to forage below the forest canopy for small flying insects (Churchill 1998).	Atlas of NSW, EPBC, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Nyctophilus corbeni (syn. N. timoriensis)	South-eastern Long-eared Bat (Corben's Loong-eared Bat & Greater Long-eared Bat)	V	V	The species has a limited distribution that is restricted around the Murray-Darling Basin in south-eastern Australia (Turbill & Ellis 2006). It occurs in far eastern South Australia, in areas north of the Murray River (Turbill *et al.* 2008). It occurs in a range of inland woodland vegetation types being most abundant in vegetation with a distinct canopy and a dense cluttered shrub layer (Dominelli 2000; Ellis *et al.* 1999; Lumsden & Bennet 2003; Parnaby 1995; Turbill & Ellis 2006). Roosting and breeding habitat includes in tree hollows and under loose bark in arid and semi-arid Australia (Strahan 1995) and forages in the understorey of woodlands and open savannah and swamps (Churchill 1998).	Atlas of NSW, EPBC, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Dasyurus maculatus maculatus	Spotted-Tailed Quoll (Southern Subspecies)	E	V	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold (NSW National Parks and Wildlife Service 1999f). Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods (NSW National Parks and Wildlife Service 1999d, 1999f).	Namoi CMA	Low – No preferred habitat recorded.	No.
Petaurus norfolcensis	Squirrel Glider		V	The Squirrel Glider is sparsely distributed along the east coast and immediate inland districts from western Victoria to north Queensland. In NSW it is found in dry sclerophyll forest and woodland but not found in dense coastal ranges, inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. It is associated with mixed tree species stands with a shrub or Acacia midstorey. It requires abundant tree hollows for refuge and nest sites and feeds on gum of acacias, eucalypt sap and invertebrates (NSW National Parks and Wildlife Service 1999e).	Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Sminthopsis macroura	Stripe-faced Dunnart		V	The species are found in many habitats in the arid and semi-arid parts of Australia; they occur in low shrublands of saltbush and bluebush, in tussock grasslands on clay, sandy or stony soils, among sparse shrublands and on low, shrubby, rocky ridges. Dense populations occur in tussock grasslands. The species shelters in cracks in the soil or under rocks and logs, probably in nests (Strahan 1995).	Namoi CMA	Low – No preferred habitat recorded.	No.
Petaurus australis	Yellow-bellied Glider		V	Restricted to tall, mature eucalypt forest in high rainfall areas of temperate to sub-tropical eastern Australia. Feeds on nectar, pollen, the sap of eucalypts and sometimes insects. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows and year round food resources are available from a mixture of eucalypt species (NSW National Parks and Wildlife Service 1999g, 2003c).	Namoi CMA	Low – No preferred habitat recorded.	No.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat		V	This species is widespread through tropical Australia and migrates to southern Australia in summer. Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts and breeds in tree hollows but has also been recorded roosting under exfoliating bark, in burrows of terrestrial mammals, in soil cracks and under slabs of rock and in the nests of bird and sugar gliders (Churchill 2008).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Reptiles							

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence[4]	Impact assessment required?
Underwoodisaurus sphyrurus	Border Thick-tailed Gecko	V	V	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. It is found on rocky hills with dry open eucalypt forest or woodland. It favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter (Department of Environment and Conservation 2005b; NSW National Parks and Wildlife Service 2002b; Royal Botanic Gardens 2005).	EPBC, Namoi CMA	Low – No preferred habitat recorded.	No.
Hoplocephalus bitorquatus	Pale-headed Snake		V	A partly arboreal, nocturnal species found in a range of habitats from rainforest and wet sclerophyll forest to the drier eucalypt forests of the western slopes. Feeds largely on frogs and lizards (Cogger 2000).	Atlas of NSW, Namoi CMA	**Moderate –** preferred habitat recorded.	**Yes –** as potential habitat was recorded an impact assessment has been undertaken in Appendix E.
Aprasia parapulchella	Pink-tailed Worm Lizard (syn. Pink-tailed Legless Lizard)	V	V	This lizard is known from four sites in eastern Australia: near Canberra in the ACT, Tarcutta and Bathurst in NSW, and near Bendigo in Vic. In general, lizards occur in open grassland habitats that have a substantial cover of small rocks (Osbourne & Jones 1995). Lizards also show a preference for sunny aspects, avoiding S facing slopes. Some specimens have been collected from grassland sites that appear not to support any native grasses and several animals have been found on the edge of Callitris enlicheri woodland and Eucalyptus macrorhyncha woodland (Barrer 1992). A burrowing species, it is usually found under rocks on well-drained soil and in ant nests, occasionally with several individuals found under the same rock (Swan *et al.* 2004).	EPBC, Namoi CMA	Low – No preferred habitat recorded.	No.

Notes:

1. Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the EPBC Act.
2. Listed as an Endangered Population (E2), Vulnerable (V), Endangered (E1), Critically Endangered (CE) or Extinct (E4) under the TSC Act.
3. EPBC = EPBC Act Protected Matters Search Tool Report

Atlas of NSW Wildlife = Office of Environment and Heritage Bionet Atlas – 10 km buffer of study area

Fisheries = Department of Primary Industries Fishing and Aquaculture Records Viewer

Namoi CMA = OEH Namoi CMA Liverpool Range (Part B) regional search

4. Refer to Section 4 of the main report

References

Anstis, M 2002, *Tadpoles of South-eastern Australia: a Guide with Keys*, vol. 1, 1 vols., New Holland Publishers, Sydney.

Australian Museum 2003, *Great Egret factsheet*, Australian Museum,

Barrer, P 1992, *A survey of Aprasia parapulchella along parts of the lower Molonglo River corridor*, ACT Parks & Con. Wildlife Research Unit, Canberra,

Barrett, GW, Barry, SC, Cunningham, RB & Poulter, R 2003, *The new atlas of Australian Birds*, Ornithologists Union, Melbourne.

Barrett, GW, Ford, HA & Recher, HF 1994, 'Conservation of woodland birds in a fragmented rural landscape', *Pacific Conservation Biology*, no. 1, pp. 245-56.

Blakers, M, Davies, SJJF & Reilly, PN 1984, *The Atlas of Australian Birds*, Melbourne University Press, Melbourne.

Churchill, S 1998, *Australian Bats*, Reed New Holland, Sydney.

Churchill, S 2008, *Australian Bats*, 2nd edn, Allen & Unwin, Sydney.

Cogger, HG 2000, *Reptiles and Amphibians of Australia*, Reed Books, Sydney.

Davidson, I & Robinson, D 1992, *Grey-crowned Babbler Action Statement No 34* Department of Sustainability and Environment, Victoria.

Department of Environment and Conservation 2005a, *Brown Treecreeper (eastern subspecies) - Profile*, Department of Environment and Conservation, viewed 24 July 2009 2009, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10171>.

Department of Environment and Conservation 2005b, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2006a, *Atlas of NSW Wildlife*, Department of Environment and Conservation,

Department of Environment and Conservation 2006b, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment Climate Change and Water 2010a, *Bionet*, Department of Environment Climate Change and Water.

Department of Environment Climate Change and Water 2010b, *Threatened species, populations and communities database*, Department of Environment Climate Change and Water, <http://www.threatenedspecies.environment.nsw.gov.au/>.

Department of Trade and Investment Regional Infrastructure and Services 2011, *Threatened Species Priorities Action Statement - Profiles for species, populations and ecological communities*, Department of Trade and Investment Regional Infrastructure and Services, <http://pas.dpi.nsw.gov.au/Species/Species_Home.aspx>.

Dominelli, S 2000, *Distribution, roost requirements and foraging behaviour of the Greater Long-eared Bat (Nyctophilus timoriensis) and the Little Pied Bat (Chalinolobus picatus) in the Bookmark Biosphere Reserve*, An Unpublished Report prepared for Bookmark Biosphere Trust, South Australia.

Ellis, M, Lumsden, L, Schultz, M, Reardon, T, Richards, G & Hoy, G 1999, 'Eastern Long-eared Bat Nyctophilus timoriensis', in A Duncan, G Baker & M N. (eds), *The Action Plan for Australian Bats*, Environment Australia, Canberra, pp. 42-3.

Garnett, ST & Crowley, GM 2000, *The Action Plan for Australian Birds*, Environment Australia, Canberra.

Higgins, PJ (ed.) 1999, *Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbirds*, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

Higgins, PJ & Peter, JM (eds) 2002, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 6: Pardalotes to Shrike-thrushes, Oxford University Press, Melbourne.

Lumsden, L & Bennet, A 2003, *Bats and paddock trees: insights from recent research*, Department of Sustainability and Environment, Victoria.

Marchant, S & Higgins, PJ 1990, *Handbook of Australian, New Zealand and Antarctic Birds*, vol. Volume One - Ratites to Ducks, Oxford University Press, Melbourne.

Marchant, S & Higgins, PJ (eds) 1993, *Handbook of Australian, New Zealand and Antarctic Birds Volume 2: Raptors to Lapwings*, vol. 2, Volume 2: Raptors to Lapwings, Oxford University Press, Melbourne.

Morton, SR, Brennan, KG & Armstrong, MD 1989, *Distribution and Abundance of Waterbirds in the Alligator Rivers Region, Northern Territory.*

NSW Fisheries Scientific Committee 2008, *Final Determination for Pristis zijsron Green Sawfish*.

NSW National Parks and Wildlife Service 1999a, *Glossy Black-cockatoo threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999b, *Koala threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999c, *Malleefowl Threatened Species Information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999d, *Spotted-tailed Quoll threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999e, *Squirrel Glider threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999f, *Terms of licence under the Threatened Species Conservation Act 1995. Appendix B of the Integrated Forestry Operations Approval for the Upper North East Region.*,

NSW National Parks and Wildlife Service 1999g, *Yellow-bellied Glider threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002a, *Threatened Species of the Upper North Coast of New South Wales - Fauna*, NSW National Parks and Wildlife Service, Northern Directorate, Coffs Harbour.

NSW National Parks and Wildlife Service 2002b, *Threatened species of the upper north coast of New South Wales - Flora*, NSW National Parks and Wildlife Service, Northern Directorate, Coffs Harbour.

NSW National Parks and Wildlife Service 2003a, *Brush-tailed Rock Wallaby Warrumbungles endangered population threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003b, *Draft Recovery Plan for the Koala*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003c, *Recovery Plan for the Yellow-bellied Glider (Petaurus australis)*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientifc Committee 2001, *Final Determination to list the Hooded Robin (South-eastern form) as a Vulnerable species*, Department of Environment and Climate Change, Hurstville.

NSW Scientific Committee 2001a, *Final determination to list the Grey-crowned Babbler as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2001b, *Final determination to list the Speckled warbler as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2005, *Final determination to list the population of the Australian Brush-turkey Alectura lathami in the Nandewar and Brigalow Belt South Bioregions as an Endangered Population*, Department of Environment and Conservation, Hurstville.

Office of Environment and Heritage 2011a, *Atlas of NSW Wildlife*, Office of Environment and Heritage,, <http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp>.

Office of Environment and Heritage 2011b, *Threatened Species, Populations and Communities Database*, Office of Environment and Heritage, <http://www.threatenedspecies.environment.nsw.gov.au/>.

Office of Environment and Heritage 2012, *BioNet the Atlas of NSW Wildlife Database Search*, <http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx>.

Osbourne, WS & Jones, SR 1995, *Recovery Plan for the Pink-tailed Worm Lizard (Apriasia parapulchella). Technical Report No. 10*, Department of Environment, Land and Planning, Canberra.

Parnaby, HE 1995, *Greater Long-eared Bat Nyctophilus timoriensis*, Reed Books, Chatswood, NSW.

Pizzey, G & Knight, F 2007, *Field Guide to the Birds of Australia*, Harper and Collins, Sydney.

Price, CJ 2004, 'The Bush Stone-curlew Burhinus grallarius on the Central Coast of NSW – A Case study in Conservation Management; unpublished thesis', University of Sydney.

Read, JL 1994, 'The diet of three species of firetail finches in temperate South Australia', *Emu*, vol. 94, no. 1-8.

Royal Botanic Gardens 2005, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, Sydney,

Schodde, R & Mason, IJ 1999, *Directory of Australian Birds: Passerines*, CSIRO, Melbourne.

Strahan, R 1995, *The Mammals of Australia*, Reed New Holland, Sydney.

Swan, G, Shea, G & Sadlier, R 2004, *A Field Guide to Reptiles of New South Wales*, Reed New Holland, Sydney.

Swift Parrot Recovery Team 2001, *Swift Parrot Recovery Plan*, Department of Primary Industries, Water and Environment, Hobart.

Threatened Species Scientific Committee 2011, *Maccullochella peelii peelii (Murray Cod, Cod, Goodoo) Listing Advice - Advice to the Minister for Sustainability, Environment, Water, Population and Communities on amendment to the list of Threatened Species under the Environment Protection and Biodiversity*

Conservation Act 1999 (EPBC Act), Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Traill, BJ & Duncan, S 2000, *Status of birds in the New South Wales temperate woodlands region*, Consultancy report to the NSW National Parks and Wildlife Service by the Australian Woodlands Conservancy, Chiltern, Victoria.

Turbill, C & Ellis, M 2006, 'Distribution and abundance of the south eastern form of the Greater Long-eared Bat Nyctophilus timoriensis', *Australian Mammalogy*, vol. 28, pp. 1-7.

Turbill, C, Lumsden, L & Ford, G 2008, *South-eastern Long-eared Bat Nyctophilus sp. In: Van Dyck, S. and R. Strahan, (eds.), eds. The Mammals of Australia.*, New Holland, Sydney.

Turner, V & Ward, SJ 1995, 'Eastern Pygmy-possum', in R Strahan (ed.), *The Mammals of Australia*, Reed New Holland, Sydney, pp. 217-8.

Appendix E

Significance assessments

Appendix E – Significance assessments

Idemitsu Boggabri Coal Pty Limited (Boggabri Coal) is applying for a project area Modification to its current approval PA 09_0182.

Section 5A of the EP&A Act requires that a 7 part test is undertaken to assess the likelihood of significant impact upon threatened species, populations or ecological communities under the *Threatened Species Conservation Act 1995* (TSC Act 1995) (Department of Environment and Climate Change 2007).

For threatened biodiversity under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) significance assessments have been completed in accordance with the *Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of Environment 2013)*. Species listed under both the TSC Act and the EPBC Act has been assessed using both assessment guidelines separately.

The following assessments were undertaken to consider impacts of works associated with the proposed Modification upon species, populations or communities with a moderate or greater likelihood of occurring within the proposed Modification area. A total of 22.7 ha of native vegetation will require removed as part of the proposed modification.

One threatened species of plant *Tylophora linearis* listed under both the TSC Act and the EPBC Act was recorded within the approved project boundary. In addition the proposed Modification area contained one threatened ecological community listed under both the TSC Act and EPBC Act and potential habitat for three threatened species of plant and 25 species of animal.

Contents

1. Box-Gum Woodland

Status

White Box-Yellow Box-Blakely's-Red Gum grassy woodlands and derived native grasslands is an ecological community listed as critically endangered under the EPBC Act 1999 and White Box-Yellow Box-Blakely's-Red Gum woodland is listed as an Endangered Ecological Community (EEC) under the TSC Act 1995.

Two vegetation communities occurring within the proposed Modification area, White Box – White Cypress Pine Grassy woodland, White Box – White Cypress Pine grassy Woodland (low condition), have been identified as being commensurate with the NSW listing of Box-gum woodlands and would be directly affected by the proposed Modification. As the understorey is not predominantly native and there are fewer than 12 native species, the community fails to meet the federal listing criteria.

Distribution, habitat and ecology

This community occurs along the western slopes and tablelands of the Great Dividing Range from southern Queensland through NSW to central Victoria (Threatened Species Scientific Committee 2006). The community is generally found on moderate to highly fertile soils on tablelands and the western slopes of NSW (NSW Scientific Committee 2002).

This community canopy layer is dominated by one or more of *Eucalyptus albens* (White Box) *E. melliodora* (Yellow Box) and *E. blakelyi* (Blakely's Red Gum). Vegetation communities where the canopy layer of the aforementioned eucalypts has been removed and the grassy native understorey is present are also considered to be included as the Threatened community in both the federal and state listings. Therefore the structure of this community can be variable from grassy woodland to derived grasslands and the structure will often be a result of past land use practices. In western NSW the community intergrades with *Eucalyptus microcarpa* (Western Grey Box) or *Eucalyptus moluccana* (Grey Box) without the three aforementioned canopy trees present. The federal listing includes these vegetation assemblages as part of the Critically Endangered Community, where they occur within the Nandewar Bioregion only. The dominant understorey species of herbs and grasses vary across the range of the community due to latitudinal and climatic conditions. However, *Themeda australis* (Kangaroo Grass) and *Poa sieberiana* (Snow Grass) were originally dominant across a large part of the community's range, but these species are sensitive to grazing pressure and have declined in recent years (Cole & Lunt 2005).

Threats

Threats for this EEC include (Office of Environment and Heritage 2012):

- clearing, degradation and fragmentation of remnants for agriculture, forestry, infrastructure and residential development
- heavy grazing and trampling by grazing stock
- invasion of remnants by non-native plant and animal species
- disturbance and clearance during road, rail and infrastructure maintenance and upgrades
- collection or harvesting of woody-debris for firewood or 'clean-up'.

Specific impacts

The existing mapping and field surveys confirmed that 1.2 ha of Box gum woodland consistent with the endangered TSC Act community and 1.2 ha of Box gum woodland consistent with the critically endangered EPBC Act community will be impacted by the proposed Modification.

Vegetation communities commensurate with the TSC Act listed EEC, which are present within the proposed Modification area, are:

- Yellow Box – Blakely's Red Gum grassy woodland.
- White Box White Cypress Pine grassy woodland.

As part of the proposed modification no area of White Box White Cypress Pine grassy woodland would be impacted upon by the project. In total, 1.2 ha of Yellow Box – Blakely's Red Gum grassy woodland will be removed or modified as part of the proposed Modification. Whilst this small area will add incrementally to the loss of this community it is small in comparison to larger areas of this community present in the wider region.

1.1 TSC Act significance assessment

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

Not applicable.

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

Not applicable.

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

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

The proposed Modification will result in a reduction in the overall extent of Box-Gum woodland by 1.2 ha. A further area may be affected by indirect edge effects.

The cumulative impact will reduce this community to a small extent but unlikely to place the local occurrence at risk of extinction, as a large area Box-gum Woodland occur in the wider region.

The proposed Modification is not considered significant and is unlikely to place a local occurrence at risk of extinction.

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

It is unlikely that the composition will be substantially or adversely modified as a result of the proposed Modification. Management and mitigation measures outlined in the Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment (Parsons Brinckerhoff 2010b) and Modification 3 (Parsons Brinckerhoff 2013), if adhered to, should minimise any impacts to abiotic characteristics that affect composition.

Connectivity will remain relatively unchanged within the locality - continuing current genetic flow and dispersal mechanisms.

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

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

Approximately 1.2 ha of this EEC would be removed or modified. This is in addition to the area being removed for the mine expansion (BCEP).

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Box-gum Woodlands EEC is highly fragmented across its former extent. Patches of Box-gum woodland, such as that in the proposed Modification area, are important in maintaining linkages for both flora and fauna movement and genetic exchange across modified landscapes (Gibbons & Boak 2002).

Whilst the proposed removal of 1.2 ha will reduce the occupancy area of the EEC it is unlikely to contribute significantly to the fragmentation currently experienced by the EEC. This is because the areas to be removed are largely on the edge of larger stands of bushland.

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

The proposed Modification will remove 1.2 ha of low condition EEC and is considered unlikely to cause significant fragmentation or isolation. This habitat is not considered to be important to the long-term survival of the EEC in the locality with large areas of this community occurring in the wider region of equal or greater value.

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

The Office of Environment and Heritage maintains a register of critical habitat. The land within the subject site is not listed as a critical habitat and it is not considered to be critical to the survival of Box-gum Woodlands.

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

A recovery plan has not been prepared for the Box-gum woodland ecological community by the Office of Environment and Heritage. The Office of Environment and Heritage is developing a targeted strategy for the management of this endangered ecological community under the Saving Our Species program (SOS). In the interim the management actions outlined in Table 1.1 have been developed. The project is unlikely to significantly affect these actions.

Table 1.1 Management actions for Box-gum woodland

Management action	Likely to be impacted upon by the project
Continue the operation of the Conservation Management Networks in NSW.	No
Employ extension officers to facilitate implementation of actions.	No
Maintain database of Box-Gum Woodland under all conservation agreements and recovery actions.	No
Identify key sites for protection or acquisition.	No

Management action	Likely to be impacted upon by the project
Survey key identified remnants on public land in order to identify remnant in high condition and protect sites as demonstration areas for EEC management.	No
Negotiate protection of sites through management agreements and covenants.	No
Target Box-Gum Woodland sites for incentive and long-term stewardship schemes, especially on private land and TSRs.	No
Integrate conservation of Box-Gum Woodland with other landscape conservation programs.	No
Ensure Box-Gum Woodland is afforded high level of protection by relevant environmental management committees when developing environmental policy.	No
Prepare management plans for high priority sites.	No
Promote use of existing management kits and develop further guidelines to address management issues.	No
Identify sites where current management practices are beneficial to biodiversity and promote these as models for best practice.	No
Target priority weeds for control.	No
Install markers and signs along roads, tracks, rail & utility easements.	No
Determine optimal management regimes for management of high quality remnants (e.g. fire regimes).	No
Determine techniques for restoring degraded remnants.	No
Investigate opportunities and promote examples where agricultural practices are integrated successfully with conservation.	No
Identify methods for controlling particular introduced species identified as significantly threatening.	No
Survey and analyse distribution of groups of organisms other than vascular plants to gain understanding of geographical and ecological patterns.	No
Undertake genetic research of key components (e.g. forbs, grasses, shrubs).	No
Continue to assess social and economic benefits and costs of Box-Gum Woodland conservation.	No
Develop agreed guidelines for identification and assessment of remnant quality.	No
Produce map of predicated pre-1750 extent of Box-Gum Woodland.	No
Collate existing survey and mapping data and use towards production of integrated and updatable map.	No
Identify gaps in survey and assessment data across Box-Gum Woodland distribution and target future surveys to target these gaps.	No

Management action	Likely to be impacted upon by the project
Investigate use of remote sensing techniques to assist in future survey work.	No
Control of Coolatai grass in high-quality remnants of Box-Gum Grassy Woodland in the upper Namoi Catchment.	No
Monitor effectiveness of Coolatai grass control in high-quality remnants of Box-Gum Grassy Woodland in the upper Namoi Catchment.	No
Monitor effects of Coolatai grass invasion on high-quality remnants of Box-Gum Grassy Woodland in the upper Namoi Catchment.	No

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

The proposed Modification constitutes key threatening processes: clearing on native vegetation and loss of hollow-bearing trees. It may also encourage the invasion of native plant communities by exotic perennial grasses. The proposed Modification has been designed to avoid existing trees and stands of vegetation, existing trees will be retained, were possible.

Conclusion

The proposed Modification will result in the clearing of 1.2 ha of low condition Box-gum Woodland EEC. Whilst this small area will add incrementally to the loss of this community it is small in comparison to larger areas of this community present in the wider region. Whilst the overall occupancy area will be reduced, it is unlikely that removal of this small patch will contribute significantly to fragmentation or modify the composition so that the EEC is placed at risk of extinction. It will however, add incrementally to loss of this EEC.

1.2 EPBC Act significance assessment

The following assessment has been completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of Environment 2013) and is related to those remnants of the ecological community as defined by the EPBC Act Policy Statement - White Box-Yellow Box-Blakely's Red Gum grassy woodlands and derived native grasslands (Department of Environment and Heritage 2006) and the Commonwealth Threatened Species Scientific Committee (Department of Environment and Heritage 2004).

An action is likely to have a significant impact on a community if there is a real chance or possibility that it will result in one or more of the following:

Reduce the extent of an ecological community

The proposed Modification would result in a reduction of the extent of the Box-gum Woodlands within the Study Area. A total of 1.2 ha of the EPBC listed community would be removed. As this is a relatively small amount it is unlikely to be significant as there is larger areas of this community occurring in the wider region.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The Modification within the EPBC listed community would fragment the connection of the woodland to the adjoining Leard State Forest.

While the woodland area is relatively small, these small patches are important in maintaining linkages across modified landscapes for fauna movement and genetic exchange for both fauna and flora (Gibbons & Boak 2002). The proposed Modification would increase the distance between patches of the ecological community at a landscape scale, thereby increasing fragmentation of the ecological community. The *EPBC Act Policy Statement on White Box Yellow Box Blakely's Red Gum Woodland* (Department of the Environment and Heritage 2006b) indicates that at distances smaller than 75 m, separated vegetation can be considered as part of a single patch. The proposed Modification is estimated to be a 20 m disturbance corridor. Although the proposed impact width is relatively small, it will contribute to a small inhibition of ecological functioning; for example the movement of fauna and dispersal of flora species will be reduced to some extent by the construction of the road.

Box-gum Woodlands are heavily fragmented in the Project locality and in the wider region as a result of past land uses which include grazing and other agricultural practices. The proposed road re-alignment would add to the cumulative fragmentation of this community.

Adversely affect habitat critical to the survival of an ecological community

No critical habitat has been listed for the Box-gum Woodlands ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment and Heritage 2006c).

Habitat critical to the survival of an ecological community may, however, also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of Environment 2013).

A draft national recovery plan has been developed by Department of Environment (Department of Environment Climate Change and Water 2011). This national recovery plan is to minimise the risk of extinction to the community through the following objectives:

1. Achieve no net loss of the community or condition of the community throughout its geographic range.
2. Increase protection of sites where there is potential for high recovery.
3. Increase landscape functionality of the ecological community through management and restoration of degraded sites.
4. Increase transitional areas around remnants and linkages and between linkages.
5. Bringing about enduring changes in participating land managers attitudes and behaviours towards environmental protection and sustainable land management practices to increase the extent, integrity and function of Box gum grassy woodlands.

Whilst the project will removed a small extent of Box-gum woodland it is unlikely to have a significant impact upon this community. The project does not interfere with any of the remaining objectives of the national recover plan.

The area of woodland to be removed is not as intact as some other representative areas, nevertheless given that over 90% of the original pre-1750 extent has already been removed, and only 5% of the original extent is of sufficient condition to be considered part of the listed community (Threatened Species Scientific Committee 2006), all representations of the community are important. However, it is unlikely that the area within the proposed Modification Area is critical to the survival of the community compared to larger more intact areas.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

Given the small amount of Box-Gum Woodland to be removed (1.2 ha), it is unlikely this would have a substantial alteration to groundwater levels or surface water drainage. In addition, the soil will not be significantly impacted.

Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of to date functionally important species for example through regular burning or flora or fauna harvesting?

The species composition of the Box-gum woodland to be removed is believed to be similar to that elsewhere in the patch. It is unlikely that removing 1.2 ha of the vegetation would cause a substantial change in the species composition of the vegetation elsewhere within the patch.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**

Much of the landscape surrounding the proposed Modification Area is already weed invaded. With the implementation of appropriate weed management practices (such as those detailed in Section 6 of the main

Ecological Assessment), the proposed Modification Area will not significantly increase weed levels from that which already exist in the landscape and within the Box-gum Woodland patch. Fragmentation however, does have potential to increase weed invasion within the adjoining Leard State Forest.

Will the action interfere with the recovery of an ecological community

The removal of any occurrence of Box-gum Woodland will contribute to the continual decline of the community, and therefore will interfere with its national recovery. However given the small size to be removed this is not likely to be significant.

Conclusions

The proposed Modification would result in a reduction in the extent of Box-gum Woodlands by 1.2 ha. Although the loss of 1.2 ha is not significant in itself due to the small size, this contributes incrementally into loss of this community.

Impacts to the woodland area can be minimised through design by utilising existing tracks and avoiding woodland stands where possible. Given the poor quality and small area of Box-gum Woodland to be removed by the proposed Modification Area and in relation to higher quality of similar Box-Gum Woodland available in the locality and wider region.

2. *Digitaria porrecta*

Status

Digitaria porrecta (Finger Panic Grass) is listed as Endangered under the TSC Act 1995. The species was delisted from the EPBC Act on 14 December 2014.

Description

The species has grey leaves which are 2-3 mm wide with sharp hairs along the middle of the leaf blade. Flowers are clustered together along a stalk in a cylinder shape (Department of Environment and Climate Change 2009). Flowering occurs in summer (Jan-Feb), inflorescences are exerted with racemes stiffly spreading at maturity, the lower flowers arranged whorls of four to six (Wheeler *et al.* 2002).

Distribution, habitat and ecology

Digitaria porrecta populations occur on the North Western Slopes and Plains from near Moree south to Tambar Springs and from Tamworth to Coonabarabran in NSW (Department of Environment Water Heritage and the Arts 2008a) where it grows in native grassland, woodlands or open forest with a grassy understorey, on richer soils. It is often found along roadsides and travelling stock routes where there is light grazing and occasional fire (Office of Environment and Heritage 2011).

Most frequency recorded associated with over storey trees such as *Eucalyptus albens* and *Acacia pendula*. Common associated understorey species include *Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus tronum* and *Neptuna gracilis*.

Threats

Threats include grazing, urban expansion, clearing of native habitat for cropping and pastures, destruction and disturbance of habitat for roadside maintenance, competition from introduced grasses such as *Chloris gayana* (Rhodes Grass) and *Urochloa panicoides* (Liverseed Grass) and frequent fires (Department of Environment Water Heritage and the Arts 2008a).

Specific impacts

No *Digitaria porrecta* was located during surveys, however habitat for *Digitaria porrecta* within the proposed Modification area was identified in the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Derived native grassland

A total of 22.7 ha of potential habitat will be removed as a result of the proposed Modification.

2.1 TSC Act significance assessment

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

The lifecycle of *Digitaria porrecta* within the proposed Modification area is unlikely to be affected by the proposed Modification. While the pollination mechanisms of *Digitaria porrecta* have not been identified, like other stoloniferous or rhizomatous grasses, it is likely to be reliant on wind pollination for cross or self-pollination and asexual (vegetative) reproduction. The species small, light seeds are also likely to be dispersed by wind or by attachment to fauna. As the proposed Modification is unlikely to affect wind conditions in the area, or greatly affect the distance between individuals, it is considered unlikely to result in the loss of pollinators or disruption of seed dispersal mechanisms.

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

Not applicable.

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

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

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

Not applicable.

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

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

Digitaria porrecta is a tufted grass that occurs on rich soils of basaltic geologies within grassy woodlands and grassland communities (Department of Environment and Climate Change 2009). The proposed Modification will remove 22.7 ha of potential habitat for this species. This is in addition to the 700.4 ha of vegetation being removed by the BCEP. This is not considered a significant proportion of the habitat available within the region.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. Reproduction of *Digitaria porrecta*, like many other grasses, is likely to involve a combination of vegetative reproduction and cross or self-pollination. Pollination vectors are unknown for this species, but other species of *Digitaria porrecta* utilise wind pollination. The species is most likely to rely on a combination of wind dispersal and attachment to fauna for seed dispersal. As these processes are unlikely to be significantly affected by the proposed Modification it is considered that habitat connectivity for *Digitaria porrecta* in the wider region would not be significantly affected.

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

22.7 native grassland and grassy woodland will be removed as a result of the proposed Modification, resulting in a small incremental loss of potential *Digitaria porrecta* habitat. This habitat is not considered to be important in terms of the long-term survival of the species due to the extent of similar or greater quality habitat in the surrounding landscape.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species. The habitat within the boundaries of the proposed Modification is not considered to be critical to the survival of this species.

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

Neither a recovery nor threat abatement plan has been prepared for *Digitaria porrecta*, however, priority actions for the recovery of this species have been identified by Office of Environment and Heritage (Department of Environment Water Heritage and the Arts 2008). The proposed Modification will not interfere with any of the identified recovery actions.

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

The proposed Modification will directly involve one Key Threatening Process for this species: clearing of native vegetation. Invasion of habitat by exotic perennial grasses may also occur unless weed control measures are implemented during construction.

Conclusion

No *Digitaria porrecta* were observed during site inspections, however 22.7 ha of potential habitat was identified in the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Derived native grassland

The proposed Modification is unlikely to have an adverse effect on the lifecycle of a viable local population so that *Digitaria porrecta* is placed at risk of extinction. The proposed Modification is unlikely to affect pollination or seed dispersal mechanisms, because the areas to be removed are largely on the edge of larger stands of bushland and as such the edge effect and barrier effects will not be significantly altered from current regimes. The importance of the habitat to be removed by the proposed Modification, in terms of the long-term survival of *Digitaria porrecta* in the locality, is likely to be low. Consequently, a significant impact to *Digitaria porrecta* is considered unlikely to occur as a result of the proposed Modification.

3. Diuris tricolor

Status

Diuris tricolor (Pine Donkey Orchid) is listed as Vulnerable under the TSC Act 1995. The species was delisted from the EPBC Act 1999 on 19 August 2011.

Distribution, habitat and ecology

Diuris tricolor (formerly known as *Diuris sheaffiana*) is a terrestrial species (it grows from the ground rather than from rocks or vegetation).

Diuris tricolor grows in sclerophyll forest among grass, often with native Cypress Pine (*Callitri*s spp.). It is found in sandy soils, either on flats or small rises. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include *Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta*, Ironbark and *Acacia* Shrubland (Jones 2006). The understorey is often grassy with herbaceous plants such as Bulbine species. Flowers from September to November or generally spring (Jones 2006).

Threats

Threats for this species include habitat clearing and Modification, difficulty of detection due to short flowering period, impacts by feral animals, and competition from weed species (OEH 2012).

Specific impacts

No *Diuris tricolor* was observed during survey in May 2013, however this is outside of the flowering period, between September and November, and as such the species is unlikely to have been detected even if present.

No *Diuris tricolor* was located during surveys, however habitat for *Diuris tricolor* within the proposed Modification area was identified in the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Derived native grassland

A total of 22.7 ha of potential habitat will be removed as a result of the proposed Modification.

3.1 TSC Act significance assessment

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

Diuris tricolor (Pine Donkey Orchid) is likely to be pollinated through a process called pseudocopulation (Jones 1988). The glands on the perianth segments are a source of the sexual attractants for the pollinators, male thynnine wasps are drawn to the flowers by scent mimicking the female thynnine wasp pheromone. Once in sight of the flower, the male attempts to copulate with the labellum of the flower, mistaking it for a female wasp, and effects pollination. Habitat for these pollinators is vital for the continuation of the life cycle of this cryptic orchid. Removal of 22.7 ha of potential habitat is unlikely to have a significant impact to these processes considering the areas to be removed are largely on the edge of larger stands of bushland, reducing the in areas already impacted by edge effect and weed invasion.

The lifecycle of *Diuris tricolor* within the proposed Modification area is unlikely to be significantly impacted.

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

Not applicable.

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

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

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

Not applicable.

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

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

The proposed Modification will remove 22.7 ha of potential habitat. This is in addition to the 676.4 ha of vegetation being removed by the BCEP. As a large area of potential habitat remains in the locality, this is not considered a significant proportion of the habitat available within the region.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. As previously mentioned the proposed Modification is unlikely to affect the mechanisms by which this species cross-pollinates or disperses.

The removal of 22.7 ha of potential habitat is unlikely to further fragment the population significantly.

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

Due to the small size and relatively degraded nature of the habitat to be removed, it is not considered to be important to the long-term survival to either of the species in the locality.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species. Nor is the habitat present considered critical to the survival of the species.

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

Neither a recovery nor threat abatement plan has been prepared for *Diuris tricolor*, However, ten priority actions for the recovery of this species have been identified by Office of Environment and Heritage. The proposed Modification will not interfere with any of the identified recovery actions.

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

The proposed Modification involves the clearing of native vegetation, a known threating process for this species. As the area proposed to be removed is small (22.7 ha) and of limited quality it is not considered to significantly contribute to this key threatening process. It will however add incrementally to the process.

Conclusion

Approximately 22.7 ha of potential habitat will be removed by the proposed Modification. This includes the following vegetation communities identified within the proposed Modification area:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Derived native grassland

It is unlikely that removal of this small amount of habitat would have a significant impact upon the species, however it contributes to the cumulative removal of known habitat for the BCEP proposed Modification.

4. *Prasophyllum sp Wybong*

Status

Prasophyllum sp. Wyobong (C. Phelps ORG 5269) is listed as a Critically Endangered species under the EPBC Act.

Distribution, habitat and ecology

Prasophyllum sp. Wybong is a terrestrial orchid species that grows to approximately 30cm high. The species has a dull green basal leaf that is tubular and fleshy. The single flower spike has numerous fragrant flowers.

The species is endemic to NSW and is known to occur near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Most populations are small, although the Wybong population contains by far the largest number of individuals.

The orchid is perennial appearing as a single leaf over winter and spring. The species flowers in spring and dies back to a tuber over the summer and autumn. The known habitat of the species is open eucalypt woodland and grassland (Office of Environment and Heritage 2014).

Threats

Threats for this species include habitat clearing including mining, weed invasion (especially exotic grasses), vehicle traffic, roadside maintenance, inappropriate disturbance regimes, chemical drift from agriculture, illegal collection and chance extinction of small populations due to the few number of individuals in most populations (Office of Environment and Heritage 2014).

Specific impacts

No *Prasophyllum sp. Wybong* was during the field survey, however habitat for the species within the proposed Modification area was identified in the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Derived native grassland

A total of 22.7 ha of potential habitat will be removed as a result of the proposed Modification.

4.1 EPBC Act significance assessment

Prasophyllum sp. Wybong is listed as a Critically Endangered species under the EPBC Act 1999. The following assessment has been undertaken following the Principal Significant Impact Guidelines 1.1 (Department of Environment 2013).

Will the action lead to a long-term decrease in the size of a population?

No *Prasophyllum sp Wybong* was recorded within the proposed Modification area. However, if present the proposed Modification would lead to a decrease in the size of a local population. Given the higher quality habitat within the broader the locality the removal habitat is considered unlikely to lead to a long term decrease.

Will the action reduce the area of occupancy of the species?

If present the proposed Modification would reduce the area of occupancy for a local population of *Prasophyllum sp. Wybong*.

Will the action fragment an existing important population into two or more populations?

No *Prasophyllum sp Wybong* was recorded within the proposed Modification area. Therefore, the proposed Modification is not likely to fragment an existing important population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the *Prasophyllum sp. Wybong* under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of Environment, 2013)

The habitat that would be affected as a result of the proposed Modification does not represent habitat critical to the survival of *Prasophyllum sp. Wybong*.

Will the action disrupt the breeding cycle of a population?

If present, the population of *Prasophyllum sp. Wybong* within the boundaries of the proposed Modification the fertilisation and dispersal mechanisms are unlikely to be affected by the proposed Modification therefore the breeding cycle is unlikely to be disrupted.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposed Modification will reduce the availability of habitat by 22.7 ha. Given the condition of habitat present, availability of higher quality habitat in the broader locality and the extent likely to be impacted (22.7 ha) the proposed Modification is not considered likely to cause the species to decline.

Will the action result in invasive species that are harmful to a critically endangered species becoming established in the critically endangered species´ habitat?

The proposed Modification area is already subject to high weed invasion as a result of agricultural activities. Doe to the high number of weeds existing in the study area and if the appropriate weed management actions were implemented the establishment of additional weeds would mean it would be unlikely that a significant invasive species would be introduced by the proposed Modification.

Will the action introduce disease that may cause the species to decline?

No, there are no known diseases associated with *Prasophyllum sp. Wybong*.

Will the action interfere substantially with the recovery of the species?

No *Prasophyllum* sp. *Wybong* were recorded within the proposed Modification area, however suitable habitat for the species does occur. The condition of habitat present is highly degraded as a result of agricultural activities. Due to the condition of habitat to be affected, greater quality habitat within the broader locality the removal of 22.7 ha of habitat is unlikely to substantially interfere with the recovery of the species.

Conclusion

Based on the above assessment, the reduction of potential *Prasophyllum sp. Wybong* habitat by 22.7 ha is unlikely to significantly impact upon the species.

5. *Tylophora linearis*

Status

Tylophora linearis is listed as Endangered under the EPBC Act 1999 and Vulnerable under the TSC Act 1995.

Description

The species is an herbaceous climber in the Apocynaceae family. This species has cylindrical stems which have clear latex. The leaves are dark green in colour, linear in shape and grow to approximately 100 mm in length and 4 mm in width. Flowers are purplish internally with olive green petals, these flowers cluster in radiating groups of 3 to 8 (Office of Environment and Heritage 2013). Fruits form follicles 95-100 mm in length and 5 mm in width. This species flowers in Spring with flowers being recorded in early winter around May and as late as November. Fruiting occurs approximately two to three months later (Department of Environment Water Heritage and the Arts 2008b).

Distribution, habitat and ecology

Tylophora linearis populations occurs in ten known populations from Southern Queensland into Central NSW and as far south as Temora. This species is known to occur in several state forests including Goonoo, Pillaga West, Pillaga East, Bibblewindi, Cumbil, Hiawatha and Eura State Forests. This species has also been recorded in Coolbaggie Nature Reserve, Goobang National Park and Beni State Conservation Area. Old records for the species are as far north as Crow Mountain near Barraba and near Glenmorgan in the western Darling Downs (Office of Environment and Heritage 2013).

This species has been recorded associated with dry scrub, open forest and woodlands. Most frequency recorded associated with over storey trees such as *Melaleuca uncinata, Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, Acacia lineata* and *Myoporum* sp. This species has been recorded in EPBC Act listed communities of Brigalow (*Acacia harpophylla* dominant and co-dominant) and White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (Department of Environment Water Heritage and the Arts 2008b). The population within the vicinity of the proposed Modification area at Piliga West State Forest occurred within woodland dominated *by Eucalyptus pilligaensis* and *Callitris glaucophylla* with an understorey of *Acacia hakeoides* (NSW Scientific Committee 2008).

Threats

The main identified threats include forestry activities, and fire. Track maintenance and inappropriate disturbance regimes and Invasion of habitat from introduced weeds such as Lantana (*Lantana camara*) have also been identified as a threat to *Tylophora linearis* (Department of Environment Water Heritage and the Arts 2008b).

Specific impacts

Twenty Two stems of *Tylophora linearis* do occur within the previous area for clearing under Project Approval 09_0182, however 22.7 ha of potential habitat for *Tylophora linearis* occurs within the proposed modification area and is being cleared and therefore has been assessed as part of this impact assessment.

Potential habitat has been recorded within the proposed Modification area in the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland

- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Derived native grassland

A total of 22.7 ha of potential habitat will be removed as a result of the proposed Modification.

5.1 TSC Act significance assessment

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

The lifecycle of *Tylophora linearis* within the proposed Modification area is unlikely to be affected by the proposed Modification. While the pollination mechanisms of *Tylophora linearis* have not been identified, like other species of the *Tylophora* genus, it is likely to be insect pollinated. The woodland and grassland communities within the Modification provide habitat for the pollinators of *Tylophora linearis*. The species has plumed seeds which are dispersed by wind (Benson & McDougall 1993). The proposed Modification is unlikely to affect wind conditions in the area, and removal of 22.7 ha of potential habitat for *Tylophora linearis* is unlikely to have a significant impact upon the lifecycle processes.

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

Not applicable.

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

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

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

Not applicable.

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

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

The proposed Modification will remove 22.7 ha of potential habitat for this species. This is in addition to the vegetation being removed by the BCEP. As a large area of potential habitat remains in the locality and a relatively large population remains within the locality, this is not considered a significant proportion of the habitat available within the region.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. As previously mentioned the proposed Modification is unlikely to affect the mechanisms by which this species cross-pollinates or disperses.

The removal of 22.7 ha of potential habitat within the proposed modification area is unlikely to further fragment the population significantly.

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

Due to the small number of individuals to be removed and the size and relatively degraded nature of the habitat to be removed, it is not considered to be important to the long-term survival to either of the species in the locality.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species. The habitat within the boundaries of the proposed Modification is not considered to be critical to the survival of this species.

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

Neither a recovery nor threat abatement plan has been prepared for *Tylophora linearis*, However, 12 priority actions for the recovery of this species have been identified by Office of Environment and Heritage (Office of Environment and Heritage 2013). The proposed Modification will not interfere with any of the identified recovery actions.

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

The proposed Modification will directly involve one Key Threatening Process for this species: clearing of native vegetation. Invasion of habitat by exotic perennial grasses may also occur unless weed control measures are implemented during construction.

Conclusion

Twenty two stems of *Tylophora linearis* have previously been recorded within the previously approved project boundary, with 42.8 ha of potential habitat was identified in the modification area, however of this 22.7 ha of potential habitat will be removed as part of the modification. Habitat for this species occurs in the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Derived native grassland

The proposed Modification is unlikely to have an adverse effect on the lifecycle of a viable local population so that *Tylophora linearis* is placed at risk of extinction. The proposed Modification is unlikely to affect pollination or seed dispersal mechanisms, because the areas to be removed are largely on the edge of larger stands of bushland and as such the edge effect and barrier effects will not be significantly altered from current regimes. The importance of the habitat to be removed by the proposed Modification, in terms of the long-term survival of *Tylophora linearis* in the locality, is likely to be low. Consequently, a significant impact to *Tylophora linearis* is considered unlikely to occur as a result of the proposed Modification.

5.2 EPBC Act significance assessment

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will result in one or more of the following.

Will the action lead to a long-term decrease in the size of a population?

Twenty two *Tylophora linearis* stems have previously been observed within previously approved project boundary. The proposed modification will not result in the removal of any known individuals. However, over the long-term it is unlikely to lead to the extinction of this species as a result of the proposed Modification because of the minimal disturbance (22.7 ha) and the extent of similar or greater quality habitat in the surrounding landscape.

Will the action reduce the area of occupancy the species?

Approximately 22.7 ha of potential habitat with the proposed modification area for *Tylophora linearis* would be affected by the proposed Modification. As the vegetation to be cleared (within the proposed modification area) are relatively small in terms of the extent of similar or greater quality habitat available in the surrounding landscape, the proposed Modification will not significantly reduce the area of occupancy for the species.

Will the action fragment an existing population into two or more populations?

No *Tylophora linearis* individuals were identified within the proposed modification area. The proposed Modification would not fragment an existing population into two or more populations. Existing potential habitat is fragmented as a consequence of existing land use practices, therefore the proposed Modification is not expected to increase fragmentation or isolation.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

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

Potential habitat within the proposed modification area are likely to be affected as a result of the proposed Modification is unlikely to be important for the long-term survival of *Tylophora linearis*, important for genetic diversity, or important for re-introductions as this patch of habitat is small and generally low condition.

Will the action disrupt the breeding cycle of a population?

Pollination vectors are unknown for this species, but other species of *Tylophora* are known to be pollinated by insects (Benson & McDougall 1993). *Tylophora linearis* produces plumed seeds and most likely relies on wind for seed dispersal. As these processes is unlikely to be significantly affected by the proposed Modification it is conceded that the breeding cycle for *Tylophora linearis* population are unlikely to be significantly affected.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposed Modification will impact 22.7 ha of habitat within the proposed modification area via the direct removal of suitable habitat. However, this does not constitute a significant proportion of the habitat available within the region, and as such is unlikely to result in a decline in the species.

Will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?

The area of potential habitat which surrounds the proposed Modification is already disturbed from past land use practices and exotic species invasion; weeds occur commonly throughout all vegetative communities in the proposed Modification area. The proposed Modification is unlikely to significantly increase the spread of existing invasive species or contribute to the introduction of new species that are harmful to *Tylophora linearis*. If appropriate weed control management plans are implemented, impacts to potential habitat or any populations that are potentially present can be minimised.

Will the action introduce disease that may cause the species to decline?

There are no diseases known to affect this species and the proposed Modification is unlikely to introduce plant pathogens to the area.

Will the action interfere with the recovery of the species?

A recovery plan has not been prepared for the species, however, management actions as part of the saving our species program have been identified by Office of Environment and Heritage (2013). The proposed Modification will not interfere significantly with any of the identified management actions.

Conclusion

The proposed Modification will require the removal of 22.7 ha of potential habitat identified in the following vegetation communities present within the proposed Modification area:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

Based on the relatively small area of habitat to be removed within the proposed modification area, is unlikely to be significantly affected by the proposed Modification. Overall, the potential impact from the proposed Modification on the species is not considered significant.

6. Threatened woodland birds

Threatened woodland birds have been assessed together as they generally share similar habitat requirements, threats that affect their recovery and potential impacts. Woodland species of bird considered in this significance assessment include:

- Brown Treecreeper (*Climacteris picumnus victoriae*).
- Hooded Robin (*Melanodryas cucullata cucullata*).
- Black-chinned Honeyeater (*Melithreptus gularis gularis*).
- Painted Honeyeater (*Grantiella picta*).
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*).
- Speckled Warbler (*Pyrrholaemus sagittatus*).
- Diamond Firetail (*Stagonopleura guttata*).
- Varied Sittella (*Daphoenositta chrysoptera*).

Status

All eight species are part of a group of woodland birds considered to be declining within Australia (Reid 1999; Trail & Duncan 2000) and all are listed as Vulnerable under the TSC Act.

Threats

Threats that affect these species include clearing of woodland resulting in loss and fragmentation of habitat; Modification and destruction of ground habitat through heavy grazing and compaction by stock; removal of litter and fallen timber; introduction of exotic pasture grasses; and frequent fire (Department of Environment and Conservation 2006c; Reid 1999; Trail & Duncan 2000).

Specific impacts

No threatened woodland birds were observed during the site inspections; however 21.9 ha of potential habitat will be removed as a result of the Modification. This is made up of all the Woodland habitats in the proposed Modification area, including:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

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

Brown Treecreepers occur in eucalypt woodland and adjoining vegetation. Sometimes this species is recorded in semi-cleared pasture; in grasslands scattered with trees in cleared paddocks outside woodlands or in shelterbelts fringing cleared lands (Higgins & Peter 2002). It is sedentary and nests in tree hollows (Garnett & Crowley 2000) breeding in pairs or communally in small groups within territories ranging in size up to 11 ha. The nest is a collection of grasses, feathers and other soft material, placed in a suitable tree hollow or similar site (Higgins *et al.* 2001). Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (Pizzey & Knight 2007).

Hooded Robin - south-eastern form (*Melanodryas cucullata cucullate*)

Hooded Robins occur in lightly wooded country, usually open eucalypt woodland, mallee and acacia shrublands. Movements are not well known, however, they are thought to be resident or sedentary, but may undertake some local movements (Department of Environment and Conservation 2006c), possibly in response to drought and food availability (Pizzey & Knight 1997). Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than one to five metres above the ground (Higgins & Peter 2002).

Black-chinned Honeyeater - eastern subspecies (*Melithreptus gularis gularis*)

This species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. It also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees (Department of Environment and Conservation 2006c). It is a gregarious species usually seen in pairs and small groups of up to 12 birds (Higgins & Davies 1996). Feeding territories are large, making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least five ha. Nectar is taken from flowers, and honeydew is gleaned from foliage (Higgins & Davies 1996).

Painted Honeyeater (*Grantiella picta*)

Painted Honeyeaters occur in dry forests and woodlands. The primary food is mistletoes in the genus Amyema, although they will take some nectar and insects (Department of Environment and Conservation 2006c). The breeding distribution is dictated by the presence of mistletoes, which are largely restricted to older trees. The species is less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).

Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)

The Grey-crowned Babbler is found mainly in rural districts where it predominantly lives in roadsides and private land (Schulz 1991). Suitable habitats are usually abundant with leaf litter and debris; often dominated by eucalypts including box and ironbark species, partly-cleared woodland, acacia shrubland and adjoining farmland (Higgins 1999). Grey-crowned Babblers is unlikely to occur in regrowth forest, large patches of forest or woodland and forest with dense understorey or grassland with few trees (Schulz 1991).

An understorey of young trees and shrubs, in the 10 to 25 cm diameter at breast height range, is used for nest sites and shelter, and a relatively sparse ground layer with more litter and less ground cover is preferred by the species (Adam & Robinson 1996). Within that broad habitat category, they prefer sites with large trees, a scattered understorey of small trees or shrubs and a sparse ground layer of litter and short grass (Davidson & Robinson 1992). At the local scale, the species is common in edge habitats where there is access to both tree-cover and open ground. Historically this edge habitat would be found near larger trees in mature woodland habitat, but is now largely restricted to roadside vegetation and the edges of remnant patches (Robinson *et al.* 2001). The Grey-crowned Babbler is a prolific nest builder, building nests throughout the year for both breeding and roosting (Counsilman 1979), and defend a territory of approximately 10 ha, however territories up to 50 ha have been recorded.

Speckled Warbler (*Pyrrholaemus sagittatus*)

Speckled Warblers prefers eucalypt dominated vegetation that has a grassy understorey, often on rocky ridges or in gullies (NSW Scientific Committee 2001). The bird is a sedentary species that breeds in pairs and trios, and feeds on seeds and insects on the ground and in understorey vegetation and builds domed nests on the ground in grass tussocks, dense leaf litter and fallen branches (Reid 1999). Speckled Warblers occur at low densities (0.19-0.54 per ha) and have relatively large home ranges of 6-12 ha for pairs or trios of birds (Higgins & Peter 2002).

Diamond Firetail (*Stagonopleura guttata*)

Diamond Firetails are found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Woodlands. They occur also in open forest, mallee, native grasslands, and in secondary grasslands derived from other communities (Trail & Duncan 2000). They feed exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). They are usually encountered in flocks of between five and 40 birds, with groups separating into small colonies to breed, between August and January (Department of Environment and Conservation 2006c). Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. The species appears to be sedentary, although some populations move locally (Higgins & Peter 2002).

Varied Sittella (*Daphoenositta chrysoptera*)

The Varied Sittella is sedentary and inhabits most of mainland Australia, with a nearly continuous distribution in NSW from the coast to the far west (Higgins & Peter 2002). It inhabits open eucalypt forests and woodlands (particularly rough-barked species), mallee, inland acacia woodland and coastal tea-tree scrubs (Pizzey & Knight 2007).

Varied Sittella are highly social, with groups foraging together, whereby they fly into the heads of trees and generally make their way down limbs and the trunk of the tree. They feed on arthropods, which are gleaned from dead branches, small branches in the canopy and crevices from rough or decorticating bark (NSW Scientific Committee 2009c). This species typically breeds in groups of five to seven individuals during spring and summer, with nests well camouflaged and situated in a fork, high in the living tree canopy. The same fork or tree is often used in successive years. During winter this species forms larger companies.

The threats that affect Varied Sittella include the continued decline in habitat cover and quality (Watson *et al.* 2005). Furthermore, cleared agricultural landscapes potentially act as a barrier to movement and dispersal due the sedentary nature of this species. Thus, survival and population viability is considered sensitive to processes such as reduction in patch size and isolation and simplification of habitat including the removal of canopy cover, logs, fallen branches and litter. Therefore, three Key Threatening Processes listed under the TSC Act affect this species; clearing of native vegetation, loss of hollow-bearing trees and the removal of dead wood and dead trees.

6.1 TSC Act significance assessment

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

No threatened woodland species of bird were recorded during recent field surveys. Previous field studies associated with Boggabri Coal have recorded all of these species in the locality. It is therefore assumed that approximately 21.9 ha of potential habitat would be affected by the proposed Modification. This habitat provides potential foraging, roosting and breeding resources for the species. This area is a small portion of the available habitats in the area.

Any species located in the proposed Modification area would be considered a small patch of a larger meta-population therefore it is unlikely that the local population would be placed at risk of extinction by the proposed Modification.

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

Not applicable

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

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

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

Not applicable

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

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

It is estimated that approximately 21.9 ha of potential threatened woodland bird habitat would be affected by the proposed Modification. However, this habitat is not considered to be core and similar habitat of equal or greater quality exists in the adjacent landscapes.

Specific habitat features likely to be affected include down timber (used for foraging) and mature trees with mistletoe that is used by Painted Honeyeater which is a specialist forager.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Available threatened woodland bird habitat in the locality is considered to be already fragmented, with the exception of Leard State Forest which occurs as a continuous patch of woodland vegetation. It is unlikely that the proposed Modification would contribute significantly to the fragmented state of woodland bird habitat however it would add incrementally to the impacts associated with the BCEP Project.

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

Due to the small size of the sites, any species within the Modification is as are considered a small proportion of a larger meta-population and are therefore not considered to be important to the long-term survival of the assessed species in the locality.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species. Habitat occurring adjacent to the proposed Modification area in the remaining Leard State Forest, is considered to represent 'core habitat', particularly for sedentary species including Brown Treecreeper, Hooded Robin, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella.

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

No recovery or threat abatement plans have been prepared for the threatened woodland bird species being assessed. The Office of Environment and Heritage has identified a number of priority actions for the recovery of each of these species, except the Varied Sittella. The proposed Modification will not interfere significantly with any of these priority actions.

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

With respect to threatened woodland bird species, the proposed Modification contributes to one key threatening process – clearing of native vegetation. As the proposed Modification will only make a minor contribution to this threatening process it is considered unlikely to significantly affect species.

Conclusion

No threatened woodland bird species were located during the surveys. In previous studies conducted for Boggabri Coal eight threated woodland species were recorded in the locality, including Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella.

It is estimated that 21.9 ha of potential habitat would be affected by the proposed Modification. This is made up of the following vegetation communities within the proposed Modification area:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

Similar habitats of equal or greater quality will remain within and surrounding the boundaries of the proposed Modification. Populations, if present, are considered to be small patches of a larger metapopulation. The proposed Modification is unlikely to increase fragmentation. Based on the above assessment, woodland birds are unlikely to be significantly impacted by the proposed Modification, however the impacts add incrementally to those associated with the BCEP Project.

7. Spotted Harrier (*Circus assimilis*)

Status

The Spotted Harrier is listed as a Vulnerable species under the TSC Act.

Distribution, habitat and ecology

The Spotted Harrier is widespread throughout most of the Australian mainland. Individuals disperse widely, with this species being nomadic and irruptive in response to local conditions (food abundance). The Spotted Harrier occupies grassy open woodland, inland riparian woodland and grasslands, but is most commonly associated with native grassland and agricultural environments (NSW Scientific Committee – preliminary determination). This species builds a stick nest in open or remnant woodland and generally breeds from August to December or February to April (Pizzey & Knight 2007). The diet of the Spotted Harrier generally consists of terrestrial mammals (rodents), birds (quail) and reptiles (NSW Scientific Committee 2009b).

Threats

The main threat that affects this species is the clearing and degradation of foraging and breeding habitat, particularly where it affects prey densities. Other threats include the possibility of secondary poisoning from rodenticides and pindone used to control rabbits (NSW Scientific Committee 2009b).

Specific impacts

This species was recorded in agricultural land associated with BCEP during field studies and is frequently observed within and around the proposed Modification area. The proposed Modification would remove 65.4 ha of potential habitat for this species, including all the vegetation communities present in the proposed Modification area.

7.1 TSC Act significance assessment

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

The Spotted Harrier was recorded in agricultural land associated with BCEP during field studies in 2010.

Approximately 0.8 ha of potential foraging habitat would be affected by the proposed Modificationthis area is considered to be potential foraging habitat.

This species is more commonly associated with native grasslands and agricultural landscapes, where they hunt low over the ground searching for prey. While the proposed Modification would affect 0.8 ha of potential foraging habitat, similar habitat would remain in the area. This area is considered known foraging habitat due to sightings during previous field surveys.

While the proposed Modification would remove foraging habitat, it is not likely that the lifecycle of this species would be affected. Potential nesting and nesting habitats would remain in the locality post-development. The mobility of the species would not restrict breeding mechanisms and allow dispersal to similar, higher quality habitat in the locality.

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

Not applicable.

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

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

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

Not applicable.

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

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

Approximately 0.8 ha of known foraging habitat (grassland and agricultural crops, similar to where this species was recorded during previous studies) would be affected by the proposed Modification. This area is not considered to represent core habitat for this species, although it is recognised that it may provide potential nesting and foraging opportunities. Similar habitats would remain in the locality post-development.

The associated BCEP could potentially create new habitat for this species at the completion of mining activities when the subject site (particularly the open cut pit) is likely to be rehabilitated.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Spotted Harrier is widespread throughout most of the Australian mainland, except in densely forest or wooded habitats of the coast. While this species is widespread, individuals are sparsely distributed, with this species being nomadic and irruptive in response to local conditions. The ability for the Spotted Harrier to access adjacent habitat would remain. As such, it is unlikely that the proposed Modification will fragment or isolate the Spotted Harrier habitat to individuals or a local population's detriment. However, it would reduce the overall extent of known habitat to a small degree and further exacerbate key threatening processes for these species.

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

This area is not considered to represent core habitat for this species, although it is recognised that it may provide potential nesting and foraging opportunities. Extensive areas of similar habitats would remain in the locality post-development.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species.

The areas proposed for the works are not considered to be critical to the survival of this species due to their small size.

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

Neither a recovery nor threat abatement plan has been prepared for the Spotted Harrier. No recovery actions have been identified by the Office of Environment and Heritage.

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

The proposed Modification would involve a small amount of clearing of native vegetation, which is a known threatening process for this species. Whilst extensive areas of similar habitats would remain in the locality post-development, the proposed Modification would contribute to the threatening process.

Conclusion

This species was not observed during field survey for the proposed Modification, however, the Spotted Harrier was recorded foraging over grassland and agricultural crops during surveys for the BCEP Project and is frequently observed within the grasslands within and directly adjoining the proposed Modification area. 0.8 ha of potential foraging habitat would be affected by the proposed Modification. The area affected is not considered to represent core habitat for this species.

As this species is likely to exist in similar agricultural environments and remnant vegetation in the locality, it is not likely that this species would be significantly affected by the proposed Modification.

8. Little Lorikeet (*Glossopsitta pusilla*)

Status

The Little Lorikeet is listed as a Vulnerable species under the TSC Act 1995.

Distribution and habitat

The Little Lorikeet inhabits forests and woodlands, with most associations occurring in dry, open eucalypt forest and woodlands (Office of Environment and Heritage 2011b).

Threats

Key threats to this species include:

- Extensive clearing of woodlands for agriculture. Small scale clearing, such as during road works and fence construction, continues to destroy habitat and it will be decades before revegetated areas supply adequate forage sites.
- The loss of old hollow bearing trees has reduced nest sites, and increased competition with other native and exotic species that need large hollows with small entrances to avoid predation. Felling of hollow trees for firewood collection or other human demands increases this competition.
- Competition with the introduced Honeybee for both nectar and hollows exacerbates these resource limitations.

Specific impacts

No little lorikeet specimens were recorded during the survey. The species is considered to have a moderate likelihood of occurring in the areas of the proposed Modification. The proposed Modification will remove 21.9 ha of potential habitat for this species including all the Box Gum woodlands. Vegetation communities within the proposed Modification area which are considered potential habitat for this species are;

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

No little lorikeet was located during surveys, however habitat for little lorikeet was identified within the woodlands within the proposed Modification area.

A total of 21.9 ha of potential habitat will be removed as a result of the proposed Modification.

8.1 TSC Act significance assessment

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

The Little Lorikeet is dependent on flowering resources across a wide range of habitats (woodlands and forests). Breeding and nesting occurs from May – September close to feed areas and typically in riparian areas (OEH 2012).

As the impact area is 21.9 ha it is unlikely that the lifecycle of this opportunistic species would be significantly affected, considering that there is larger areas of foraging and breeding habitat for this species within the wider region.

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

Not applicable

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

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

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

Not applicable

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

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

It is estimated that 21.9 ha of potential foraging habitat for the assessed species will be affected by the proposed Modification. Given the mobility of this species, it is not considered to be significant in terms of the available (potential) habitat in the wider locality.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

As the Little Lorikeet is dependent on flowering resources across a wide range of already fragmented habitat, it is unlikely that the removal of 21.9 ha of native vegetation will significantly affect these species. The likelihood of isolation is also low due to their mobility.

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

This area is not considered to represent core habitat for this species, although it is recognised that it may provide potential nesting and foraging opportunities. Similar habitats would remain in the locality post-development.

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

Critical habitats are areas of land crucial to the survival of particular threatened species, population or ecological community. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species.

Due its high mobility, the Little Lorikeet is capable of accessing off-site habitat resources. Therefore the habitat that is present is not considered to be critical to the survival of the species.

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

There are no recovery threat abatement plans or priority actions prepared for the Little Lorikeet.

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

With respect to the Little Lorikeet, the proposed Modification contributes to one key threatening process – clearing of native vegetation. As the proposed Modification will only make a minor contribution to this threatening process it is considered unlikely to significantly affect species.

Conclusion

Within the survey area potential foraging resources were located in the following vegetation communities within the proposed Modification area:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

21.9 ha of potential habitat for the little lorikeet would be affected by the proposed Modification. However, given the species high mobility and ability to access remnant woodland in the locality and region, it is not likely that this species would be significantly affected by the proposed Modification. Although it would further exacerbate key threatening processes that affect this species.

9. Swift Parrot (*Lathamus discolour*)

Status

The Swift Parrot is listed as Endangered under the TSC Act 1995 and the EPBC Act 1999.

Distribution and habitat

Breeding occurs in Tasmania, migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW.

In mainland Australia the species is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering *Acacia pycnantha*, is indicated. Sites used vary from year to year (Garnett & Crowley 2000),(Swift Parrot Recovery Team 2001).

Threats

Key threats to this species include:

- On the mainland the main threat is loss of habitat through clearing for agriculture, and urban and industrial development.
- Collisions with wire netting fences, windows and cars, during the breeding season and winter migration (especially where such obstacles are in close proximity to suitable habitat).

Specific impacts

No Swift Parrot specimens were recorded during field surveys in May 2013. The species is considered to have a moderate likelihood of occurring in the areas of the proposed Modification. The proposed Modification will remove 21.9 ha of potential woodland habitat for this species including the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

9.1 TSC Act significance assessment

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

The Swift Parrot is an opportunistic blossom nomad dependent on flowering resources across a wide range of habitats (woodlands and forests). The removal of 21.9 ha of habitat containing suitable foraging trees for these species is highly unlikely to disrupt their lifecycle. However, given the species high mobility and ability to access remnant woodland in the locality and region, it is not likely that this species would be significantly affected by the proposed Modification.

Breeding events for the Swift Parrot occur during summer in Tasmania so no critical breeding habitat will be affected by the proposed Modification. It is therefore considered that the proposed Modification is not likely to affect the lifecycle of this species.

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

Not applicable

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

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

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

Not applicable

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

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

It is assumed that approximately 21.9 ha of potential foraging habitat for the assessed species will be affected by the proposed Modification. Given the mobility of this species, it is not considered to be significant in terms of the available (potential) habitat in the wider locality.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

As the Swift Parrot is dependent on flowering resources across a wide range of already fragmented habitat, it is unlikely that the removal of 21.9 ha of native vegetation will significantly affect these species. The likelihood of isolation is also low due to their mobility.

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

This area is not considered to represent core habitat for this species, although it is recognised that it may provide potential nesting and foraging opportunities. Similar habitats would remain in the locality post-development.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, population or ecological community. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species.

As previously mentioned, due its high mobility, these species are capable of accessing off site habitat resources. Moreover, Swift Parrots breed in spring/ summer in Tasmania and as such, no breeding habitat would be affected by the proposed Modification. It is therefore considered that the proposed Modification will not have an adverse effect on critical habitat.

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

There is neither a recovery nor threat abatement plan for the Swift Parrot. The Office of Environment and Heritage has however identified 14 priority actions owing to the small extent of potential habitat to be removed (21.9 ha), the proposed Modification is not considered inconsistent with any identified priority action statements or recovery measures.

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

With respect to the Swift Parrot the proposed Modification contributes to one key threatening process – clearing of native vegetation. As the proposed Modification will only make a minor contribution to this threatening process it is considered unlikely to significantly affect this species.

Conclusion

Potential foraging resources were located in the proposed Modification area within the following vegetation communities:

- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Pilliga Box – Poplar Box White cypress pine grassy open forest.

It is estimated that 21.9 ha of potential winter foraging habitat for the Swift Parrot would be affected by the proposed Modification. However, given the species high mobility and ability to access adjacent remnant habitat in the locality and region, it is not likely that this species would be significantly affected by the proposed Modification. However, it would further exacerbate key threatening processes that affect this species.

9.2 EPBC Act significance assessment

The Swift Parrot is listed as Endangered under the EPBC Act.

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will result in one or more of the following.

Lead to a long-term decrease in the size of a population

Potential foraging habitat for this species exists in the proposed Modification area, however the extent proposed to be removed represents a very small proportion of available habitat in the locality. As Swift Parrots breed in Tasmania and given the high mobility of this species, no breeding resources would be affected by the proposed Modification. Therefore, it is considered unlikely that the proposed Modification would lead to a long-term decrease in this species.

Reduce the area of occupancy of the species

The proposed Modification will remove 21.9 ha of foraging habitat for this species. This area is relatively small in terms of the extent of similar or greater quality habitat available in the proposed Modification area and surrounding landscape.

Fragment an existing population into two or more populations

Owing to the mobility of this species, the proposed Modification is unlikely to fragment any populations potentially present.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of Environment, 2013).

The proposed Modification would remove 21.9 ha of suitable winter foraging habitat. As this species is highly mobile, it is likely that the abundance of higher quality foraging resources in the locality would be used by locally occurring Swift Parrots. As such the habitat within the proposed Modification area is not considered to be critical to the survival of the species.

Disrupt the breeding cycle of a population

Swift Parrots breed in Tasmania during spring and summer, migrating to south-eastern Australia during autumn and winter (Department of Environment and Conservation 2006c). While Swift Parrots are dependent on flowering resources across a wide range of habitats (woodlands and forests) within their NSW wintering grounds, the removal of 21.9 ha of suitable habitat is not likely to disrupt their migratory patterns. As such, the proposed Modification is not likely to affect their breeding cycle.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed Modification will remove 21.9 ha of potential foraging habitat for this species. This area of potential habitat is relatively small in terms of the extent of similar or greater quality habitat within the surrounding landscape. As such, it is unlikely that the proposed Modification would cause the Swift Parrot to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Swift Parrot would become further established as a result of the proposed Modification.

Introduce disease that may cause the species to decline, or

It is not likely that disease would be increased by the proposed Modification.

Interfere with the recovery of the species.

The Action Plan for Australian Birds (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Swift Parrot Recovery Plan (Swift Parrot Recovery Team 2001) include:

- identify priority habitats and sites across the range of the Swift Parrot
- implement management strategies to protect and improve priority habitats and sites resulting in a sustained improvement in carrying capacity
- reduce the incidence of collisions with man-made structures
- determine population trends within the breeding range
- quantify improvements in carrying capacity by monitoring changes in extent and quality of habitat
- increase public awareness about the recovery program and to involve the community in the recovery.

Owing to the small extent of potential habitat to be removed and its location outside of listed priority habitats, it is considered that the proposed Modification will not interfere substantially with the recovery of the Swift Parrot.

Conclusion

Potential habitat for the Swift Parrot was present within the proposed Modification area within the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

This species is considered to have a moderate-high likelihood of occurrence within the proposed Modification area. The proposed Modification would remove 21.9 ha of potential habitat for the Swift Parrot, which represents a small proportion of available habitat in the locality. Owing to the mobility of the species and small extent of potential habitat to be removed, the proposed Modification is unlikely to significantly impact upon this species or interfere with its recovery.

10. Regent Honeyeater (*Xanthomyza phrygia*)

Status

The Regent Honeyeater is listed as Endangered and Migratory under the EPBC Act 1999 and Critically Endangered under the TSC Act 1995. Under the Environment Protection and Biodiversity Conservation Act 1999 important habitat for migratory species includes areas where the species is declining. Given that this species is endangered, it can be considered to be declining within the proposed Modification area and the wider locality. This species is therefore assessed using the threatened species criteria of the Principal Significance Guidelines 1.1 (Department of the Environment and Heritage 2006a).

Distribution, habitat and ecology

Regent Honeyeaters inhabit dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak (Department of Environment and Conservation 2006c). The woodlands they inhabit support a significantly high abundance and species richness of bird. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes (Higgins *et al.* 2001).

The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Nectar and fruit from the mistletoes *Amyema miquelii, A. pendula* and *A. cambagei* are also eaten during the breeding season (Oliver 2000). When nectar is scarce, lerp and honeydew comprise a large proportion of the diet. Insects make up about 15 % of the total diet and are important components of the diet of nestlings (Higgins *et al.* 2001). A shrubby understorey is an important source of insects and nesting material (Oliver *et al.* 1998).

Colour-banding of Regent Honeyeater has shown that the species can undertake large-scale nomadic movements in the order of hundreds of kilometres (Higgins *et al.* 2001). However, the exact nature of these movements is still poorly understood. It is likely that movements are dependent on spatial and temporal flowering and other resource patterns. To successfully manage the recovery of this species a full understanding of the habitats used in the non-breeding season is critical (Department of Environment and Conservation 2006c).

There are three known key breeding areas, two of them in NSW — Capertee Valley and Bundarra-Barraba regions (Geering & French 1998). The species breeds from May to March, but with peak breeding activity from September to November (NSW Department of Environment and Climate Change 2009b) in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River She-oak. Regent Honeyeaters usually nest in horizontal branches or forks in tall, mature eucalypts and She-oaks (Oliver 2000). An open cup-shaped nest is constructed of bark, grass, twigs and wool (Oliver *et al.* 1998).

Threats

Threats to this species include:

- Historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development, particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands.
- Continuing loss of key habitat tree species and remnant woodlands from strategic agricultural developments, timber gathering and residential developments.
- Suppression of natural regeneration of over storey tree species and shrub species from overgrazing. Riparian gallery forests have been particularly affected by overgrazing.
- Inappropriate forestry management practices that remove large, mature resource-abundant trees. Firewood harvesting in Box-Ironbark woodlands can also remove important habitat components.

- Competition from larger aggressive honeyeaters, particularly Noisy Miners, Noisy Friarbirds and Red Wattlebirds.
- Egg and nest predation by native birds (Department of Environment and Conservation 2006c).

Specific impacts

This species was not recorded during surveys for the BCEP project or the proposed Modification, however habitat exists within the Box Gum habitats of the proposed Modification area, including:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

Approximately 21.9 ha of potential habitat will be removed as a result of the Modification. Whilst this small area will add incrementally to the loss of habitat for the Regent Honeyeater it is small in comparison to larger areas of this community present in the wider region.

10.1 TSC Act significance assessment

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

It is assumed that 21.9 ha of potential habitat for this species, including foraging, roosting and nesting resources would be affected by the proposed. The proposed Modification areas are situated approximately 50 km to the south-west of one of only two main breeding locations in NSW, being the Bundarra-Barraba area. While this species has not been recorded in the BCEP project area, the presence of large tracts of suitable habitat coupled with records of this species occurring west to the Pilliga Nature Reserve (NSW Department of Environment and Climate Change 2009b), indicate that the proposed Modification area might be utilised at least on a transient basis. While this species may exhibit some fidelity to nesting areas, pairs have also been recorded breeding up to 75 km from sites used in the previous breeding season (Oliver 1998) (Oliver 2000) (Geering & French 1998) (Oliver *et al.* 1998). However, any identified population of Regent Honeyeater in the area would not be restricted to habitat within the subject site, due to the species' large home range, similar foraging and nesting habitat can be accessed in the local area. Although the proposed Modification may temporarily affect the dynamics of any potential local population, it is not likely to affect the lifecycle of this species, but would exacerbate key threatening processes that currently undermine this species recovery.

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

Not applicable.

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

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

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

Not applicable.

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

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

21.9 ha of habitat is likely to be removed or modified as a result of the proposed Modification. This is in addition to the incremental loss of habitat for this species.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The habitat within the project area is already largely fragmented. Removal of 21.9 ha of potential habitat for the species would not affect habitat connectivity to a level that would impact upon the conservation of the species, especially considering the high mobility of the species.

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

Whilst the proposed Modification will result in a small incremental loss in habitat it is unlikely to significantly affect the long term survival of the Regent Honeyeater.

This area is not considered to represent core habitat for this species, although it is recognised that it may provide potential breeding and foraging opportunities. Similar habitats would remain in the locality post-development.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act 1995, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species.

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

The Action Plan for Australian Birds (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Regent Honeyeater recovery plan (Menkhorst *et al.* 1999) include:

- Maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites.
- Monitor trends in the Regent Honeyeater population size and dispersion across its range to allow assessment of the efficacy of management actions
- Facilitate research on strategic questions that will enhance the capacity to achieve the long-term objectives. In particular, determine the whereabouts of Regent Honeyeaters during the non-breeding season and during breeding season absences from known sites. Identify important sites and habitat requirements at these times.
- Maintain and increase community awareness, understanding and involvement in the recovery effort
- Maintain the captive population of Regent Honeyeaters at a size that will provide adequate stock to: provide insurance against the demise of the wild population; continuously improve captive-breeding and husbandry techniques; provide adequate stock for trials of release strategies; and maintain 90 % of the wild heterozygosity in the captive population.

The removal of a small area of habitat for this species is unlikely to interfere with the objectives of the Regent Honeyeater recovery plan.

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

With respect to the Regent Honeyeater the proposed Modification contributes to one key threatening process – loss of foraging habitat (mature key nectar tree species & mistletoe). As the proposed works will only make a minor contribution to this threatening process it is considered unlikely to significantly affect species.

Conclusion

Approximately 21.9 ha of potential habitat will be removed by the proposed Modification. This is made up of the following vegetation communities present within the proposed Modification area:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

It is unlikely that removal of this small amount of woodland would have a significant impact upon the Regent Honeyeater..

10.2 EPBC Act significance assessment

Will the action lead to a long-term decrease in the size of a population of a species?

The subject site boundary is situated approximately 50 km to the south-west of one of only two main breeding locations in NSW, being the Bundarra-Barraba area. The presence of large tracts of suitable habitat coupled with records of this species occurring west to the Pilliga Nature Reserve (NSW Department of Environment and Climate Change 2009b), indicate that the subject site might be utilised on a transient basis. However, any identified population of Regent Honeyeater in the area would not be restricted to habitat within the subject site, due to the species' large home range, similar foraging and nesting habitat can be accessed in the locality. Therefore, the proposed Modification is not likely to result in a decline of the local population.

Will the action reduce the area of occupancy of the species?

The subject site is situated approximately 50 km to the south-west of one of only two main breeding locations in NSW, being the Bundarra-Barraba area (NSW Department of Environment and Climate Change 2009b). Furthermore, this species is known to disperse widely (Higgins *et al.* 2001), and with records occurring west to the Pilliga Nature Reserve (NSW Department of Environment and Climate Change 2009b), it is considered that this species might utilise habitat resources within the proposed Modification area on at least a transient basis. Although the species is highly mobile, which is likely to be in response to spatial flowering and resources (Higgins *et al.* 2001), the removal of 21.9 ha of potential habitat would reduce the area of occupancy for the Regent Honeyeater. However this is unlikely to be significant due to the small area of removal.

Will the action fragment an existing population into two or more populations?

Regent Honeyeaters are highly mobile and have a large foraging range that enables them to access similar habitat resources in the locality. Therefore, it is not likely that the proposed Modification would isolate habitat or fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

The Regent Honeyeater is known to breed in two main areas in NSW, being the Bundarra-Barraba area and Capertee Valley. Regent Honeyeater's typically occur in associations that support species which produce copious amounts of nectar, including *Eucalyptus albens*. They are also associated with woodland that support *E. blakelyi, E. crebra* and sometimes native Callitris (pine) woodlands mixed with eucalypts (NSW Department of Environment and Climate Change 2009b). The Modification supports *Eucalyptus albens* and *E. crebra*, and thus, with the Modification occurring in proximity to a known breeding area, it potentially provides important breeding resources for this species. However, as this species would not be restricted to habitat within the Modification study area, this area may not be considered critical to the survival of this species.

Will the action disrupt the breeding cycle of a population?

The proposed Modification would affect 21.9 ha of potential habitat for this species, including foraging and nesting resources. Furthermore, the Modification study area occurs approximately 50 km from one of two main locations where this species is concentrated, being the Bundarra-Barraba area (NSW Department of Environment and Climate Change 2009b), While this species may exhibit some fidelity to nesting areas, pairs have also been recorded breeding up to 75 km from sites used in the previous breeding (Oliver 1998) (Oliver 2000) (Geering & French 1998) (Oliver *et al.* 1998). Therefore, while this species may utilise habitat resources in the Modification study area on at least a transient basis, the removal of 21.9 ha of potential habitat is not likely to disrupt the breeding cycle of a potential population of Regent Honeyeater. It will however add incrementally to the processes threatening this species.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The modification study area occurs approximately 50 km to the south-west of one, of only two main locations where this species is concentrated in NSW, being the Bundarra-Barraba area (NSW Department of Environment and Climate Change 2009b). The removal of 21.9 ha of vegetation would not significantly modify, destroy, remove and decrease the availability of habitat for Regent Honeyeater, although it adds to the incremental loss of habitat for this species.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Regent Honeyeater would become further established as a result of the proposed modification.

Will the action introduce disease that may cause the species to decline?

No. It is not likely that disease would be increased by the removal of a small area of habitat for the proposed modification.

Will the action interfere with the recovery of the species?

The Action Plan for Australian Birds (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Regent Honeyeater recovery plan (Menkhorst *et al.* 1999) include:

- Maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites.
- Monitor trends in the Regent Honeyeater population size and dispersion across its range to allow assessment of the efficacy of management actions
- Facilitate research on strategic questions that will enhance the capacity to achieve the long-term objectives. In particular, determine the whereabouts of Regent Honeyeaters during the non-breeding season and during breeding season absences from known sites. Identify important sites and habitat requirements at these times.
- Maintain and increase community awareness, understanding and involvement in the recovery effort
- Maintain the captive population of Regent Honeyeaters at a size that will provide adequate stock to: provide insurance against the demise of the wild population; continuously improve captive-breeding and husbandry techniques; provide adequate stock for trials of release strategies; and maintain 90 % of the wild heterozygosity in the captive population.

It is not likely that the proposed modification will significantly interfere with the recovery of the species.

Conclusion

Populations of Regent Honeyeaters in the locality are considered important, particularly those using the area for breeding resources. It is considered unlikely that the proposed Modification would significantly affect the species. However, the proposed Modification would add incrementally to the processes threatening this species, through the removal of 21.9 ha of potential habitat, including:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.

- Yellow Box-Blakely'sBlakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

Whilst a small area of habitat for this species will be removed it is unlikely that this will lead to a significant impact for this species.

11. Superb Parrot (*Polytelis swainsonii*)

Status

The Superb Parrot is listed as Vulnerable under both the Environment Protection and Biodiversity Conservation Act 1999 and Threatened Species Conservation Act 1999.

Distribution, habitat and ecology

Superb Parrots inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. On the South-west Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box (Higgins 1999). This species nests in small colonies, often with more than one nest in a single tree, and breed between September and January (Department of Environment and Conservation 2006c). Part of the population of this species undertakes regular seasonal movements from the south-west slopes region to the eucalypt–pine woodlands of central-north and central-west NSW, with the range extending north to around Narrabri and Wee Waa (Department of Environment Water Heritage & Arts 2009)

Superb Parrots may forage up to 10 km from nesting sites, primarily in grassy box woodland. They feed in trees and understorey shrubs and on the ground; their diet consists mainly of grass seeds and herbaceous plants. The parrots also eat fruits, berries, nectar, buds, flowers, insects and grain (Higgins 1999)

Threats

Threats to this species include:

- poor regeneration of nesting trees and food resources
- removal of hollow-bearing trees
- clearing of woodland remnants
- feeding on grain spills and subsequently being struck by vehicles
- loss of hollows to feral bees and native and exotic hollow-nesting birds
- illegal trapping which can also result in the destruction of hollows (Department of Environment and Conservation 2006c).

Specific impacts

This species was not recorded during surveys for the BCEP project or the proposed Modification; however habitat exists within the woodlands and open forest habitat of the proposed Modification area, including the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

Approximately 21.9 ha of potential habitat will be removed as a result of the Modification.

11.1 TSC Act Significance assessment

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

Habitat likely to be affected by the proposed Modification provides foraging, roosting and breeding resources. It is unlikely that removal of 21.9 ha of potential habitat, representing only a small fraction of available habitat, would have a significant impact upon the lifecycle of the species in the locality, however it adds to the cumulative loss of habitat for this species within the locality.

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

Not applicable

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

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

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

Not applicable

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

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

Superb Parrot is a highly mobile, remnant habitat occurring outside the boundaries of the proposed Modification is likely to support local populations. It is unlikely that removal of 21.9 of potential habitat would have a significant impact upon the species, however it adds to the loss of habitat for this species.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The habitat within the project area is already fragmented. Removal of a total 21.9 ha of potential habitat across the Modification sites would not affect habitat connectivity to a level that would impact upon the conservation of the species.

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

Whilst the proposed Modification will result in a small incremental loss in habitat it is unlikely to significantly affect the long term survival of the Superb Parrot.

This area is not considered to represent core habitat for this species, although it is recognised that it may provide potential nesting and foraging opportunities. Similar habitats would remain in the locality in the long term.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However despite not being on the register habitat within the proposed Modification is not considered to be critical.

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

There is a national recovery plan for the Superb Parrot that outlines 4 broad recovery actions for the species. The proposed modification is unlikely to interfere with these recovery objectives owing to the small extent of potential habitat to be removed, the proposed Modification is not considered inconsistent with any identified priority action statements or recovery measures.

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

With respect to the Superb Parrot the proposed Modification contribute to one key threatening process – clearing of native vegetation. As the proposed works will only make a minor contribution to this threatening process it is considered unlikely to significantly affect species.

Conclusion

21.9 ha of potential habitat will be removed by the proposed Modification. This is made up of the following vegetation communities identified in the proposed Modification area:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

It is unlikely that removal of 21.9 ha of grassy woodland would have a significant impact upon the species; however it a.

11.2 Significance assessment – Environmental Planning and Assessment Act 1979

How is the Project likely to affect the lifecycle of a threatened species and/or population?

This species has a breeding range occurring in three main areas, being; the Murray and Edwards Rivers; along the Murrumbidgee River; and an area bounded by Molong, Yass and Young (Department of Environment and Conservation 2006b). At least part of the population of the Superb Parrot undertakes regular seasonal movements, vacating breeding areas at the conclusion of the breeding season and heading north to the eucalypt-pine woodlands of central-west NSW (Department of Environment and Conservation 2006b) (Department of Environment Water Heritage & Arts 2009). While this species is dependent on flowering resources across a wide range of habitats (woodlands and forests) in its wintering grounds in NSW, the removal of 33.8 ha of potential habitat is not likely to disrupt their migratory pattern, which generally occurs 50 km to the west of the Project. As such, the Project is not likely to affect this species lifecycle.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Approximately 21.9 ha of potential foraging habitat for this species would be affected by the Modification. This species has a breeding range occurring in three main areas, being; the Murray and Edwards Rivers; along the Murrumbidgee River; and an area bounded by Molong, Yass and Young (Department of Environment and Conservation 2006b). Therefore, no breeding habitat would be affected by the Project.

Vegetation occurring within the proposed Modification area could potentially be used by individuals of those populations of this species that migrate to the north of their range during winter. This species range extends north to around Wee Waa and Narrabri, from a line joining Coonabarabran and Narrabri, and extending as far west as Quambone, with occasional records further (Department of Environment Water Heritage & Arts 2009) (Department of Environment and Conservation 2006b). Although Leard State Forest essentially occurs outside the normal range of where this species migrates; the removal of approximately 21.9 ha of potential foraging habitat might reduce the area of occupancy of this species. However, given that this species was not recorded in the proposed Modification area or the BCEP Project Boundary, that the northern range of this species effectively occurs (approximately) 50 km to the north-east of Leard State Forest, and the fact that any local population of Superb Parrot would not be restricted to habitat resources in the proposed Modification area; it is considered that the Modification would not reduce the area of habitat for this species.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The Superb Parrot is found throughout all regions of eastern inland NSW. Breeding sites are known to occur in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round, and also in an area bounded by Molong, Yass and Young. (Department of Environment and Conservation 2006b). At least part of the population of the Superb Parrot undertakes regular seasonal movements, vacating breeding areas at the conclusion of the breeding season and heading north to the eucalypt-pine woodlands of central-west NSW during winter (Webster 1988). The north of this species' range (for that part of the population which migrates annually) extends to around Wee Waa and Narrabri from a line joining Coonabarabran and Narrabri, and extends as far west as Quambone, with occasional records further west (Department of Environment and Conservation 2006b). Although the proposed Modification area essentially occurs outside the normal range of where this species migrates; any identified species potentially occurring within the proposed Modification area could be considered as occurring at the north-eastern limit of its distribution. However, with such a far ranging distributional limit in the northern wintering grounds, this species would not be at the distributional limit of its known distribution.

How is the Project likely to affect current disturbance regimes?

The proposed Modification area currently exhibits disturbance regimes associated with agriculture, grazing and mining. These disturbances include vegetation clearing and habitat removal, artificial noise/light regimes and some weed invasion.

The Modification would increase the clearing of native vegetation, which is a known disturbance for this species. The Modification would also increase edge effects and would essentially introduce edge effects into new areas, however the areas impacted are already suffer edge effects and weed invasion.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Modification due to the small area to be impacted (21.9 ha) and the high mobility of this species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the Threatened Species Conservation Act 1995, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared due to this species listing as a Vulnerable species. However, potential habitat occurring in the proposed Modification area is not considered critical to the survival of this species.

Conclusion

Although the Superb Parrot was not recorded in the proposed Modification area however within the proposed Modification area there is potential foraging resources for that part of the population that migrates north at the conclusion of the breeding season (winter). While the Modification would affect 21.9 ha and this would add to the remnant woodland, being removed as part of the BCEP Project, it is considered that the Modification would not reduce the area of occupancy of this species as the general area that this species occupies during migration, essentially occurs (approximately) 50 km to the west of the modification area. While vagrant records of this species may occur within the vicinity of the proposed Modification area, it is not likely that this species would be significantly affected by the Modification.

12. Turquoise Parrot (*Neophema pulchella*)

Status

The Turquoise Parrot is listed as Vulnerable under Schedule 2 of the TSC Act.

Distribution and habitat

Turquoise Parrots occur in the foothills of the Great Dividing Range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey, often in the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland (Department of Environment and Conservation 2006c). They nest in tree hollows, stumps or even fence posts, from August to December, laying four or five eggs on a nest of decayed wood dust. This species is usually seen in pairs or small, possibly family, groups and has also been reported in flocks of up to 30 individuals (Higgins 1999). The parrots spend most of the day on the ground and feed on seeds of both native and introduced grass and herb species. They forage quietly and may be quite tolerant of disturbance (Garnett & Crowley 2000).

Threats

This species is predominately threatened by degradation or loss of habitat, particularly the loss of hollow bearing trees (OEH 2012).

Specific impacts

This species was recorded during recent field surveys for the BCEP Project, in Grassy Woodlands on fertile soils, however was not recorded during survey for the proposed Modification. Within the proposed Modification area, potential habitat exists within the following vegetation communities:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

Approximately 21.9 ha of potential habitat would be modified as a result of the Modification.

12.1 TSC Act significance assessment

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

Habitat likely to be affected by the proposed Modification provides foraging, roosting and breeding resources. It is unlikely that removal of 21.9 ha of potential habitat, representing only a small fraction of available habitat, would have a significant impact upon the lifecycle of the species in the locality

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

Not applicable

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

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

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

Not applicable

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

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

Turquoise Parrot is commonly associated with disturbed areas and often favours the ecotone of forest edges and pasture or other grasslands (NSW Department of Environment and Climate Change 2009c). As this species is highly mobile, remnant habitat occurring outside the boundaries of the proposed Modification is likely to support local populations. It is unlikely that removal of 21.9 ha of potential habitat would have a significant impact upon the species.

(iv) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The habitat within the project area is already fragmented. Removal of a total 21.9 ha of potential habitat across the Modification sites would not affect habitat connectivity to a level that would impact upon the conservation of the species.

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

Whilst the proposed Modification will result in a small incremental loss in habitat it is unlikely to significantly affect the long term survival of the Turquoise Parrot.

This area is not considered to represent core habitat for this species, although it is recognised that it may provide potential nesting and foraging opportunities. Similar habitats would remain in the locality post-development.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However despite not being on the register habitat within the proposed Modification is not considered to be critical.

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

There is neither a recovery nor threat abatement plan for the Turquoise Parrot. The Office of Environment and Heritage has however identified 10 priority actions. Owing to the small extent of potential habitat to be removed, the proposed Modification is not considered inconsistent with any identified priority action statements or recovery measures.

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

With respect to the Turquoise Parrot the proposed Modification contribute to one key threatening process – clearing of native vegetation. As the proposed works will only make a minor contribution to this threatening process it is considered unlikely to significantly affect species.

Conclusion

21.9 ha of potential habitat will be removed by the proposed Modification. This is made up of the following vegetation communities identified in the proposed Modification area:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

It is unlikely that removal of 21.9 ha of habitat would have a significant impact upon the species.

13. Little Eagle (*Hieraaetus morphnoides*)

Status

The Little Eagle is listed as a Vulnerable species under the TSC Act.

Distribution, habitat and ecology

The Little Eagle is distributed throughout most of the Australian mainland, except in the most densely forested parts of the Great Dividing Range escarpment (NSW Scientific Committee 2009a), with adults being sedentary (to partly migratory in autumn-winter) and young being dispersive (Pizzey & Knight 2007). The Little Eagle occupies plains, foothills, open eucalypt forest and woodland or open woodland, while acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993). This species builds a large stick nest in tall living trees within remnant patches of vegetation and generally breeds from July to October (Pizzey & Knight 2007). The diet of the Little Eagle generally consists of terrestrial mammals, birds and reptiles (NSW Scientific Committee 2009a).

Threats

Over 50 % of forest and woodlands in NSW have been cleared (Lunney 2004), thus, the main threat that affects this species is the further clearing and degradation of foraging and breeding habitat (NSW Scientific Committee 2009a). On the NSW tablelands and western slopes, important habitat is 53 – 84 % cleared and moderately to highly stressed (NSW Scientific Committee 2009a). Loss of breeding sites may bring this species into increasing interspecific competition with the larger and more dominant Wedge-tailed Eagle.

Specific impacts

This species has been recorded during field studies for BCEP, soaring over the proposed Modification area and adjoining landscapes. As all the vegetation communities are considered potential habitat for the Little Eagle, The proposed Modification would require clearing of 22.7 ha of potential breeding and foraging habitat for this species.

13.1 TSC Act significance assessment

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

Approximately 22.7 ha of known and potential foraging and breeding habitat for Little Eagle would be affected by the proposed Project Boundary Modification.

The proposed Modification would not require the removal of hollow-bearing trees, which are a requirement for this species to build a nest – therefore not reducing potential breeding habitat. Also similar habitats will remain in the area. As it is a marginal disturbance, and considering the mobility of this species and the large home ranges occupied, it is considered unlikely that the proposed Modification would adversely affect the lifecycle of the species. However, it would add incrementally to the loss of foraging habitat.

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

Not applicable.

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

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

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

Not applicable.

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

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

97.7 ha of potential habitat would be removed representing a small reduction in habitat for the Little Eagle.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). An area of 22.7 ha comprising nesting and foraging habitat, would be affected by the proposed Project Boundary Modification, thereby reducing the overall extent of known and potential habitat. Connectivity would not be affected any more than currently occurs in the locality.

Due to the large home range and mobility of this species, the ability to access adjacent habitat occurring outside the proposed Modification area would remain. Therefore, it is unlikely that individuals or a local population of this species would become fragmented or isolated from other areas of habitat. However, it would reduce the overall extent of known habitat and further exacerbate key threatening processes for this species.

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

Due to the small size of habitat to be disturbed (22.7 ha) and considering the remaining habitat within the locality and the wider region this area is not considered to represent core habitat for this species, although it is recognised that it provides nesting and foraging opportunities.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. Regardless, the small area of habitat affected by the proposed Modification is not considered critical to the survival of this species.

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

Neither a recovery nor threat abatement plan has been prepared for the Little Eagle. There have also been no recovery actions identified by the Office of Environment and Heritage.

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

The proposed Modification would involve a small amount of clearing of native vegetation, which is a known disturbance for this species.

Conclusion

The proposed Modification would impact upon 22.7 ha of known foraging habitat. While this reduction would add incrementally to the loss of foraging and breeding habitat in the locality, it is not likely to significantly affect this species, as a large continuous patch of remnant woodland would remain within the locality and the wider region of the proposed Modification.

14. Square-tailed Kite (*Lophoictinia isura*)

Status

The Square-tailed Kite (Debus *et al.* 1993)is listed as a Vulnerable species under the TSC Act (NSW National Parks and Wildlife Service 1999b).

Distribution, habitat and ecology

This raptor is endemic to Australia and is widespread throughout the mainland, although it is sparsely distributed (Marchant and Higgins 1993). The species is recorded along coastal and sub-coastal areas, from south-western to northern Australia, Queensland, NSW and Victoria. Scattered records throughout NSW indicate that the species is a regular resident along the major west-flowing river systems. This species is also migratory throughout its range and is a summer breeding migrant to south-eastern and south-western Australia. The Square-tailed Kite inhabits open forests, woodlands with particular preference for timbered watercourses. Within NSW, the species is often associated with ridge and gully forests containing Eucalyptus longifolia (Woollybutt), E. maculata (Spotted Gum) E. elata (River Peppermint) and E. smithii (Ironbark Peppermint), as well as forests containing Angophora and Callitris and Box-Ironbark woodland.

The Square-tailed Kite occupies large home ranges, in the order of 100 square kilometres, and is specialist hunter of passerines (particularly honeyeaters) and foliage insects, with most prey taken from the outer foliage of the tree canopy (NSW National Parks and Wildlife Service 1999b). Breeding occurs from July to February with an average clutch size of three eggs. Nest sites are generally located near watercourses in a fork or large horizontal branches of eucalypts or Angophora tree species.

Except when breeding, this species tends to be a solitary bird, usually seen hunting alone high in, or just above the tree canopy in coastal or sub-coastal rainforest, forest or woodland. Nests have been reported in Eucalyptus spp., Angophora spp. and native pine forests. Prey taken has included fledging birds, insects, rabbits and lizards.

Threats

Over 50 % of forest and woodlands in NSW have been cleared (Lunney 2004), thus, the main threat that affects this species is the further clearing and degradation of foraging and breeding habitat (NSW National Parks and Wildlife Service 1999b).

Specific impacts

This species has been anecdotally recorded in Leard State Forest (David Robertson 2009). Habitat exists within the Box Gum habitats of the proposed Modification area, including:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest
- Derived native grassland

The proposed Modification would clear 22.7 ha of habitat for this species in addition to the habitat cleared for the BCEP project.

14.1 TSC Act significance assessment

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

The Square-tailed Kite has been anecdotally recorded in Leard State Forest (David Robertson 2009). Approximately 22.7 ha of potential foraging and breeding habitat for Square-tailed Kite would be affected by the proposed Modification.

Whilst the proposed Modification will reduce potential foraging and breeding opportunities for this species, remaining Leard State Forest would occur as a large continuous patch of remnant woodland adjacent. Therefore, it is likely to support nesting and foraging resources for this species. Moreover, given the mobility of this species and large home ranges occupied, this species would be able to access similar habitats in the locality with ease.

While the loss of potential habitat would add incrementally to the loss of foraging and breeding habitat, it is not likely to substantially affect the lifecycle of this species in the locality.

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

Not applicable.

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

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

Not applicable.

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

Not applicable.

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

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

The Square-tailed Kite is known to occupy territories up to 100 square kilometres in eucalypt forest, woodland, open woodland and riparian woodland (NSW National Parks and Wildlife Service 1999a); therefore, it is estimated that less than 22.7 ha of habitat will be affected by the proposed Modification.

Habitat to be removed provides potential breeding and foraging resources for this species. However, the remaining large continuous patch of remnant woodland in the locality and the wider region is likely to provide greater nesting and foraging resources for this species.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Remnant forest and woodland vegetation is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife

Service 2003). Whilst small areas of remnant vegetation, comprising potential breeding and foraging habitat, would be affected by the proposed Modification, connectivity would not be impacted any more than currently occurs in the locality. Due to the large home range and mobility of this species, the ability to access adjacent habitat occurring outside the proposed Modification would remain. Therefore, it is unlikely that individuals or a local population of this species would become fragmented or isolated from other areas of habitat.

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

In consideration of the potential habitat remaining in the locality, and the high mobility of the species, this area is not considered to represent core habitat for this species, although it is recognised that it may provide potential nesting and foraging opportunities. The small incremental loss in habitat it is unlikely to significantly affect the long term survival of the Square-tailed Kite.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species.

The habitat in the proposed Modification area is not considered critical.

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

Neither a recovery nor threat abatement plan has been prepared for the Square-tailed Kite, however three priority actions have been identified by Office of Environment and Heritage. The proposed Modification is unlikely to interfere with these actions, as no nest tree was identified.

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

The proposed Modification would involve a small amount of clearing of native vegetation, which is a key threatening process.

Conclusion

The Square-tailed Kite has been anecdotally recorded in Leard State Forest. It is estimated that 22.7 ha of potential foraging habitat would be affected by the proposed Modification. While this reduction would add incrementally to the loss of foraging and breeding habitat in the locality, it is not likely to significantly affect this species, as a large, continuous patch of remnant woodland would surround the proposed Modification area, which is likely to provide foraging and nesting opportunities.

15. Barking Owl (*Ninox connivens*) and Masked Owl (*Tyto novaehollandiae*)

The Barking Owl and Masked Owl have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as result of the proposed Modification. Neither species were recorded during survey for the Modification within the proposed Modification area. All native communities are potential habitat for these species.

Barking Owl – *Ninox connivens*

The Barking Owl is listed as Vulnerable under Schedule 2 of the TSC Act. Barking Owls inhabit eucalypt woodland, open forest, swamp woodlands, and especially in inland areas, timber along watercourses (Pizzey & Knight 1997). Dense vegetation is used occasionally for roosting. During the day this species roosts along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts (Higgins 1999).

Barking Owls feed on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals, such as smaller gliders, possums, rodents and rabbits, becoming important during breeding. Estimates of Barking Owl home ranges indicated that territories range from 30 ha to 200 ha and hunt 5 km from roosts (Higgins 1999). However, surveys in the Pilliga forests of western NSW (Kavanagh, R. P. 2009) found that Barking Owl home ranges averaged approximately 2,000 ha. Regurgitated pellets also showed that prey items consisted of mostly birds, insects and some mammals.

Eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*Eucalyptus albens*), Red Box (*Eucalyptus polyanthemos*) and Blakely's Red Gum (*Eucalyptus blakelyi*). Nest-hollow entrances are 2 m to 35 m above the ground with a diameter of 20 cm to 46 cm and depth of 20 cm to 300 cm. Breeding occurs during late winter and early spring (NSW National Parks and Wildlife Service 2003).

Cluster analysis of records from NSW Wildlife Atlas within 300 km diameter around the Pilliga forests (Soderquist 2009) identified seven Barking Owl populations in the region of north-west NSW. The Pilliga population spreads to the Warrumbungle ranges and to the lower slopes of Mount Kaputar. While this population is an extensive one, no obvious lines of connectivity to other populations in the region were evident. Moreover, the gaps between these populations are generally wide expanses of mostly cleared habitat and without knowledge of juvenile dispersal ability, connectivity across the landscape cannot accurately be determined (Soderquist 2009).

Masked Owl – *Tyto novaehollandiae*

The Masked Owl is listed as Vulnerable under Schedule 2 of the TSC Act 1995. Masked Owls are distributed mainly throughout NSW from the coast where it is most abundant to the western plains (NSW Scientific Committee 2004), where they inhabit a diverse range of wooded habitats including eucalypt forests, woodlands and almost treeless inland plains. Optimal habitat includes an open understorey and a mosaic of sparse and dense ground cover. Large hollows in live or occasionally dead eucalypts are used for roosting (Department of Environment and Conservation 2006a) but are also known to roost and nest in dense foliage in gullies and caves (Garnett & Crowley 2000).

Masked Owls typically prey on terrestrial mammals including rodents and marsupials but would also take other species opportunistically. Territories range 400 ha to 1000 ha and forages by hunting from perches at ecotones within forests and at forest edges (Kavanagh, R. P. a. M. M. 1996).

Eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*Eucalyptus albens*) and Blakely's Red Gum (*Eucalyptus blakelyi*). Nest-hollow entrances are at least three metres above the ground with a diameter greater than 40 cm and depth greater

than 100 cm. Breeding mostly occurs during autumn and winter (NSW National Parks and Wildlife Service 2003).

Specific Impacts

The proposed Modification would remove 21.9 ha of potential habitat, in the form of the Woodlands within the proposed Modification area, including:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

Habitat likely to be affected provides foraging, roosting and breeding resources for these species.

15.1 TSC Act significance assessment

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

The habitat to be removed provides feeding resources for Barking Owls and Masked Owls in the form of birds, insects and some terrestrial mammals. Roosting and breeding resources in the proposed Modification area include dense clumps of canopy leaves in large Eucalypts for the Barking Owl and large hollows in Eucalypts for the Masked Owl. No hollow-bearing trees will be removed by the proposed Modification.

It is unlikely that the removal of 21.9 ha for the proposed Modification would significantly impact upon the lifecycle of the species.

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

Not applicable

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

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

Not applicable

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

Not applicable

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

(i) t**he extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed Modification would remove 21.9 ha of potential habitat in total. It is unlikely this would significantly impact upon the species. However, it contributes to the loss of 379.4 ha of known habitat for the BCEP project.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Much of the habitat within the proposed Modification area and locality is already fragmented. Removal of 21.9 ha of potential habitat for the species would not increase habitat fragmentation to a level that would impact upon the conservation of the species. Moreover, these species have large home ranges (up to 1000 ha for the Masked Owl and 2000 ha for the Barking Owl).

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

This area is not considered important for the long term survival of the species, as additional breeding and foraging habitat will remain in the locality, and 21.9 ha of habitat to be removed only represents a small fraction of the species range.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species. However, the potential habitat to be cleared is not considered to be critical to the survival of these species.

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

Neither a recovery nor threat abatement plan has been prepared for either of the Owls.

A number of priority actions have been identified by the Office of Environment and Heritage; 17 for the Barking Owl and 24 for the Masked Owl. Owing to the small extent of habitat to be affected, the proposed Modification is not considered inconsistent with any identified priority action statements or recovery measures.

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

The proposed Modification would involve a small amount of clearing of native vegetation including the removal of hollow bearing trees, which are key threatening process that threaten these species.

Conclusion

Approximately 21.9 ha of potential habitat will be removed for the proposed Modification. It is unlikely that removal of this small amount of woodland would have a significant impact upon these species; however it contributes to the cumulative removal of known habitat within the locality.

16. Hollow dependant microchiropteran bats

Threatened hollow-dependent species of microchiropteran bat have been assessed together as they generally share similar habitat requirements, threats that affect their recovery, and potential impacts as result of the proposed Project Boundary Modification. Hollow-dependent microchiropteran bats considered for this impact assessment are:

- Greater Long-eared Bat – south eastern form (*Nyctophilus timoriensis*).
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*).
- Greater Long-eared Bat – south-eastern form

Greater Long-eared Bat

The Greater Long-eared Bat is listed as Vulnerable under the TSC Act 1995 and the EPBC Act 1999.

Greater Long-eared Bats inhabit a variety of vegetation types, including mallee and box eucalypt dominated communities, but they are distinctly more common in box/ironbark/cypress-pine vegetation, which occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. They roost in tree hollows, crevices and under loose bark. It is a slow flying, agile bat using the understorey to hunt non-flying prey — especially caterpillars and beetles — and will even hunt on the ground. Mating takes place in autumn, with one or two young born in late spring to early summer (Churchill 2008).

Although no individuals were recorded during current surveys, this species has previously been recorded in Leard State Forest (Pennay 2001), and suitable habitat exists within the proposed Modification area.

Eastern False Pipistrelle

The Eastern False Pipistrelle is listed as Vulnerable under the TSC Act 1995.

This species is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (Department of Environment and Climate Change 2005; NSW Department of Environment and Climate Change 2009a). Its distribution extends over the Great Dividing Range, with a preference for wet altitude forests. This species is thought to hunt beetles and moths above, or just below the canopy. The Eastern False Pipistrelle roosts in tree hollows, although it can sometimes be found in caves (Jenolan area) and buildings (Churchill 1998). This species hibernates during winter, with females pregnant in late spring-early summer (NSW Department of Environment and Climate Change 2009a).

This species was recorded via Anabat during field surveys for the BCEP in 2010.

Yellow-bellied Sheathtail Bat

The Yellow-bellied Sheathtail Bat is listed as Vulnerable under the TSC Act 1995.This species has been frequently observed in the Box Gum woodlands within Leard State Forest. This species is wide ranging and found across northern and eastern Australia, encompassing the majority of NSW. Although, only scattered records exist across the New England Tablelands and north-west slopes (NSW Department of Environment and Climate Change 2009d). This species occurs in eucalypt forest where it flies high above the canopy, feeding on insects. In mallee or open country it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows and is thought to be a migratory species to southern Australia during late summer and autumn (Churchill 1998). Little is known about this species' life cycle. Breeding has been recorded from December to late March in this species (NSW Department of Environment and Climate Change 2009d).

This species was recorded via Anabat during field surveys for the BCEP – more detail in the Continuation of Boggabri Coal Mine - Biodiversity Impact Assessment (Parsons Brinckerhoff 2010).

Threats (combined for all species)

- Loss or Modification of habitat (including feeding habitat) near roosting and maternity sites.
- Clearing and isolation of dry eucalypt forest and woodland, particularly about cliffs and other areas containing suitable roosting and maternity sites, mainly as a result of agricultural and residential development.
- Predation by cats.
- Application of pesticides in or adjacent to foraging areas may reduce the availability of invertebrates, or result in the accumulation of toxic residues in individuals' fat stores.
- Damage to roosting and maternity sites from mining operations.
- There is a strong likelihood that unrecorded populations could be unintentionally affected by land management actions.

Specific Impacts

The proposed Modification would remove 22.7 ha of potential habitat, in the form of all vegetation communities identified within the proposed Modification area. Habitat likely to be affected provides foraging, roosting and breeding resources for these species.

16.1 TSC Act significance assessment

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

Field surveys identified that the proposed Modification area contains hollow-bearing trees. During previous studies conducted for the BCEP two Threatened hollow-dependent species of microchiropteran bat, Eastern False Pipistrelle and Yellow-bellied Sheathtail Bat, were recorded via Anabat. Greater Long-eared Bat has previously been recorded in the area by NSW National Parks and Wildlife Service (Pennay 2001).

The proposed Modification will not require the removal of any hollow bearing trees but will require the removal. Modification of 22.7 ha of native vegetation, all of which is considered foraging habitat. As no hollow bearing trees will be removed as a result of the proposed Modification and that a large number of hollow bearing trees will remain in the locality the proposed Modification is unlikely to have a significant adverse effect on the lifecycle of this species as it is relatively small areas of potential breeding, foraging and commuting habitat being impacted.

Furthermore, as outlined in the Continuation of Boggabri Coal Mine - Biodiversity Impact Assessment (Parsons Brinckerhoff 2010) a large continuous patch of remnant woodland, with a similar or greater density of hollow-bearing trees, would remain in the area surrounding the proposed Modification area providing important habitat resources for foraging, roosting and breeding.

The cumulative effect of the proposed Modification and the BCEP may affect the local population. However the Modification alone is not considered likely to have a significant impact on these species.

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

Not applicable.

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

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

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

Not applicable.

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

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

22.7 ha of native vegetation representing suitable foraging habitat for this species is likely to be affected by the proposed Modification. This is a relatively small area of potential foraging and roosting habitat being impacted

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

The proposed Modification is unlikely to represent significant habitat isolation and/or fragmentation given the small incremental increase of disturbance of potential habitat (22.7 ha) and the mobility of the species.

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

The proposed Modification would remove 22.7 of moderate to good value habitat that provides foraging resources. Increasing the total area affected by the BCEP and associated works.

The area of habitat proposed to be removed for the BCEP alone was considered to be of importance to the long-term survival of Hollow Dependant Microchiropteran Bats in the locality. The further disturbance caused by the proposed Modification would further reduce the area of occupancy for these species.

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

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act 1995, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species due to their Vulnerable species listing. The habitat which would be affected by the proposed Modification is not considered critical to the survival of the species.

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

No recovery or threat abatement plans have been prepared for any of the hollow dependant Microchiropteran bats. The Office of Environment and Heritage has however identified measures that need to be implemented to recover these species.

The proposed development is not likely to significantly adversely affect any of these recovery actions with the possible except of vegetation removal around possible marginal (non-breeding) roost sites (i.e. small fissures in trees). This impact is unlikely to significantly affect the recovery of any local population of the species.

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

The action proposed constitutes the following key threatening processes, as listed under the TSC Act 1995:

- clearing of native vegetation

Considering the cumulative impact the BCEP and proposed Modification, these key threatening processes could negatively impact the Hollow Dependant Microchiropteran Bats. However, the proposed Modification would only affect a marginal area of suitable habitat in relation to the availability to these habitats in the broader locality.

Threat abatement plans have not been prepared for these processes.

Conclusion

Field surveys identified numerous hollow bearing trees within the proposed Modification area. During previous studies, conducted for the Continuation of Boggabri Coal Mine - Biodiversity Impact Assessment (Parsons Brinckerhoff 2010), two threatened hollow-dependent species of microchiropteran bat, Eastern False Pipistrelle and Yellow-bellied Sheathtail Bat, were recorded via Anabat. Greater Long-eared Bat has previously been recorded in the area by NSW National Parks and Wildlife Service (Pennay 2001).

In addition to the habitat being affected by the BCEP, 22.7 ha of moderate to good habitat would be removed. Therefore, whilst it is considered that the proposed Modification would reduce the area of occupancy and add incrementally to processes that threaten these species, it is unlikely to be a significant impact upon these species.

16.2 EPBC Act significance assessment – Greater Long-eared Bat

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will result in one or more of the following.

Will the action lead to a long-term decrease in the size of an important population of a species?

The proposed Modification would remove 22.7 ha of habitat for this species, including potential foraging resources. However, this species is highly mobile (known to forage more than three kilometres from roost sites) (Churchill 1998), and similar foraging and roosting resources would remain in the locality.

Will the action reduce the area of occupancy of an important population of the species?

A local population of Greater Long-eared Bat would not be restricted to habitat resources in the proposed Modification area. A relatively small patch (22.7 ha) of potential foraging and roosting habitat for this species would be affected by the proposed Modification and similar habitat resources will remain in the surrounding landscape. Thus, the proposed Modification is not considered likely to reduce the area of occupancy of an important population of Greater Long-eared Bat.

Will the action fragment an existing important population into two or more populations?

Habitat connectivity would be unlikely to be significantly affected by the proposed Modification. Given the mobility of the Greater Long-eared Bat and the similar habitats in the locality it is unlikely that the proposed Modification would isolate the habitat fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat is listed for this species under the EPBC Act 1999.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- For activities such as foraging, breeding, roosting, or dispersal.
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- To maintain genetic diversity and long-term evolutionary development, or
- For the reintroduction of populations or recovery of the species or ecological community (Department of Environment, 2013).

The proposed Modification would remove approximately 22.7 ha of potential foraging and breeding habitat for this species. However, this species high mobility would allow it to access and occupy foraging and roosting/breeding resources outside the proposed Modification area. Furthermore a large stand of continuous remnant woodland would remain around the area. Therefore, habitat within the subject site is not considered critical to the survival of the species.

Will the action disrupt the breeding cycle of an important population?

Any potential population of this species occurring within the proposed Modification area is not considered an important population. While the proposed Modification might disrupt the dynamics of a potential population, similar breeding resources would remain in the large stand of continuous remnant woodland in the locality.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposed Modification would decrease the availability of suitable habitat by 22.7 ha. However, important habitat resources such as tree hollows have similar densities inside and outside the proposed Modification area (Parsons Brinkerhoff 2010). Furthermore, the proposed Modification is not likely to increase the degree of fragmentation or isolation of this species. Thus, it is considered unlikely that the decrease in available habitat would cause the species to decline.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

It is not likely that invasive species (such as introduced predators) that are harmful to the Greater Long-eared Bat would become further established as a result of the proposed Modification.

Will the action introduce disease that may cause the species to decline?

No. There are no known diseases that are likely to increase in the area as a result of the proposed Modification.

Will the action interfere with the recovery of the species?

The Action Plan for Australian Bats (Duncan *et al.* 1999) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific roosting requirements.

Based on the potential ecological impacts of the proposed Modification on the Greater Long-eared Bat, as discussed above, it is not likely that the activities would interfere with the recovery of this species.

Conclusion

Populations of Greater Long-eared Bat potentially occurring in the proposed Modification area are not considered to be critical to the survival of the species. Based on the above assessment, this species is not likely to be significantly affected by the 22.7 ha of potential habitat to be removed for the proposed Modification.

17. Squirrel Glider (*Petaurus norfolcensis*)

Status

The Squirrel Glider is listed as Vulnerable under TSC Act 1995.

Distribution, habitat and ecology

Squirrel Gliders inhabit mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range. Suitable vegetation communities include at least one species of plant that flowers heavily in winter and one or more of the smooth-barked eucalypts (Department of Environment and Conservation 2005)

Tree hollows greater than five centimetres diameter, in both living and dead trees as well as hollow stumps, are used as den sites for refuge and nesting (Gibbons & Lindenmayer 2000). Studies in Queensland showed that Squirrel Gliders used ironbark eucalypts and stags more than the hollows of smooth barked eucalypts and non-eucalypt tree species (Rowston 1998).

Squirrel Gliders use tree hollows for diurnal shelter either alone or in family groups of up to six individuals and offspring that occupy the same hollow simultaneously. The size and composition of groups of gliders occupying a particular hollow varies from day to day because gliders regularly swap den trees (van der Ree 2002). The nests are bowl-shaped and lined with leaves within tree hollows (Triggs 1996).

Squirrel Gliders are nocturnal and display seasonal trends in feeding behaviour that are in accordance with phenological patterns consists of trees and shrubs (Goldingay & Sharpe 1998). Their diet includes acacia gum, eucalypt sap, nectar, honeydew and manna, lichens with invertebrates and pollen providing protein (NSW National Parks and Wildlife Service 1999b).

Squirrel Gliders are agile climbers and can glide for more than 50 metres in one movement. Nightly movements are estimated at between 300 metres and 500 metres. Home-ranges have been estimated as between 0.65 hectares and 8.55 hectares and movements tend to be greater for males than females. The home-range of a family group is likely to vary according to habitat quality and availability of resources, with more productive forests attributed to smaller home ranges (Quin 1995).

Specific impacts

This species was not recorded during the field survey however, this species is considered with a moderate or higher likelihood to utilise the Woodland habitats within the proposed Modification area, due to the presence of numerous habitat trees which provide suitable tree hollows and foraging resources. A total of 21.9 ha of potential habitat will be removed as a result of the Modification. No hollow-bearing trees will be removed. This is made up of all the Woodland habitats in the proposed Modification area, including:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

The removal of 21.9 ha of potential habitat will reduce the potential habitat and roosting opportunities for this species within the locality. However, a large tract of continuous bushland will remain in addition to many hollow bearing trees adjacent to the Modification sites.

17.1 TSC Act significance assessment

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

Boggabri Coal currently operates on the southern edge of Leard State Forest, which occurs as a >8,000 hectare remnant stand of vegetation, surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The proposed Modification will impact up on 21.9 ha of potential foraging and breeding resources.

If present within the proposed Modification area, this species is likely to persist in similar habitats outside the proposed Modification area. This species regularly swap den sites, occupy territories between 0.65 hectares and 8.55 hectares, and have nightly movements ranging from 300 metres to 500 metres.

It is considered unlikely that the species lifecycle will be affected by the proposed Modification itself; however it will add incrementally to the impact to this species. The proposed modification is unlikely to have a significant impact upon this species due to the small area of removal.

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

Not applicable.

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

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

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

Not applicable.

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

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

21.9 ha of potential foraging and breeding habitat for this species would be affected by the proposed Modification. While this species was not recorded in the proposed Modification area during the field survey, potential habitat resources have been identified in the area.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003).

Whilst 21.9 ha of potential habitat would be affected by the proposed Modification, thereby reducing the overall extent of potential habitat, connectivity would not be significantly impacted any more than currently occurs in the locality

Due to the relatively large home range and mobility of this species, this potential loss of habitat is unlikely to result in isolation of habitat any more than currently occur within the locality. The ability to access adjacent habitat, occurring in the surrounding landscape, outside the proposed Modification area will remain. Therefore, it is unlikely that any local population of Squirrel Glider would become fragmented or isolated from other areas of habitat any more than currently occurs within the proposed Modification area. However, the proposed Modification would reduce the overall extent of potential habitat and further exacerbate key threatening processes affecting this species.

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

The importance of habitat to be removed by the proposed Modification, in terms of the long-term survival of the Squirrel Glider, is not considered to be high. It will reduce the over-all occupancy area for the species and potentially affect a minor amount of important foraging resources.

Whilst the Modification alone is not considered a significant impact to the species, the cumulative impacts of the BCEP are considered to be important to the long-term survival of the Squirrel Glider in the locality.

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

The Office of Environment and Heritage maintains a register of critical habitat. Land within the proposed Modification area is not listed or considered as critical habitat.

Habitat being removed for the associated BCEP is considered to be 'core habitat'' for this species, as Leard State Forest effectively occurs as an island of remnant vegetation surrounded by a cleared landscape.

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

Neither a recovery nor threat abatement plan has been prepared for this species. The Office of Environment Heritage has identified 9 priority actions for this species. The proposed Modification does not interfere with any of these actions.

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

With respect to the Squirrel Glider, the proposed Modification contributes to one key threatening process - clearing of native vegetation. As the proposed works will only make a minor contribution to this threatening process it is considered unlikely to significantly affect species.

Conclusion

No squirrel gliders have been recorded within the proposed Modification area. However potential habitat resources were identified in the form of hollow bearing trees and foraging trees with in the vegetation communities within the proposed Modification area, including:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

It is assumed that 21.9 ha of potential habitat for the Squirrel Glider would be affected by the proposed Modification, which will increase the total area, impacted upon by BCEP and associated works. Given the species high mobility and ability to access adjacent remnant woodland in the locality and region, it is not

likely that this species would be significantly affected by the proposed Modification itself – but it is considered to be affected by the cumulative impact of the proposed Modification and the BCEP.

18. Koala (*Phascolarctos cinereus*)

Status

The Koala is listed as Vulnerable under the TSC Act 1995 and Vulnerable for the combined populations of Queensland, New South Wales and the Australian Capital Territory under the EPBC Act 1999.

Description

The Koala is an arboreal marsupial with fur ranging from grey to brown above, and is white below. It has large furry ears, a prominent black nose and no tail. It spends most of its time in trees and has long, sharp claws, adapted for climbing. Adult males weigh 6 - 12 kilograms and adult females weigh 5 to 8 kilograms (NSW National Parks and Wildlife Service 2002a).

Distribution, habitat and ecology

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In New South Wales it mainly occurs on the central and north coasts with some populations in the western region. It was historically abundant on the south coast of New South Wales, but now occurs in sparse and possibly disjunct populations (NSW National Parks and Wildlife Service 2003a).

Koalas are found in areas where there are suitable feed trees, ranging from open eucalypt woodlands to dense forests. Like other folivores, this species tends to be associated with forests growing on high-nutrient soils along river flats and drainage lines, most of which have been cleared for farmland (NSW National Parks and Wildlife Service 1999b). The suitability of forest and woodland communities as habitat for Koalas is influenced by the size and species of trees present, soil nutrients, climate, rainfall and the size and disturbance history of the habitat patches. Koalas feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species (Moore and Foley 2000).

Koalas are generally inactive for most of the day, feeding and moving mostly at night. They spend most of their time in trees, but will descend and traverse open ground to move between trees. They are generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Home range size varies with quality of habitat, ranging from less than two hectares to several hundred hectares in size (Lunney et al. 2000).

Females reach sexual maturity at approximately two years and can produce one offspring each year, generally in summer (Ellis et al. 2000). Following birth, the young lives in the pouch for 6 months and on leaving the pouch it remains dependent on its mother, riding on her back. Dispersal distances of young generally range from 1 11 kilometres, although movements in excess of 50 kilometres have been recorded (NSW National Parks and Wildlife Service 2003a).

In coastal northern New South Wales, populations have been estimated to range from one animal every 45 hectares to one every 4.5 hectares (average one every 20-25 hectares) (Melzer *et al.* 2000). Most young disperse at two to three years of age and females remain in their natal area. If no suitable habitat is found by young individuals then they become nomadic (Lunney *et al.* 2000).

Threats

Specific threats identified in the Koala Draft Recovery Plan (NSW National Parks and Wildlife Service 2003a) include:

- destruction of habitat by clearing for urban development, agriculture and mining, particularly on high nutrient content soils

- fragmentation of habitat by roads, urban development and agriculture, which creates barriers to movement, isolates individuals and populations, alters population dynamics and prevents gene flow and the ability to maintain recruitment levels
- mortality from attacks by dogs, road fatalities, fires, drought or other natural disasters, particularly in fragmented landscapes without suitable refuge areas
- degradation of habitat by fire, weed invasion, removal of important habitat trees and climate change
- in stressed populations, infection by Chlamydia, causing cystitis, kerato conjunctivitis, infertility and other symptoms.

Specific impacts

One Koala was recorded during the nocturnal spotlight field surveys for BCEP in 2010, in the area immediately adjoining the proposed Modification area. Potential habitat for Koalas exists in all the Box Gum woodland and the Poplar woodland within the proposed Modification area, including:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- White Box White Cypress Pine grassy woodland

In total, 21.9 ha of potential habitat would be removed as a result of the proposed Modification.

18.1 TSC Act significance assessment

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

No Koalas were observed during field surveys for the Modification, however habitat for this species was identified within the proposed Modification area. The low numbers of Koala recorded during field surveys for the BCEP in 2010 and lack of breeding females suggests that the areas proposed for the activities would not be considered core Koala habitat. The proposed Modification would remove a small area of 21.9 ha of habitat for the Koala. Koala habitat will be retained in adjacent areas, continuing to provide Koalas with sufficient foraging and breeding resources.

As such, it is unlikely that the removal of marginal foraging habitat would disrupt the local population of Koala and place it risk of extinction.

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

Two populations of Koala are currently listed as Endangered under Part 2 of Schedule 1 of the TSC Act (Hawks Nest and Tea Gardens area population and the Pittwater Local Government Area population). The proposed Modification area is outside the occurrence of these populations.

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

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

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

Not applicable.

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

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

The amount of marginal foraging habitat (which includes sparsely distributed feed trees) proposed for removal is considered to be relatively small. The habitat proposed for removal (approximately 21.9 ha) is insignificant in relation to the amount of undisturbed good quality habitat that will remain within the wider locality.

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

The home range of Koala varies with quality of habitat, ranging from less than two hectares to several hundred hectares in size (Lunney *et al.* 2000). The feed trees proposed for removal occur in the isolated patches of Poplar Box Grassy Woodland, River Red Gum located throughout the survey site and all the White box woodlands. Koala habitat will remain in the locality and the nature of clearing will not fragment habitat significantly.

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

The survey area provides a relatively small amount of suitable foraging habitat for Koalas. Foraging opportunities occurring in the proposed Modification area (i.e. *Eucalyptus populnea* and *E. pilligarensis* trees), will be retained within the wider locality. The proposed Modification would not impact habitat considered critical to the long-term survival of populations in the locality and is unlikely to further create a barrier to movement for the species.

The quality and importance of habitat proposed for removal is not considered to be significant for the local Koala population.

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

The Office of Environment and Heritage maintains a register of critical habitat. No critical habitat has been listed for this species to date. The land within the proposed Modification area is highly fragmented with weed incursions and contains only a moderate diversity of native understory species. This land does not contain significant foraging habitat for Koala. As such this area is unlikely to be critical to the survival of the species.

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

A recovery plan has been prepared for the Koala (Department of Environment and Climate Change 2008b) and aims to:

- reverse the decline of the Koala in NSW
- ensure adequate protection, management and restoration of Koala habitat
- maintain healthy and breeding populations of Koalas are present throughout their current range (NSW National Parks and Wildlife Service 2003a).

Specific objectives of the plan are to:

- conserve Koalas in their existing habitat
- rehabilitate and restore Koala habitat and populations
- develop a better understanding of the conservation biology of Koalas
- ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local scale
- manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care
- manage over-browsing to prevent both Koala starvation and ecosystem damage in discrete patches of habitat.

Although the proposed Modification would include removal of a small area of fragmented habitat (21.9 ha) this is unlikely to affect the conservation of Koalas within the proposed Modification area or interfere with any of the other objectives of the draft recovery plan.

The proposed Modification would not interfere with the objectives or recovery actions proposed in the plan.

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

Key Threatening Processes are listed in Schedule 3 of the TSC Act 1995. The Koala is subject to a number of key threatening processes as well as other threats (Table 16.1).

The proposed Modification would include clearing of native vegetation which is listed as a Key Threatening Process under the TSC Act 1995. However, the native vegetation to be affected is minimal and would include only a few individual *Eucalyptus populnea* a preferred feed tree, in several isolated patches Poplar Box Grassy Woodland. The proposed Modification would be unlikely to result in the increase in any other recognised threat for this species.

Table 16.1 Recognised threats for Koalas

Threat to species	Key Threatening Process	Threat likely to increase as a result of the proposed Modification
Clearing of Native Vegetation	Yes	Yes
Predation by European Red Fox	Yes	No
Fragmentation of habitat through clearing for agriculture and development in coastal areas	No	No
Mortality from attacks by dogs, road fatalities, fires, drought or other natural disasters, particularly in fragmented landscapes without suitable refuge areas	No	No
Increase in weed invasion	Invasion by vines and scramblers is listed Invasion by *Lantana camara* has a preliminary listing	No
Stressed populations, infection by Chlamydia, causing cystitis, keratoconjunctivitis, infertility and other symptoms	No	No
Ecological consequences of high frequency fires	Yes	No
Degradation of habitat and removal of important habitat trees	No	No. Only a few young feed trees on the edge of a clearing would be removed.
Human caused climate change	Yes	No

Conclusion

No Koalas were recorded during field surveys for the proposed Modification however habitat in the form of feed trees (*E. poplar* and *E. pilligaensis*) were identified therein. One Koala was recorded during field surveys for the associated BCEP in 2010.

The proposed Modification requires the removal of 21.9 ha of woodland containing feed trees likely to be utilised by Koalas. Vegetation to be removed is not considered to be of great significance to the species, due to the abundance of retained habitat of similar or higher quality elsewhere in the wider locality. Therefore, it is considered unlikely that the proposed works will have a significant adverse effect on the species.

18.2 EPBC Act significance assessment

The Koala is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of Environment 2013). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

Is this part of an important population?

The Koala occurs along the east coast of Australia and extends into Woodland, Mulga and River Red Gum forests west of the Great Dividing Range (Department of Environment and Climate Change 2008a). The range of the Koala covers all such suitable areas of NSW.

What is of most importance to this species is the presence of feed tree species as listed in Schedule 2 of the NSW SEPP 44. The survey area contains two feed tree species *E. poplar* and *E. pilligaensis.* These feed tree species also occur in abundance within the locality and greater region further afield. Although the site does provide potential foraging habitat due to the presence of feed tree species, similar suitable habitat occurs widely within the vicinity of the survey area and the wider locality. As a consequence, foraging habitat within the site is not considered critical to maintaining Koala populations.

Potential occurrences of this species within the survey area are not at the limits of the species' distribution and as such the site can only be considered to represent a part of the range of widely occurring individuals. For these reasons, if present within the site, individuals of this species would not be considered to be part of an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

Lead to a long-term decrease in the size of an important population of a species

Not applicable, not part of an important population see above.

Reduce the area of occupancy of an important population of the species

Not applicable, not part of an important population see above.

Fragment an existing important population into two or more populations

Not applicable, not part of an important population see above.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)

- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of Environment 2013).

The relatively small area of potential habitat likely to be affected by the Modification (21.9 ha) represents a relatively small component of locally occurring resources that would be accessible to this species. Therefore, the removal of about 21.9 ha of potential habitat would not be considered critical to the survival of this species.

Disrupt the breeding cycle of an important population

Not applicable, not part of an important population see above.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The Modification would remove approximately 21.9 ha of potential habitat for this species. It is not expected that the Modification will significantly modify, destroy, remove, isolate or decrease the availability or quality of habitat for the Koala to cause the species to decline. The Modification area is located within the locality and Boggabri Mine Biodiversity Offset properties which contain similar and higher quality habitat than that contained within the Modification area. This species is known to highly mobile in which to seek out preferable feeding resources and the Modification area would represent a small portion of this foraging area. The area of potential habitat likely to be affected (21.9 ha) represents a small component of locally occurring resources that would be accessible to this highly mobile species. Therefore, the removal of about 21.9 ha of potential habitat, is unlikely to cause the Koala to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Koala would become further established as a result of the Modification.

Introduce disease that may cause the species to decline

It is not likely that diseases that are potentially harmful to the Koala would become further established or introduced as a result of the Modification.

Will the action interfere with the recovery of the species?

The NSW Recovery plan for the Koala (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Koala recovery plan (Menkhorst *et al.* 1999) include:

1. conserving koalas in their existing environment;
2. rehabilitating and restoring koala habitat and populations;
3. developing a better understanding of the conservation biology of koalas;
4. ensuring the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local scale;

5. managing captive, sick or injured koalas and orphaned wild koalas to ensure consistent and high standards of care;

6. managing overbrowsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat; and

7. coordinating, promoting of implementation, and monitoring of the effectiveness of the NSW Koala Recovery Strategy across NSW.

Based on the potential ecological impacts of the Modification on this species, as discussed above, it is likely that the Modification would be in conflict with the second objective above, by removing approximately 21.9 ha of potential habitat for the Koala. However, the habitat to be removed is relatively low quality with scattered feed tree species and habitat compensatory programs including biodiversity offsetting involving habitat rehabilitation and conservation is being undertaken on Boggabri Mine Offset properties in the vicinity of the Modification.

Due to the largely low quality habitat likely to be affected by the Modification and the abundance of similar, and likely better quality habitat in the locality and greater region, the Modification is not likely to interfere with the recovery of the this species.

Conclusion

No Koalas were recorded during field surveys for the proposed Modification however habitat in the form of feed trees (*E. poplar* and *E. pilligaensis*) were identified therein. One Koala was recorded during field surveys for the associated BCEP in 2010.

The proposed Modification requires the removal of 21.9 ha of woodland containing feed trees likely to be utilised by Koalas. Vegetation to be removed is not considered to be of great significance to the species, due to the abundance of retained habitat of similar or higher quality elsewhere in the wider locality.

While the Modification would add incrementally to the loss of suitable habitat for this species, given that the Modification is associated with the existing Boggabri Mine complex, the Modification is not likely to further fragment or isolate potential habitat for these species. Therefore, the proposal is not likely to have a significantly adverse effect on the Koala.

19. Pale-headed Snake (*Hoplocephalus bitorquatus*)

Status

The Pale-headed Snake is listed as Vulnerable under the TSC Act.

Description

The Pale-Headed Snake is a medium-sized largely tree-dwelling snake to 90 cm long. It is a uniform light brown or grey above with a white or cream band on the nape, bordered by a narrow blackish bar which may be solid, or broken in the middle. The top of the head is grey, and may have a series of black spots, which are most prominent along the edge of the white nape. The lips may have black vertical bars. The belly is creamy grey sometimes with darker flecks (Office of Environment and Heritage 2011b).

Distribution/habitat

It has a patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. The species is found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. It favours streamside areas, particularly in drier habitats. It is known to shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees (Office of Environment and Heritage 2011b).

Ecology

This snake eats a variety of vertebrates, particularly tree-dwelling species, including frogs, geckos, skinks and bats. Examination of museum specimens revealed that frogs were the most common prey item (77 per cent of 26 prey items). Pale-headed Snakes hunt out in the open at night: however during the day they may remain active within their shelter and ambush other creatures also taking refuge.

Mating behaviour has been observed mostly in captive individuals. Behaviour interpreted as courtship took place in both spring (October) and autumn (April), and actual mating in spring (September), summer (February) and autumn (March, May). In the wild, females with very large follicles have been found in mid-spring (October) and gravid females have been found in early summer (January). The species is live-bearing, and give birth to between 2 and 11 young measuring around 26-27 cm long.

Threats

Threats to the Pale-headed Snake include:

- clearing and fragmentation of habitat
- forestry practices which result in loss of old or dead trees
- too frequent burning for fuel reduction or grazing management which destroys old and dead trees and removes understorey vegetation
- illegal collection of snakes from the wild (Office of Environment and Heritage 2011a).

Recovery actions

A recovery plan has not been prepared for this species. However, the Office of Environment and Heritage has identified the following recovery measures:

- manage fire to protect old and dead trees and maintain understorey vegetation
- retain hollow-bearing trees as well as large, mature trees

- manage grazing to maintain understorey vegetation
- retain and protect stands of native vegetation, especially those with old and dead trees and along creek lines
- establish and protect forested wildlife corridors
- keep only captive-bred snakes in captivity and seek a reptile-keeper's licence from the DEC (Office of Environment and Heritage 2011b).

Specific impacts

No Pale-headed Snakes were recorded within the proposed Modification area. Potential habitat for the Pale-headed Snake exists in the riparian and woodland habitats within the proposed Modification area. These habitats include the following:

- Pilliga Box – Poplar Box White cypress pine grassy open forest.
- Yellow Box-Blakely's Red Gum grassy woodland
- Narrow - leaved Ironbark - White Cypress Pine shrubby open forest

In total, 21.9 ha of potential habitat would be removed as a result of the proposed Modification.

19.1 TSC Act significance assessment

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

This species requires large hollow bearing trees to complete vital aspects of its lifecycle such as reproduction. No hollow bearing trees will be removed by the proposal. There are a number of trees within the area however these will not require removal. Given that these trees are located in small areas of native vegetation isolated by grazed paddocks, and elevated from riparian foraging habitat, they are less likely to be utilised by the species than those located in larger areas of habitat in the locality or trees located near streams.

Although the cumulative effect of the proposed Modification and the BCEP may affect the local population, given the relatively small amount of potential habitat to be removed, it is unlikely that local populations of this species would be placed at a greater risk of extinction by the modification alone.

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

Not applicable

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

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

Not applicable

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

Not applicable

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

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

It is estimated that approximately 21.9 ha of suitable habitat would be affected by the proposal. Although hollow-bearing trees do occur within the area none will be removed.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Approximately 21.9 ha of potential habitat is likely to be disturbed in the study area, and whilst potential habitat would be affected by the proposed Modification, thereby reducing the overall extent of potential habitat, connectivity would not be significantly impacted any more than currently occurs in the locality.

It is considered unlikely that habitat would become further isolated or fragmented significantly beyond that currently existing within the study area.

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

The proposal will result in the removal of approximately 21.9 ha of potential habitat for the Pale-Headed Snake. Little increase in fragmentation is expected from the proposed modification in light of the fragmented landscape surrounding the study area. Some small increase to isolation of habitat patches will occur. However, no impacts to dispersal are predicted for this species.

The importance of the habitat to be removed by the proposal in terms of the long-term survival of the Pale-Headed Snake in the locality is likely to be low. The habitat on site is considered to be moderately suitable when compared to the habitat present in the broader locality. The area of potential habitat to be removed is unlikely to be of critical importance to the long-term survival of the Pale-Headed Snake as it is small in relation to the extent of available habitat that occurs in the locality.

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

No critical habitat has been listed for the Pale-headed Snake to date. It is estimated that approximately 21.9 ha of suitable habitat would be affected by the proposed Modification: Suitable habitat occurring in the Modification is not considered critical to the survival of these species.

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

There is no recovery plan for the Pale-headed Snake as produced under the TSC Act. The Office of Environment and Heritage has identified recovery measures of which two will be interfered with by the Project:

- retain hollow-bearing trees as well as large, mature trees
- retain and protect stands of native vegetation, especially those with old and dead trees and along creek lines (Office of Environment and Heritage 2011b).

Owing to the small area of potential habitat for the Pale-Headed Snake to be removed and the extent of similar or greater quality habitat within the surrounding landscape, the proposed Modification is unlikely to interfere substantially with the recovery of the species.

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

The action proposed constitutes the following key threatening processes, as listed under the TSC Act 1995:

- clearing of native vegetation

Considering the cumulative impact the BCEP and proposed Modification, these key threatening processes could negatively impact the Pale-headed Snake. However, the proposed Modification would only affect a small area of suitable habitat in relation to the availability to these habitats in the broader locality.

Threat abatement plans have not been prepared for these processes.

Conclusion

Taking into consideration the significant impact criteria outlined above, and based on the fact that the potential habitat that would be affected (21.9 ha) is only likely to make up a small proportion of the habitat in the locality, the proposed Modification is unlikely to result in a significant impact to the Pale-Headed Snake.

20. Appendix E References

Adam, P & Robinson, D 1996, 'Negative effects of fuel-reduction burning on the habitat of the Grey-crowned Babbler *Pomatostomus temporalis*', *Victorian Naturalist*, vol. 113, pp. 4-9.

Benson, D & McDougall, L 1993, 'Ecology of Sydney Plant Species Part 1: Ferns, Fern-allies, Cycads, Conifers and Dicotyledon families Acanthaceae to Aspclepiadaceae', *Cunninghamia*, vol. 3, no. 2, pp. 257-422.

Churchill, S 1998, *Australian Bats*, Reed New Holland, Sydney.

Churchill, S 2008, *Australian Bats*, 2nd edn, Allen & Unwin, Sydney.

Cole, I & Lunt, ID 2005, 'Restoring Kangaroo Grass (*Themeda triandra*) to grassland and woodland understoreys: a review of establishment requirements and restoration exercises in south-east Australia', *Ecological management and restoration*, vol. 6, no. 1, pp. 28-33.

Counsilman, JJ 1979, 'Notes on the breeding biology of the Grey-crowned Babbler', *Bird Behaviour*, vol. 1, no. 1, pp. 114-24.

David Robertson 2009, *Discussion of local threatened species*

Davidson, I & Robinson, D 1992, *Grey-crowned Babbler Action Statement No 34* Department of Sustainability and Environment, Victoria.

Debus, SJS, McAllan, IAW & Morris, AK 1993, 'The Square-tailed Kite *Lophoictinia isura* in NSW', *Australian Birds*, vol. 26, pp. 104- 17.

Department of Environment 2013, *Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia, Canberra, ACT,

Department of Environment and Climate Change 2005, *Eastern False Pipistrelle Threatened Species Profile*

Department of Environment and Climate Change 2007, *Threatened species assessment guidelines. The assessment of significance*, Department of Environment and Climate Change, Hurstville.

Department of Environment and Climate Change 2008a, *Approved Recovery Plan for the Koala*

Department of Environment and Climate Change 2008b, *Recovery Plan for the Koala (Phascolarctos cinereus) (Approved)*, Department of Environment and Climate Change, Sydney.

Department of Environment and Climate Change 2009, *Threatened Species Profile Digitaria porrecta (Finger Panic Grass)*, viewed 15 September 2009.

Department of Environment and Conservation 2005, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2006a, 'Recovery Plan for the Large Forest Owls: Powerful Owl *(Ninox strenua),* Sooty Owl *(Tyto tenebricosa),* Masked Owl *(Tyto novaehollandiae).*'.

Department of Environment and Conservation 2006b, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2006c, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Heritage 2004, *Grassy white box woodlands - Advice to the Minister for the Environment and Heritage from the Endangered Species Scientific Subcommittee (ESSS) on a proposal to add an ecological community to Schedule 2 of the Endangered Species Protection Act 1992 (ESP Act)*

Department of Environment and Heritage, Canberra.

Department of Environment and Heritage 2006, *Species list for the EPBC Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands*, unpublished,

Department of Environment Climate Change and Water 2011, *National Recovery Plan White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland*, Sydney.

Department of Environment Water Heritage & Arts 2009, *Polytelis swainsonii — Superb Parrot species profile*, <http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=738>.

Department of Environment Water Heritage and the Arts 2008a, *Approved Conservation Advice for Digitaria porrecta (Finger Panic Grass)*, viewed 26/10/2009 <http://www.environment.gov.au/biodiversity/threatened/species/pubs/12768-conservation-advice.pdf>.

Department of Environment Water Heritage and the Arts 2008b, *Approved conservation advice for Tylophora linearis*, viewed 31/07/2013 2013, <http://www.environment.gov.au/biodiversity/threatened/species/pubs/55231-conservation-advice.pdf>.

Department of the Environment and Heritage 2006a, *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*, Department of the Environment and Heritage, Canberra.

Department of the Environment and Heritage 2006b, *EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands* Department of the Environment and Heritage, Canberra.

Department of the Environment and Heritage 2006c, *Register of critical habitat*, Department of Environment and Heritage,, 2006.

Duncan, A, Baker, BG & Montgomery, N 1999, *The Action Plan for Australian Bats*, Canberra.

Garnett, ST & Crowley, GM 2000, *The Action Plan for Australian Birds*, Environment Australia, Canberra.

Geering, D & French, K 1998, 'Breeding biology of the Regent Honeyeater *Xanthomyza phrygia* in the Capertree Valley, New South Wales', *Emu*, vol. 98, pp. 104-16.

Gibbons, P & Boak, M 2002, 'The value of paddock trees for regional conservation in an agricultural landscape', *Ecological Management & Restoration*, vol. 3, no. 3, p. 205.

Gibbons, P & Lindenmayer, DB 2000, *Conserving hollow-dependent fauna in timber-production forests*, Australian National University, Centre for Resource and Environmental Studies., Canberra.

Goldingay, RL & Sharpe, DJ 1998, 'Feeding behaviour of the Squirrel Glider at Bungawalbin Nature Reserve, north-eastern New South Wales', *Wildlife Research*, vol. 25, no. 1, pp. 243-54.

Higgins, PJ (ed.) 1999, *Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbirds*, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

Higgins, PJ & Davies, SJF (eds) 1996, *Handbook of Australian, New Zealand and Antarctic Birds.*, Volume 3 Snipe to Pigeons, Oxford University Press, Melbourne.

Higgins, PJ & Peter, JM (eds) 2002, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 6: Pardalotes to Shrike-thrushes, Oxford University Press, Melbourne.

Higgins, PJ, Peter, JM & Steele, WK (eds) 2001, *Handbook of Australian, New Zealand and Antarctic Birds Volume 5: Tyrant-flycatchers to Chats*, Oxford University Press, Melbourne.

Jones, DL 2006, *A complete guide to native orchids of Australia including island Territories*, Reed New Holland, Sydney.

Kavanagh, RP 2009, 'Conserving Barking Owls in the Pilliga Forests', *Wingspan*, vol. 19, no. 2, pp. 28-30.

Kavanagh, RPaMM 1996, 'Home range, habitat and behaviour of the Masked Owl *Tyto novaehollandiae* near Newcastle, NSW.', *Emu*, vol. 96, pp. 250-7.

Lunney, D, Mattews, A, Moon, C & Ferrier, S 2000, 'Incorporating habitat mapping into practical Koala conservation on private lands', *Conservation Biology*, vol. 14, no. 3, pp. 669-80.

Melzer, A, Carrick, F, Menkhorst, P & Lunney, D 2000, 'Overview, critical assesment and conservation implications of Koala distribution and abundance', *Conservation Biology*, vol. 14, no. 3, pp. 619-28.

Menkhorst, P, Schedvin, N & Geering, D 1999, *Regent Honeyeater (Xanthomyza phrygia) Recovery Plan 1999-2003*, Department of Natural Resources and Environment, Canberra.

NSW Department of Environment and Climate Change 2009a, *Eastern False Pipistrelle - Threatened species profile*, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10331>.

NSW Department of Environment and Climate Change 2009b, *Regent Honeyeater - Threatened species profile*, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10841&print=yes>.

NSW Department of Environment and Climate Change 2009c, 'Turquoise Parrot Threatened species profile'.

NSW Department of Environment and Climate Change 2009d, *Yellow-bellied Sheathtail-bat - Threatened species profile*, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10741>.

NSW National Parks and Wildlife Service 1999a, *Square-tailed Kite Threatened Species Information*, NSW National Parks and Wildlife Service,, Hurstville.

NSW National Parks and Wildlife Service 1999b, *Squirrel Glider threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003, *Draft recovery plan for the Barking Owl* NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2001, *Final determination to list the Speckled warbler as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2002, *White box yellow box Blakely's red gum woodland - endangered ecological community listing. NSW Scientific Committee - final determination*, NSW National Parks and Wildlife, Hurstville.

NSW Scientific Committee 2004, *Final determination to list Masked Owl as a vulnerable species* Hurstville.

NSW Scientific Committee 2008, *Final Determination to list Tylophora linearis as a Vulnerable species*, Department of Environment and Climate Change, Hurstville.

NSW Scientific Committee 2009a, *Little Eagle (Hieraaetus morphnoides) - proposed vulnerable species listing*, Department of Environment, Climate Change and Water, Hurstville, NSW.

NSW Scientific Committee 2009b, *Spotted Harrier (Circus assimilis) - proposed vulnerable species listing*, Department of Environment, Climate Change and Water, Hurstville, NSW.

NSW Scientific Committee 2009c, *Varied Sittella (Daphoenositta chrysoptera) - proposed vulnerable species listing*, Department of Environment, Climate Change and Water, Hurstville, NSW.

Office of Environment and Heritage 2011a, *Threatened Species, Populations and Communities Database*, Office of Environment and Heritage, <http://www.threatenedspecies.environment.nsw.gov.au/>.

Office of Environment and Heritage 2011b, *Threatened species, populations and ecological communities of NSW online database*, NSW Government, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx>.

Office of Environment and Heritage 2013, *Threatened species, populations and communities database*, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx>.

Office of Environment and Heritage 2014, *Prasophyllum sp. Wybong - profile*, viewed 27 October 2014, <http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20257>.

Oliver, DL 1998, 'Roosting of non-breeding Regent Honeyeaters *Xanthomyza phyrygia*', *Emu*, vol. 98, pp. 65-9.

Oliver, DL 2000, 'Foraging behaviour and resource selection of the Regent Honeyeater *Xanthomyza phrygia* in Northern New South Wales', *Emu*, vol. 100, pp. 12-30.

Oliver, DL, Ley, AJ & Williams, B 1998, 'Breeding success and nest site selection of the Regent Honeyeater *Xanthomyza phrygia* near Armidale, New South Wales', *Emu*, vol. 98, pp. 97-103.

Parsons Brinckerhoff 2010, *Continuation of Boggabri Coal Mine - Biodiversity Impact Assessment*, A report prepared by Parsons Brinckerhoff for Hanson Bailey Pty Ltd, Newcastle, NSW.

Parsons Brinckerhoff 2013, *Booggabri Coal Expansion Project - Ecological Assessment for Boggabri Coal Project Modification* Newcastle.

Pennay, M 2001, *Results of Fauna survey work undertaken by the NSW National Parkes and Wildlife Service within Leard State Forest*, Summary report edn, WRA Biodiversity Survey Coordinator NSW National Parks and Wildlife Service, Sydney,

Pizzey, G & Knight, F 1997, *Field Guide to the Birds of Australia*, Angus and Robertson, Sydney.

Pizzey, G & Knight, F 2007, *Field Guide to the Birds of Australia*, Harper and Collins, Sydney.

Quin, DG 1995, 'Population ecology of the Squirrel Glider (*Petaurus norfolcensis*) and the Sugar Glider (*P. breviceps*) (Maruspialia : Petauridae) at Limeburners Creek, on the central north coast of New South Wales ', *Wildlife Research*, vol. 22, no. 4, pp. 471 - 505

Reid, JRW 1999, *Threatened and declining birds in the New South Wales Sheep-Wheat Belt: Diagnosis, characteristics and management*, NSW National Parks and Wildlife Service, Hurstville.

Robinson, D, Davidson, I & Tzaros, C 2001, *Biology and conservation of the Grey-crowned Babbler in Victoria*, Department of Natural Resources and Environment, East Melbourne.

Rowston, C 1998, 'Nest and refuge-tree usage by Squirrel Gliders, *Petaurus norfolcensis*, in south-east Queensland', *Wildlife Research*, vol. 25, no. 2, pp. 157 - 64.

Schulz, M 1991, 'The Grey-crowned Babbler *Pomatostomus temporalis*- a cause for concern in southern Victoria ', *Australian Bird Watcher*, vol. 14, no. 2, pp. 37-43.

Soderquist, T 2009, 'Conserving Barking Owls in the Pilliga Forests.', *Wingspan*, vol. 19, no. 2, pp. 31-3.

Swift Parrot Recovery Team 2001, *Swift Parrot Recovery Plan*, Department of Primary Industries, Water and Environment, Hobart.

Threatened Species Scientific Committee 2006, *Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the List of Ecological Communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act): White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands*, Department of the Environment and Heritage, Canberra.

Trail, BJ & Duncan, S 2000, *Status of birds in New South Wales temperate woodlands region: consultancy report to the NSW National Parks and Wildlife Service.*, Australian Woodlands Conservancy, Victoria.

Triggs, B 1996, *Tracks, scats and other traces: a field guide to Australian mammals*, Oxford University Press, Melbourne.

van der Ree, R 2002, 'The population ecology of the Squirrel Glider (*Petaurus norfolcensis*) within a network of remnant linear habitats', *Wildlife Research*, vol. 29, no. 4, pp. 329 - 40.

Watson, JEM, Whittaker, R & Freudenberger, D 2005, 'Bird community responses to habitat fragmentation: how consistent are they across landscapes?', *Journal of Biogeography*, vol. 32, no. 8, pp. 1353–70.

Webster, R 1988, *The Superb Parrot. A Survey of the Breeding Distribution and Habitat Requirements.*, ANPWS Report Series No. 12, Canberra.

Wheeler, DJB, Jacobs, SWL & Whalley, RDB 2002, *Grasses of New South Wales*, 3rd edn, University of New England, Armidale.

Appendix F

Biobanking field data sheets

ID = 1065

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14 (1.)

Site ID: both sides of proforma: a1 (2.)

Survey type: BB (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, JS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Rocklea near gate site [redacted] 1

Photo number:

Location recorded with GPS # or Tablet: (7.) 1:100,000 MAP NAME: 30.64972 150.01225 (8.)

Unique Point ID #:	ZONE	EASTING	NORTHING
		0	
		0	

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope

Aspect:

Landform (Quadrat) e.g. hillside, flat:

Landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance: Weeds / clearing / coal stockpiling

Community age estimate:

(11.) Ground Cover %: (12.)

Weeds %:	90-100	Bare soil	20
Canopy	—	Litter	0
Sub-canopy	—	Timber	0
Shrub	—	Rock (type)	0
Ground	↑	Vegetation (type)	80
		Total 100%	100

Vegetation community: (13.)

Mapped community:

Field Community: Exotic Grassland with scattered trees. ✓
Plains Grassland? x

Structure and composition ◆: (14.)

Strata[!]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance[¤]:
Can	3-5m	0-10%	Geijera parviflora
Shrub	0.4-3m	0-10%	Callitrus glaucophylla Dodonaea viscosa
Ground	0.1-1m	80-100%	Callotis lappulacea Echium plantagineum Brassica Centaurea calcitrapa

◆ Community structure should be described as per Specht et al 1995
[!] Emergent (E), >8m - tree layers (T1, T2...Tn), <8m - shrub layers (S1, S2...Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
[¤] Dominant (c), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q1

Species	Presence	Strata	Species	Presence	Strata
1 Callitris glaucophylla	1		42		
2 Dodonaea viscosa	1		43		
3 Geijera parviflora	2		44		
4 Brassica sp	5		45		
5 Calotis lappulaceae	2		46		
6 Sisymbrium irio	1		47		
7 Brassica rapa	2		48		
8 Centaurea calcitrapa	4		49		
9 Austrodanthonia	2		50		
10 Bothriochloa decepiens	2		51		
11 Austrostipa aristiglumis	1		52		
12 Petrorhagia dubia	1		53		
13 Glycine tabacina	1		54		
14 Einadia polygonoides	2		55		
15 Cirsum vulgare	1		56		
16 Sclerolaena birchilli	3		57		
17 Echium plantagineum	4		58		
18 Daucus glochidiatus	2		59		
19 Chamaesyce drummondii	1		60		
20 Lomandra multi subsp multi	1		61		
21 Medicago polymorpha	2		62		
22			63		
23			64		
24			65		
25			66		
26			67		
27			68		
28			69		
29			70		
30			71		
31			72		
32			73		
33			74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of hits (tally) ORIENTATION = 0		%
Native over-storey cover (%)			
Native mid-story cover (%)			
Native ground cover grasses (%)			
Native ground cover shrubs (%)			
Native ground cover other (%)	II	2	4
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 III	48	96

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

10 - 1066

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14	1.
Site ID: both sides of proforma Q2	2.
Survey type: BB Include quadrate size, search area, transect length etc.	3.
Recorders: AC, DL, (TB), PR, JS, SH, AR	4.
Stratification and patch ID:	5.

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure: Site 30 Nth

Photo number:

Location recorded with GPS # or Tablet: 7 1:100,000 MAP NAME: 30.624 BS 150.03995 8.

Unique Point ID #: 9.

	ZONE	EASTING	NORTHING
		0	
		0	

GPS accuracy: ± metres 10.

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

11.

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: 12.

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community:

13.

Mapped community: Pilliga Box - Poplar Box - White cypress pine grassy open

Field Community: forest.

Structure and composition ❖ :

14.

Strata[!]:	Height: range & median	% foliage cover[*]:	Dominant spp. and dominance[¤]:
Can	18-25 m	0-30 %.	Eucalyptus
Shrub	0.4-2 m	0-5 %.	~~Vac~~ Vachellia farnesiana
ground	0.1-1.8 m	50-90 %.	Austrostipa aristaglumis Circium vulgare Brassica Silybum marianum

❖ Community structure should be described as per Specht et al 1995

[!] Emergent (E), >8m - tree layers (T1, T2...Tn), <8m - shrub layers (S1, S2...Sn), ground cover (gc)

[*] 100-70%(4), 70-30%(3) 30-10% (2), <10% (1)

[¤] Dominant (d), Associater (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q2 | 2

Species	Presence	Strata	Species	Presence	Strata
1 Eucalyptus	4		43		
2 Vachellia farnesiana	2		45		
3 Austrostipa aristiglumis	3		44		
4 Cirsium vulgare	2		45		
5 Brassica	3		46		
6 Silybum marianum	2		47		
7 Echium plantagineum	3		48		
8 Eucalyptus blakelyi	1	?	49		
9 Einadia polygonoides	2		50		
10 Petrorhagia dubia	1		51		
11 Lolium perenne	4		52		
12 Aristida ramosa	1		53		
13 Sporobolus creber	1		54		
14 Daucus glochidiatus	1		55		
15 Dichanthium sericeum	2		56		
16 Panicum queenslandicum	1		57		
17 Sclerophylla birchii	2		58		
18 Eragrostis leptostachya	1		59		
19 Lepidium africanum	1		60		
20 Centaurea calcitrapa	2		61		
21 Sonchus oleraceus	2		62		
22 Chloris truncata	1		63		
23 Echium vulgare	1		64		
24 Oxalis cornicularis	2		65		
25 Calotis lappulacea	1		66		
26			67		
27			68		
28			69		
29			70		
30			71		
31			72		
32			73		
33			74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of hits (tally)	%
Native over storey cover (%)	0, 0, 0, 0, 0, 0, 0, 0, 0, 25, 30,	
Native mid-story cover (%)	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	0
Native ground cover grasses (%)	𝍸 𝍸 𝍸 𝍸 ~~𝍸~~ III	
Native ground cover shrubs (%)		
Native ground cover other (%)	II	
Exotic plant cover (%)	~~𝍸~~ 𝍸 𝍸 𝍸 𝍸	

Larger 60 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	1

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

ID-1067

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14 (1.)

Site ID: (both sides of proforma) Q3 (2.)

Survey type: BB (3.)
include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, JS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Site 8 - Bend off Haul Rd

Photo number:

Location recorded with GPS # or Tablet: GPS - 773? (7.)

1:100,000 MAP NAME: (8.)

Unique Point ID #:	ZONE	EASTING	NORTHING
		0	
		0	

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84 (9.)

Habitat Assessment & other site description notes: (11.)

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: (12.)

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community: (13.)

Mapped community:

Field Community: Exotic Grassland ✓

Structure and composition ◇: (14.)

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	–	–	–
ground	0.1 – 1 m	%	Avena fatua Echium plantaganium Lolium perienne.

◇ Community structure should be described as per Specht et al 1995
! Emergent (E), >8m - tree layers (T1, T2...Tr), <8m - shrub layers (S1, S2...Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q3 | 2.

Species	Presence	Strata	Species	Presence	Strata
1 Chloris truncata	1		42		
2 Avenya fatva	2		43		
3 Vittadinia cuneata	3		44		
4 Crassula colorata	3		45		
5 Centaurea calcitrapa	3		46		
6 Lolium perenne	4		47		
7 Sonchus olearus	2		48		
8 Sclerophylla brchilli	2		49		
9 Lepidium africanum	1		50		
10 Plantago debilis	2		51		
11 Petronagia dubia	1		52		
12 Echium plantaganievm	3		53		
13 Brassica nigra	2		54		
14 Brassica sp rapa	2		55		
15 Medicago sativa	3		56		
16			57		
17			58		
18			59		
19			60		
20			61		
21			62		
22			63		
23			64		
24			65		
25			66		
26			67		
27			68		
28			69		
29			70		
30			71		
31			72		
32			73		
33			74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of hits (tally)		%
Native over-storey cover (%)	0		0
Native mid-story cover (%)	0		0
Native ground cover grasses (%)	1	1	2
Native ground cover shrubs (%)			0
Native ground cover other (%)	IIII	4	8
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	45	90

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - Uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

ID – 1068

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14	1.
Site ID: both sides of proforma Q4	2.
Survey type: BB — Include quadrats size, search area, transect length etc.	3.

Recorders: AC, DL, (TB), PR, JS, SH, AR 4.

Stratification and patch ID: 5.

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Site 9 – ~~Dam Extension Project Area~~ Powerpole

Photo number:

Location recorded with GPS # or Tablet: 7 1:100,000 MAP NAME: GPS – 774 8.

Unique Point ID #: ZONE EASTING 0 NORTHING 9.

30.62161 / 150.07489

GPS accuracy: ± metres 10.

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes: 11.

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance: High weed, pasture, grazing

Community age estimate: clearing.

Weeds %:	
Canopy	0
Sub-canopy	0
Shrub	0
Ground	70–90%

Ground Cover %: 12.	
Bare soil	40
Litter	0
Timber	0
Rock (type)	0
Vegetation (type)	60
Total 100%	100

Vegetation community: 13.

Mapped community:

Field Community: Exotic Grassland ✓

Structure and composition ❖ : 14.

Strata¹:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	–	–	–
Ground	0.1 – 0.8 m	0 – 50 %	Lolium perenne Avena fatua

❖ Community structure should be described as per Specht et al 1995
¹ Emergent (E), >8m - tree layers (T1, T2 .. Tn), <8m - shrub layers (S1, S2 .. Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF **VEGETATION SURVEY PROFORMA P2** Site ID: Q4

	Species	Presence	Strata		Species	Presence	Strata
1	Panicum queenslanchicum	2		42			
2	Echium plantaganieum	4		43			
3	Chloris divercatum	1		44			
4	Chloris truncata	1		45			
5	Lolium perenne	5		46			
6	Centaurea calcitrapa	4		47			
7	Lepidium africanum	3		48			
8	Sclerophylla birchilli	2		49			
9	Avena fatua	4		50			
10	Erodium cryptum	1		51	Blue Crows Foot		
11	Medicago sativa	2		52			
12	Brassica rapa	3		53			
13	Brassica nigra	1		54	Sisymbrium		
14	~~Echium plantagineum~~			55			
15	Trifolium arvensis	2		56			
16				57			
17				58			
18				59			
19				60			
20				61			
21				62			
22				63			
23				64			
24				65			
25				66			
26				67			
27				68			
28				69			
29				70			
30				71			
31				72			
32				73			
33				74			
34				75			
35				76			
36				77			
37				78			
38				79			
39				80			
40				81			
41				82			

Transect Number	Number of hits (tally)		%
Native over-storey cover (%)	0 → 0		0
Native mid-story cover (%)	0 → 0		0
Native ground cover grasses (%)	IIII	6	12
Native ground cover shrubs (%)			0
Native ground cover other (%)			0
Exotic plant cover (%)	IIII IIII IIII IIII IIII IIII IIII IIII IIII IIII	44	88

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

ID – 1069

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14 (1.)

Site ID: (both sides of proforma) Q5 (2.)

Survey type: BB (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB) PR, JS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Site 10 - Dam + Stockpile

Photo number:

Location recorded with GPS # or Tablet: (7.) 1:100,000 MAP NAME: GPS - 775 (6.)

Unique Point ID #:	ZONE	EASTING	NORTHING	(9.)
		0		30.62206 150.08259
		0		

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS84

Habitat Assessment & other site description notes: (11.)

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: (12.)

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community: (13.)

Mapped community: Derived Pilligar box Native Grassland

Field Community: ?

Structure and composition ❖ : (14.)

Strata[!]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance[¤]:
Can	–	–	–
Shrub			
Ground			

❖ Community structure should be described as per Specht et al 1995
! Emergent (E), >8m - tree layers (T1, T2...Tr), <8m - shrub layers (S1, S2...Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co-dominant (co), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q5 | 2.

	Species	Presence	Strata		Species	Presence	Strata
1	Bothriochloa decepiens	2		42			
2	Brassica rapa	3		43			
3	Brassica idra	3		44	Sisymbrium		
4	Austrostipa aristaglumis	1		45			
5	Chloris divercatum	2		46			
6	Vittadinia cuneata	2		47			
7	A. ramosa	2		48			
8	Lolium perenne	5		49			
9	Avenua fatua	4		50			
10	Sclerophylla birchilli	2		51			
11	Eachylaena tomentosa	2		52			
12	Medicago polymorpha	1		53			
13	Petrorhagia dubia	1		54			
14	Centaurea calcitropa	2		55			
15	Cynodon dactylon	2		56			
16				57			
17				58			
18				59			
19				60			
20				61			
21				62			
22				63			
23				64			
24				65			
25				66			
26				67			
27				68			
28				69			
29				70			
30				71			
31				72			
32				73			
33				74			
34				75			
35				76			
36				77			
37				78			
38				79			
39				80			
40				81			
41				82			

Transect Number	Number of hits (tally)		%
Native over-storey cover (%)	0 – D		0
Native mid-story cover (%)	0 – D		0
Native ground cover grasses (%)	𝍸 𝍸 I	11	22
Native ground cover shrubs (%)			0
Native ground cover other (%)			0
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 I	26	52

BARE 𝍸 3 (6%)

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

E 48
N 2

10 - 1070

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14 (1.)	
Site ID: both sides of proforma — Q6 (2.)	
Survey type: BB (3.) — Include quadrate size, search area, transect length etc.	
Recorders: AC, DL, (TB), PR, JS, SH, AR (4.)	Stratification and patch ID: (5.)
Location details: Property name, Lot Plan #, Road Name Side of Road, land tenure: Stell - Dam Project Area Extension.	Photo number:
Location recorded with GPS # or Tablet: (7.) — 1:100,000 MAP NAME: GPS 77b (6.)	

Unique Point ID #:	ZONE	EASTING	NORTHING
		0	30.62723 150.10255
		0	

GPS accuracy: ± metres (10.) — Note: All waypoints should be recorded in map datum WGS84 (9.)

Habitat Assessment & other site description notes: (11.)

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: (12.)

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community: Not mapped but close to 7 (13.)

Mapped community: ~~Dev~~ Pilliga Box - Pop Box - White Cypress Pine grassy open.

Field Community: ?

Structure and composition ◆: Native Grassland derived pop (14.)

Strata[!]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Grnd	0.1 - 1.6 m	40-60 %	A. aristaglumis C. truncata P. Greenslandium

◆ Community structure should be described as per Specht et al 1995
[!] Emergent (E), >8m - tree layers (T1, T2...Tn), <8m - shrub layers (S1, S2...Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF **VEGETATION SURVEY PROFORMA P2** Site ID: Q6

Species	Presence	Strata	Species	Presence	Strata
1 Austrostipa aristaglumis		3	42		
2 Chloris truncata		2	43		
3 Aristida ramosa		2	44		
4 Digitaria breviglumis		2	45		
5 Chloris divericata		3	46		
6 Sclerophylla birchilli		3	47		
7 Panicum queenslandicum		3	48		
8 Medicago sativa		3	49		
9 Silybum		2	50		
10 Lolium perenne		2	51		
11 Centaurium calcitrapa		3	52		
12 Daucus glochinoides		2	53		
13 Medicago poly		1	54		
14 Trifolium arvensis		2	55		
15 Brassica rapa		1	56		
16 Echium vulgare		1	57		
17			58		
18			59		
19			60		
20			61		
21			62		
22			63		
23			64		
24			65		
25			66		
26			67		
27			68		
28			69		
29			70		
30			71		
31			72		
32			73		
33			74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of hits (tally)		%
Native over-storey cover (%)	0		0
Native mid-story cover (%)	0		0
Native ground cover grasses (%)	𝍸 𝍸 𝍸 𝍸	20	40
Native ground cover shrubs (%)	11	2	4
Native ground cover other (%)	1	1	2
Exotic plant cover (%)	𝍸 𝍸	10	20

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

ID-1071

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14	1.
Site ID: both sides of proforma Q7	2.
Survey type: BB Include quadrate size, search area, transect length etc.	3.
Recorders: AC, DL, (TB), PR, JS, SH, AR	4.
Stratification and patch ID:	5.

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure

Est Site 11 → Dam Extension Project Area

Photo number:

Location recorded with GPS # or Tablet: 7 1:100,000 MAP NAME: GPS 777 8.

Unique Point ID #:	ZONE	EASTING	NORTHING	9.
		0		30.62750 150.11862
		0		

GPS accuracy: ± metres 10. Note: All waypoints should be recorded in map datum WGS84

Habitat Assessment & other site description notes: 11.

Slope:

Aspect:

Landform (Quacrat) e.g. hillsice, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: 12.

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community: 13.

Mapped community: – Exotic on edge

Field Community: Exotic Grassland.

Structure and composition * : 14.

Strata[1]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	0.4 – 1 m	5 – 20 %	Mairena microphylla
ground	0.1 – 1 m	– %	Paddy's Curse L. perenne B. decipiens

◇ Community structure should be described as per Specht et al. 1995

1: Emergent (E), >8m - tree layers (T1, T2...Tn), <8m - shrub layers (S1, S2...Sn), ground cover (gc)

* 100-70%(4), 70-20%(3) 30-10% (2), <10% (1)

¤ Dominant (d), Associates (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF **VEGETATION SURVEY PROFORMA P2** Site ID: Q7 2.

Species	Presence	Strata	Species	Presence	Strata
1 Chloris truncata	3		42		
2 Vittadinia cuneata	2		43		
3 Echium plantaganum	4		44		
4 Rumex crispix	2		45		
5 Panicum queenslandicum	2		46		
6 Sclerophylla birchilli	3		47		
7 Austrostipa anstglumis	2		48		
8 Lolium perenne	5		49		
9 Medicago sativa	2		50		
10 Centaurium calcitrapa	4		51		
11 Aristida ramosa	2		52		
12 Dichanthium sericium	3 1		53		
13 Bothriochloa decepiens	2		54		
14 Callotis lappulaceae	1		55		
15 Chamaesyce drummondii	1		56		
16 Malvena microphylla	4		57		
17 Chloris gayana	3		58		
18 Paspalum dilatatum	3		59		
19 Cynodon dactylon	2		60		
20 Carolina modulla	2		61		
21			62		
22			63		
23			64		
24			65		
25			66		
26			67		
27			68		
28			69		
29			70		
30			71		
31			72		
32			73		
33			74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of hits (tally)	%
Native over-storey cover (%)	0	0
Native mid-story cover (%)	0	0
Native ground cover grasses (%)	1111	4 8
Native ground cover shrubs (%)	111	3 6
Native ground cover other (%)	1	1 2
Exotic plant cover (%)		84

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.6 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistant throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

ID - 1072

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14	1.
Site ID: (both sides of proforma) Q8	2.
Survey type: BB (include quadrate size, search area, transect length etc.)	3.
Recorders: AC, DL, TB, PR, JS, SH, AR	4.
Stratification and patch ID:	5.

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure

Victoria Site 30

Photo number:

Location recorded with GPS # or Tablet: GPS 778 / 1:100,000 MAP NAME: 6.

Unique Point ID #:	ZONE	EASTING	NORTHING	9.
		0		30.65324 150.12695.
		0		

GPS accuracy: ± metres 10. Note: All waypoints should be recorded in map datum WGS84

Habitat Assessment & other site description notes: 11.

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Ground Cover %: 12.

Weeds %:	Bare soil	20
Canopy	Litter	0
Sub-canopy	Timber	0
Shrub	Rock (type)	0
Ground 80-90%	Vegetation (type)	80
	Total 100%	100

Vegetation community: 13.

Mapped community: –

Field Community: Exotic Grassland.

Structure and composition ◆ : 14.

Strata[1]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	–	–	–
ground	0.1 - 0.5 m	40-90 %	Lolium perenne. Centaurium calcitrapa Bothriola decepiens Sclerophylla birchii.

◆ Community structure should be described as per Specht et al 1995

[1] Emergent (E), >8m - tree layers (T1, T2, ..Tn), <8m - shrub layers (S1, S2 ..Sn), ground cover (gc)

* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)

¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q8 | 2.

Species	Presence	Strata	Species	Presence	Strata
1 Chloris truncata		1	41		
2 Sonchus oleareus.		3	42		
3 Trifolium arversis		3	43		
4 Dichanthium sericum		3	44		
5 Centaurea calcitrapa		5	45		
6 Bothriochloa decipiens		2	46		
7 Cynodon dactylon		2	47		
8 Lolium perene		45	48		
9 Sclerophylla birchilli		3	49		
10 Sida corrugata		1	50		
11 Daucus glochinoides		1	51		
12 Vittadinia cuneata		1	52		
13 Eragrostis leptostachya		2	53		
14			54		
15			55		
16			56		
17			57		
18			58		
19			59		
20			60		
21			61		
22			62		
23			63		
24			64		
25			65		
26			66		
27			67		
28			68		
29			69		
30			70		
31			71		
32			72		
33			73		
34			74		
35			75		
36			76		
37			77		
38			78		
39			79		
40			80		
41			81		
			82		

Transect Number	Number of hits (tally)		%
Native over-storey cover (%)	0 →		0
Native mid-story cover (%)	0 →		0
Native ground cover grasses (%)	卌 卌 卌		30
Native ground cover shrubs (%)	—		0
Native ground cover other (%)	—		0
Exotic plant cover (%)	卌 卌 卌 卌 卌 卌 IIII	34	68

BARE 1

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.6 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14 (1.)

Site ID: (both sides of proforma) Q9 (2.)

Survey type: BB (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, JS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Victoria Site 30

Photo number: (6.)

Location recorded with GPS # or Tablet: GPS 779 (7.) 1:100,000 MAP NAME: (8.)

Unique Point ID #:	ZONE	EASTING	NORTHING	(9.)
		0		30.63970
		0		150.10851

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes: (11.)

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: (12.)

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community: (13.)

Mapped community: –

Field Community: ~~Exotic Grassland~~ Derived Native Grassland (Pilgar)

Structure and composition ◆: (14.)

Strata[1]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	–	–	–
ground			

◆ Community structure should be described as per Specht et al 1995
[1] Emergent (E), >8m - tree layers (T1, T2...Tn), <8m - shrub layers (S1, S2...Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q9 | 2.

	Species	Presence	Strata		Species	Presence	Strata
1	Rodanthe diffusa subsp leucactina	6		42			
2	Lolium perenne	4		43			
3	Sonchus oleacus	2		44			
4	Trifolium sativa	3		45			
5	Trifolium arvensis	1		46			
6	Centaurea calcitrapa	3		47			
7	Austrostipa aristaglumis	3		48			
8	Aristida ramosa	2		49			
9	Lepidium africanum	1		50			
10	Sclerophylla brachili	2		51			
11	Chloris divercatum	5		52			
12				53			
13				54			
14				55			
15				56			
16				57			
17				58			
18				59			
19				60			
20				61			
21				62			
22				63			
23				64			
24				65			
25				66			
26				67			
27				68			
28				69			
29				70			
30				71			
31				72			
32				73			
33				74			
34				75			
35				76			
36				77			
37				78			
38				79			
39				80			
40				81			
41				82			

Transect Number	Number of hits (tally)		%
Native over storey cover (%)	0 → D		
Native mid-story cover (%)	0 → D		
Native ground cover grasses (%)	11	2	4
Native ground cover shrubs (%)			0
Native ground cover other (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 IIII	34	68
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 I	21	42

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	
2. Proportion of canopy species regeneration	
3. Number of trees with hollows > 5 cm	

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

ID- 1074

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14	1.
Site ID: (both sides of proforma) Q10	2.
Survey type: BB (include quadrate size, search area, transect length etc.)	3.
Recorders: AC, DL, (TB), PR, JS, SH, AR	4.
Stratification and patch ID:	5.

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure: Middle paddock Victoria

Photo number:

Location recorded with GPS # or Tablet: 7 1:100,000 MAP NAME: GPS 780 8.

Unique Point ID #:	ZONE	EASTING	NORTHING	9.
		0		30.65073 150.10316
		0		

GPS accuracy: ± metres 10.

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes: 11.

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: 12.

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community: 13.

Mapped community:

Field Community: Exotic Grassland

Structure and composition ◆ : 14.

Strata[I]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	–	–	–
ground	0.1–0.4m	0–50 %	Centaurea calcitropa

◆ Community structure should be described as per Specht et al 1995

I: Emergent (E), >9m - tree layers (T1, T2, ..Tr), <9m - shrub layers (S1, S2...Sn), ground cover (gc)

* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)

¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P2

Site ID: Q10

	Species	Presence	Strata		Species	Presence	Strata
1	Brassica rapa			42	3		
2	Trifolium arvensis			43	3		
3	Lolium perenne			44	4		
4	Bothriochloa decepiens			45	1		
5	Sporobolus caroli			46	1		
6	Chloris truncata			47	1		
7	Rhodanthe diffusa subsp leucachnoi			48	2		
8	Austrodanthonia			49	2		
9	Villadinia cuneata			50	1		
10	Sclerophylla birchilli			51	2		
11	Centaurea calcitropa			52	5		
12				53			
13				54			
14				55			
15				56			
16				57			
17				58			
18				59			
19				60			
20				61			
21				62			
22				63			
23				64			
24				65			
25				66			
26				67			
27				68			
28				69			
29				70			
30				71			
31				72			
32				73			
33				74			
34				75			
35				76			
36				77			
37				78			
38				79			
39				80			
40				81			
41				82			

Transect Number	Number of hits (tally)		%
Native over-storey cover (%)			0
Native mid-story cover (%)			0
Native ground cover grasses (%)	IIII	4	8
Native ground cover shrubs (%)			0
Native ground cover other (%)	II	2	4
Exotic plant cover (%)	~~HH~~ ~~HH~~ ~~HH~~ ~~HH~~ ~~HH~~ ~~HH~~ ~~HH~~ IIII	44	88

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

N 10
E 40

ID-1075

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14 (1.)

Site ID: (both sides of proforma) Q11 (2.)

Survey type: BB (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, JS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Corner paddock

Photo number:

Location recorded with GPS # or Tablet: GPS 781 (8.)

1:100,000 MAP NAME:

Unique Point ID #:	ZONE	EASTING	NORTHING	(9.)
		0		30.63959 150.06418
		0		

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes: (11.)

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

lancform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evicence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: (12.)

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community:

Mapped community: –

Field Community: ? Exotic Grassland.

782 (13.)
30.64321
150.05663

Structure and composition ◆ : (14.)

Strata :	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	–	–	–
Ground			

◆ Community structure should be described as per Specht et al 1995
! Emergent (E), >8m tree layers (T1, T2...Tn), <8m shrub layers (S1, S2...Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q11 | 2.

Species	Presence	Strata	Species	Presence	Strata
1 Brassica rapa		4	42 Bb		
2 Brassica rog		2	43		
3 Trifolium sativa		3	44		
4 Avena fatua		3	45		
5 Sonchus oleareus		2	46		
6 Sclerophylla archilli		1	47		
7 Enchylaena tomentosa		1	48		
8 Lolium perenne	5		49		
9 Lepidium africanum		1	50		
10 Echium plantagoneum		3	51		
11 Chloris divercatum		2	52		
12 Solanum parvitorum		1	53		
13 Crassula colorata		3	54		
14 Vittadinia cuneata		2	55		
15 Tribulum arvensis		2	56		
16 centaurea calcitrapa		3	57		
17 Austrostipa aristaglumis	1		58		
18 Bromus arvensis		2	59		
19			60		
20			61		
21			62		
22			63		
23			64		
24			65		
25			66		
26			67		
27			68		
28			69		
29			70		
30			71		
31			72		
32			73		
33			74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of hits (tally)		%
Native over-storey cover (%)	0 →		0
Native mid-story cover (%)	0 →		0
Native ground cover grasses (%)	1	1	2
Native ground cover shrubs (%)			0
Native ground cover other (%)	III	3	6
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 I	46	92

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.6 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

N 3
E 47

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14 (1.)

Site ID: both sides of proforma Q12 (2.)

Survey type: BB (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, JS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
BORE

Photo number: GPS 782

Location recorded with GPS # or Tablet: (7.) 1:100,000 MAP NAME: (8.)

Unique Point ID #:	ZONE	EASTING	NORTHING	(9.)
		0		-30.64321 150.05663
		0		

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS84

Habitat Assessment & other site description notes: (11.)

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

Landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: (12.)

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total	100%

Vegetation community: (13.)

Mapped community:

Field Community: Cropping

Structure and composition ◆: (14.)

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	–	–	–
ground	0.1 – 1 m	80 – 100%	wheat

◆ Community structure should be described as per Specht et al 1995
! Emergent (E), >8m - tree layers (T1, T2...Tn), <8m - shrub layers (S1, S2 ..Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q12 | 2

Species	Presence	Strata	Species	Presence	Strata
1 Wheat	7		42		
2 Brassica rapa	3		43		
3 Sisymbrium irio	2		44		
4 Medicago poly	3		45		
5 Anagallis arvensis	2		46		
6 Vulpia myuros	1		47		
7 Lolium perenne	3		48		
8 Avena sativa	2		49		
9 Bromus cinctus	1		50		
10			51		
11			52		
12			53		
13			54		
14			55		
15			56		
16			57		
17			58		
18			59		
19			60		
20			61		
21			62		
22			63		
23			64		
24			65		
25			66		
26			67		
27			68		
28			69		
29			70		
30			71		
31			72		
32			73		
33			74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of hits (tally)	%
Native over-storey cover (%)	0	0
Native mid-story cover (%)	0	0
Native ground cover grasses (%)		0
Native ground cover shrubs (%)		0
Native ground cover other (%)		0
Exotic plant cover (%)	50	100

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

10 – 1076

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14 (1.)

Site ID: (both sides of proforma) Q13 (2.)

Survey type: BB (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, JS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Site 6 – Middle Bore

Photo number: (6.)

Location recorded with GPS # or Tablet: GPS 783 (7.)

1:100,000 MAP NAME: (8.)

Unique Point ID #:	ZONE	EASTING	NORTHING	(9.)
		0		30.64352 150.06668
		0		

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes: (11.)

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: (12.)

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total	100%

Vegetation community: (13.)

Mapped community: Exotic Grassland.

Field Community:

Structure and composition ◆: (14.)

Strata[!]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance[¤]:

◆ Community structure should be described as per Specht et al 1995
! Emergent (E), >8m - tree layers (T1, T2...Tn), <8m - shrub layers (S1, S2...Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q13 | 2.

	Species	Presence	Strata		Species	Presence	Strata
1	Echium plantgorium	2		42			
2	Avena fatua	2		43			
3	Lolium perenne	3		44			
4	Triticum aestivum	7		45			
5	Brassica rapa	4		46			
6	Brassica nigra	3		47			
7	Sonchus olearus	2		48			
8	Trifolium sativa	3	Medium	49			
9	Enchymana tomentosa	1		50			
10				51			
11				52			
12				53			
13				54			
14				55			
15				56			
16				57			
17				58			
18				59			
19				60			
20				61			
21				62			
22				63			
23				64			
24				65			
25				66			
26				67			
27				68			
28				69			
29				70			
30				71			
31				72			
32				73			
33				74			
34				75			
35				76			
36				77			
37				78			
38				79			
39				80			
40				81			
41				82			

Transect Number	Number of hits (tally)	%
Native over-storey cover (%)		
Native mid-story cover (%)		
Native ground cover grasses (%)		
Native ground cover shrubs (%)		
Native ground cover other (%)		
Exotic plant cover (%)	卌 卌 卌 卌 卌 卌 卌 卌 卌 卌	100

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

10 - 1076

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14	1.
Site ID: (both sides of proforma) Q~~3~~14	2.
Survey type: BB (include quadrate size, search area, transect length etc.)	3.
Recorders: AC, DL, (TB) PR, JS, SH, AR	4
Stratification and patch ID:	5
Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure: Roma Bore Site 6	
Photo number:	
Location recorded with GPS # or Tablet:	7
1:100,000 MAP NAME: GPS 784	8.
Unique Point ID #: ZONE EASTING NORTHING: 30.64798 150.07594	9.
GPS accuracy: ± metres	10.
Note: All waypoints should be recorded in map datum WGS84	

Habitat Assessment & other site description notes:

11.

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %:

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: 12.

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community:

13.

Mapped community:

Field Community: Exotic Grassland - Crops.

Structure and composition ❖ :

14.

Strata[I]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	–	–	–
Shrub	–	–	–
Ground			

❖ Community structure should be described as per Specht et al 1995
I: Emergent (E), >8m - tree layers (T1, T2, ..Tn); <8m - shrub layers (S1, S2...Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30-10% (2), <10% (1)
¤ Dominant (d), Associated (a), co-dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q14 | 2.

Species	Presence	Strata	Species	Presence	Strata
1 Avenva fatua	3		43		
2 Echium plantagonum	3		44		
3 Lolium perenne	4		45		
4 Trifolium arvensis	2		46		
5 Sonchus oleerus	2		47		
6 Brassica rapa	3		48		
7 Brassica sp.	2		49		
8 Sclerophylla birchilli	1		50		
9 Erodium cirnitum	1		51		
10 Wheat Triticum	6		52		
11			53		
12			54		
13			55		
14			56		
15			57		
16			58		
17			59		
18			60		
19			61		
20			62		
21			63		
22			64		
23			65		
24			66		
25			67		
26			68		
27			69		
28			70		
29			71		
30			72		
31			73		
32			74		
33			75		
34			76		
35			77		
36			78		
37			79		
38			80		
39			81		
40			82		
41					

Transect Number	Number of hits (tally)	%
Native over-storey cover (%)	0	0
Native mid-story cover (%)	0	0
Native ground cover grasses (%)	0	0
Native ground cover shrubs (%)	0	0
Native ground cover other (%)	0	0
Exotic plant cover (%)	100	100

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			1 - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

ID- 1077

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 13.10.14	1.
Site ID: both sides of proforma Q #15	2.
Survey type: BB Include quadrate size, search area, transect length etc.	3.
Recorders: AC, DL, (TB) PR, JS, SH, AR	4.
Stratification and patch ID:	5.
Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure Site 6 - Nth of Bore 5m Q5.	
Photo number:	
Location recorded with GPS # or Tablet: GPS 785	6.
1:100,000 MAP NAME:	7.
Unique Point ID #: ZONE EASTING NORTHING 0 30.63827 0 150.07869	8.
GPS accuracy: ± metres 10.	Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

11.

Slope:

Aspect:

Landform (Quadrat) e.g. hillside, flat:

landform (broad):

Nearest Drainage line / catchment:

Soil: e.g. Clay, Sand, Loam Geology type:

Evidence of disturbance:

Community age estimate:

Weeds %

Canopy

Sub-canopy

Shrub

Ground

Ground Cover %: 12.

Bare soil	
Litter	
Timber	
Rock (type)	
Vegetation (type)	
Total 100%	

Vegetation community:

13.

Mapped community: Nothing - Cracking clay.

Field Community:

Structure and composition ❖: Exotic Grassland

14.

Strata[!]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:

❖ Community structure should be described as per Specht et al 1995
! Emergent (E), >8m - tree layers (T1, T2, ..Tn), <8m - shrub layers (S1, S2 ..Sn), ground cover (gc)
* 100-70%(4), 70-30%(3), 30 - 10% (2), <10% (1)
¤ Dominant (d), Associated (a), co dominant (cd), supressed (s) or combination

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: Q15 | 2

Species	Presence	Strata	Species	Presence	Strata
1 Austrostipa aristiglumis	2		42		
2 Richardia stellaris	4		43		
3 Trifolium sativa	5		44		
4 Eleocharis pusilla	3		45		
5 Rumex crispix	1		46		
6 Anagallis arvensis	3		47		
7 Trifolium arvensis	3		48		
8 Medicago poly	2		49		
9 Vulpia myuros	3		50		
10			51		
11			52		
12			53		
13			54		
14			55		
15			56		
16			57		
17			58		
18			59		
19			60		
20			61		
21			62		
22			63		
23			64		
24			65		
25			66		
25			67		
27			68		
28			69		
29			70		
30			71		
31			72		
32			73		
33			74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of h ts (tally)		%
Native over-storey cover (%)	0 →		
Native mid-story cover (%)	0 →		
Native ground cover grasses (%)	𝍸	5	10
Native ground cover shrubs (%)			
Native ground cover other (%)	𝍸 𝍸 ||	12	24
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 ||||	34	68

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	0
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance scale 1-7			* - 6 scale conversion	
1	<5% - Rare or few individuals	3 or less individuals	1	sparse <5%
2	<5% - uncommon	more than 3 - sparsely scattered	1	sparse <5%
3	<5% - common	consistent throughout plot	2	any no. < 5%
4a	<5% very abundant	many individuals throughout plot	2	any no. < 5%
4b	5% - 25%		3	5 - 25%
5	25% - 50%		4	25 - 50%
6	50% - 75%		5	50 - 75%
7	75% - 100%		6	75 - 100%

PARSONS BRINCKERHOFF

Survey Site Form - BioBanking		Site ID: Q17	Vegetation zone:
Date	22/11/14	Surveyor(s): TB	
Waypoint ID	805	Photo numbers	one station
Coordinates	E 30.62304 N 150.14024	Photo direction 7738	(N) E S W
Mapped Vegetation type: Derived Native Grassland		Condition:	Low / Mod-good
Slope: (Gentle), Mod, Steep	Aspect (degrees or cardinal): N/A	Altitude: 280 m	
Topography: crest, ridge, upper slope, mid slope, down slope, gully, (flat), depression, watercourse, escarpment, terrace			
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?			
Soil type: sand, (loam), clay, organic, gravel, skeletal, ?		Soil disturbance: (intact), topsoil removed, fill	
Remnant / Old growth (uncleared): Yes / (No) Undecided? ~~Rem~~ Derived of Pilliga Box			
Vegetative Structure (formation) = Grassland.		Ecologically Dominant Layer (EDL) - most biomass = ground.	

Strata	Height interval	Median	Est. cover	Dominant Species & Dominance
E	~~X~~			~~X~~
T1	14 - 20	17 m	< 10%	↑
T2	-			E. pilligaensis (outside plot)
T3	-			~~X~~
S1	0.4 - 3	2 m	< 5%	Dodonea viscosa Acacia decora.
S2	~~X~~			~~X~~
G	0.1 - 1.5	1 m	80-100%	Aristida sp Enteropogon acicularis Austrostipa verticillata

Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%)
Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%)

Definitions
Dominance d = dominant; c = co-dominant; s = subdominant; a = associated
Estimated cover I = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%)

Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall
W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest

50m Transect	10 Points - Foliage Projective Cover		
Point	Canopy % (photos)	Midstorey %	Exotic %
5m	0	0	0
10m	0	5	0
15m	0	10	0
20m	0	20	0
25m	0	0	0
30m	0	0	0
35m	0	0	0
40m	0	0	0
45m	0	0	0
50m	0	0	0
Total (sum / 10) =	0%	~~[illegible]~~ 3%	0%

Ground cover tally sheet, 50 points along 50m transect - every 1m record if plant intersects (hits) point	Total (hits/50)
Native grass tally - 𝍸 𝍸 𝍸 𝍸 𝍸	50%
Native other (herb, fern, sedge, etc) tally - 𝍸 II	14%
Native shrub tally - 0	0%
Exotic tally - 𝍸 𝍸 I	22%

Bare 𝍸 II

Larger 50 x 20m plot	
Length of woody debris >10cm wide & >0.5m long	0
Proportion of canopy sp. regeneration	0
Number of trees with hollows >5cm	0

PARSONS BRINCKERHOFF

Site ID:	Survey type:Quadrat 20m x 20m

Species	Cover	Strata	Species	Cover	Strata
1 Eucalyptus pilligaensis		(outside but adjacent on	41		
2 Trifolium arvensis.		2 both sides of road?)	42		
3 White Daisy.		3	43		
4 Cheilanthes seberi		2	44 → Adjacent to plot		
5 Golden everlasting		2	45		
6 Echium plantagineum		4	46 E. pilligaensis		
7 Vittadinia prostrata		2	47 Dodonaea viscosa subsp. angustissima		
8 Boerhavia dominii		2	48 Maireana microphylla.		
9 Native herb		2	49 Acacia decora		
10 Vulpia myuros.		2	50		
11 Saffron Thistle		3	51		
12 Calotis cuneifolia		1	52		
13 Panicum sp.		1	53		
14 Dichanthium sericium.		4	54		
15 Sida corrugata.		2	55		
16 Aristida sp.		3	56		
17 Bromus molliformis		2	57		
18 Digitaria brownii		1	58		
19 Convolvulus		1	59		
20 Schleropaena		1	60		
21 Enteropogon acicularis		2	61		
22 Calotis lappulacea.		2	62		
23 Parsonsia eucalyptophylla.		1	63		
24 Lepidium africanum		1	64		
25			65		
26			66		
27			67		
28			68		
29			69		
30			70		
31			71		
32			72		
33			73		
34			74		
35			75		
36			76		
37			77		
38			78		
39			79		
40			80		

Sp. Richness	Native	Exotic
Tree		
Shrub		
Grass (annual)		
Grass (perennial)		
Other (annual)		
Other (perennial)		

Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
Native perennial grass					
Native other grass					
Native forb & other					
Native shrub (<1m)					
Exotic grass					
Exotic forb & other					
Leaf & stick litter					
Rocks					
Bare ground					
Cryptogams					
Total	100	100	100	100	100

Cover abundance scale
Modified Braun-blanquet 6 scale

1	<5% - rare
2	<5% - common
3	5 - 25%
4	25 - 50%
5	50 - 75%
6	75 - 100%

Plot Disturbance			
Clearing (inc. logging):	✓	Fire damage:	✗
Cultivation (inc. pasture):	✗	Storm damage:	✗
Soil erosion:	✗	Trampling:	✗
Firewood collection:	✗	Flood damage:	✗
Stock grazing:	✗	Feral herbivores: rabbits	
		Other:	

PB PARSONS BRINCKERHOFF

BOGGABRI MODIFICATION

Survey Site Form - BioBanking		Site ID: Q16	Vegetation zone:
Date	26/11/14	Surveyor(s): TB	
Waypoint ID	Q16MOD	Photo numbers	
Coordinates	E 30.62249 / N 150.14442	Photo direction	N / E / S / W
Mapped Vegetation type:		Condition:	Low / Mod-good
Slope: Gentle, Mod, Steep	Aspect (degrees or cardinal): SW	Altitude: 265m	
Topography: crest, ridge, upper slope, mid slope, down slope, gully, flat, depression, watercourse, escarpment, terrace			
Geology: basalt, granite, conglomerate, sandstone, siltstone/mudstone, shale, alluvium, limestone, metamorphics, gravel, ?			
Soil type: sand, loam, clay, organic, gravel, skeletal, ?		Soil disturbance: intact, topsoil removed, fill	
Remnant / Old growth (uncleared): Yes / No / Undecided?		Orientation = 225°	
Vegetative Structure (formation) = Open Woodland		Ecologically Dominant Layer (EDL) - most biomass = Canopy	

Strata	Height interval	Median	Est. cover	Dominant Species & Dominance
E				
T1	6 - 18	12 m	0-30%	Eucalyptus blakelyi E-pop Eucalyptus albens Callitris glaucophylla
T2	3 - 5	4 m	<5 %	G. parvifolora
T3	-			
S1	1 - 3	2 m	0-10%	Acacia decora Acacia Dodonae viscosa ssp cuneata
S2	-			
G	0.1 - 1.2	0.6 m	60-80%	Aristida sp Cymbopogon refractus Austrostipa scabra

Tree height (clino) level ground or top of slope = distance from tree x (top% + bottom%)

Tree height (clino) from bottom of slope = distance from tree x (top% - bottom%)

Definitions

Dominance: d = dominant; c = co-dominant; s = subdominant; a = associated

Estimated cover: i = isolated (0.2-2%); v = very sparse (2-20%); s = sparse (20-50%); m = mid dense (50-80%); d = dense (80-100%)

Walker & Hopkins height classes: 1-3m = dwarf; 3-6m = low; 6-12m = mid-high; 12-20m = tall; 20-35m = very tall; >35m = extremely tall

W&H Crown cover: <0.2% = isolated trees or clumps; 0.2-20% = open woodland; 20-50% = woodland; 50-80% = open forest; 80-100% = closed forest

50m Transect	10 Points - Foliage Projective Cover		
Point	Canopy % (photos)	Midstorey %	Exotic %
5m	15	20	0
10m	35	0	
15m	20	25	
20m	0	15	
25m	15	0	
30m	40	0	
35m	20	5	
40m	20	0	
45m	10	0	
50m	10	0	
Total (sum / 10) =			0%

Larger 50 x 20m plot

Length of woody debris >10cm wide & >0.5m long: 3, 23	26m
Proportion of canopy sp. regeneration	1
Number of trees with hollows >5cm: IIII (One stag.)	6

Ground cover tally sheet, 50 points along 50m transect - every 1m record if plant intersects (hits) point

	Total (hits/50)
Native grass tally - IIII IIII IIII IIII IIII	48%
Native other (herb, fern, sedge, etc) tally - IIII II	14%
Native shrub tally - 1	2%
Exotic tally - NONE	0%

Leaf Litter or Bare ground. = IIII IIII IIII III 36%

PARSONS BRINCKERHOFF

Site ID: Q16	Survey type:Quadrat 20m x 20m

Species	Cover	Strata	Species	Cover	Strata
1 Eucalyptus albens	3		41		
2 Eucalyptus blakelyi	5		42		
3 Eucalyptus pop	2		43		
4 Callitris glaucophylla	4		44		
5 Acacia parvifiora	2		45		
6 Acacia decora	2		46		
7 Acacia dealbata	3		47		
8 Dodonaea viscosa	2		48		
9 Sida corrugata	1		49		
10 Sporobolus creber	1		50		
11 Eremophila debilis	1		51		
12 Lomandra longifolia	3		52		
13 Dichondra repens	3		53		
14 Cheilanthes sebeyi	3		54		
15 Austrostipa verticillata	1		55		
16 Glycine tabacina	2		56		
17 Austrostipa scabra	4		57		
18 Cyperus gracilis	2		58		
19 Tylophora linearis?	1		59		
20 Vittadinia	1		60		
21 Aristida sp	3		61		
22 Optunia stricta	2		62		
23 Cheilanthes distans	1		63		
24 Cymbopogon refractus	1		64		
25 Chloris ventricosa	3		65		
26 Dichanthium sericum	2		66		
27 Plantago debilis	2		67		
28 Euchiton sp	1		68		
29 Cyclospermum leptophyllum	1		69		
30 Amaggillas avensis	1		70		
31 Medicago polymorpha	1		71		
32 Malvaeana microphylla	1		72		
33 Enteropogon acicularis	1		73		
34 Slender thistle	1		74		
35 Arthropodium minus	1		75		
36 Lomandra multiflora	1		76		
37 Digitaria brevilumis	1		77		
38 Casuarina cristata ~~Glauca~~	1		78		
39 Elymus scaber	1		79		
40 Sida sp (N)	1		80		

Sp. Richness	Native	Exotic
Tree		
Shrub		
Grass (annual)		
Grass (perennial)		
Other (annual)		
Other (perennial)		

Ground layer % 1x1 plots	Q1	Q2	Q3	Q4	Q5
Native perennial grass					
Native other grass					
Native forb & other					
Native shrub (<1m)					
Exotic grass					
Exotic forb & other					
Leaf & stick litter					
Rocks					
Bare ground					
Cryptogams					
Total	100	100	100	100	100

Cover abundance scale
Modified Braun-blanquet 6 scale

1	<5% - rare
2	<5% - common
3	5 - 25%
4	25 - 50%
5	50 - 75%
6	75 - 100%

Plot Disturbance	
Clearing (inc. logging):	Fire damage:
Cultivation (inc. pasture):	Storm damage:
Soil erosion:	Trampling:
Firewood collection:	Flood damage:
Stock grazing:	Feral herbivores:
	Other:

Appendix G

Tylophora linearis targeted searches

Parsons Brinckerhoff Australia Pty Limited

ABN 80 078 004 798

Level 3 51-55 Bolton Street
Newcastle NSW 2300
PO Box 1162
Newcastle NSW 2300
Australia
Tel: +61 2 4929 8300
Fax: +61 2 4929 8382

www.pbworld.com

Certified to ISO 9001, ISO 14001, OHSAS 18001

Memo

Date 4 August 2014

To Chase Dingle

From Alex Cockerill

Ref 2117272B-RES-MEM- Rev1

Subject Targeted Tylophora linearis search BCEP Clearing area

1. Introduction

In January 2013 a previously unrecorded small population (approx. 6 plants) of the threatened species of plant, *Tylophora linearis* (listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act)) was recorded within the north west corner of the Leard State Forest, in an areas proposed for the development of the Maules Creek Coal Project. The previously nearest known population of *Tylophora linearis* was in the Pilliga State Forest approximately 20km to the west from the Leard State Forest.

Subsequent targeted surveys for this species as part of the pre clearing surveys works for the Maules Creek Coal Project between April and June 2014 identified further populations of *Tylophora linearis* within the Leard State Forest (Personal Comms Dan Martin June 2014).

To determine if *Tylophora linearis* population extent within the Leard State Forest includes areas of the Boggabri Coal Expansion Project (BCEP) exploration lease and Project Boundary, Parsons Brinckerhoff was engaged to undertake preliminary targeted field surveys. The surveys coincided with particularly optimal conditions for this species associated with good late summer/autumn rainfall and warm autumn conditions, which contributed to good regeneration of ground cover strata after generally dry conditions.

The following memo outlines the details of results from these surveys and following targeted surveys for *Tylophora linearis* (Tylophora) in areas proposed for clearing during the 2015 tree-clearing works.

1.1 Background information on *Tylophora linearis*

1.1.1 General description and distribution

The species was originally listed under the TSC Act and EPBC Act based on the best available knowledge of the plant at the time. It was assumed that the species had a total population of between 250-500 individuals and from data gathered from a population study which counted 500 shoots within 8 of the known 10 confirmed populations of the species and that it was facing a high risk of becoming extinct in NSW in the medium-term future (NSW Scientific Committee 2008).

Tylophora linearis populations occurs in ten known populations from Southern Queensland into Central NSW and as far south as Temora. This species is known to occur in several state forests including Goonoo, Pillaga West, Pillaga East, Bibblewindi, Cumbil Hiawatha and Eura State Forests. This species has also been recorded in Coolbaggie Nature Reserve, Goobang National Park and Beni State Conservation Area. Old records for the species are as far north as Crow Mountain near Barraba and near Glenmorgan in the western Darling Downs (Threatened Species Scientific Commitee 2008).

The distribution and abundance of this species has increased over recent years including the discovery of over 183,000 individuals having been recorded within the Pilliga Forest (Eco logical AUstralia 2012). Therefore, a review of the threatened status of this species maybe required in the future as more knowledge is gained.

1.1.2 Ecology

Not a great deal is known about the ecology of *Tylophora linearis*. *Tylophora linearis* is considered to be a perennial whose populations are likely to fluctuate on a year to year basis in response to a number of environmental factors such as drought, fire and disturbance (NSW Scientific Committee 2008). Based on expert advice it is assumed that the species suckers from beneath the ground to reproduce vegetatively, producing numerous shoots within small areas within proximity. It is also considered likely that the species does not produce flowers each year, as most in the Apocynaceae do not (NSW Scientific Committee 2008). These characteristics make it difficult to count entire populations of the species as many shoots may represent one individual plant.

The reproductive strategy for *Tylophora linearis* is not known. The species flowering cues are also unknown however it is suspected that the species flowering is related to rainfall (NSW Scientific Committee 2008). The species has been recorded to flower in November or May with fruiting occurring 2 to 3 months later (Office of Environment and Heritage 2014). It is also assumed that the species is pollinated by insects as in most of the species in the Apocynaceae family.

1.1.2.1 Ecology observations made during the current surveys

During the current *Tylophora linearis* targeted surveys (May/June 2014) it was observed that the species was responsive to wet conditions and mild autumn/winter seasons. Previous surveys conducted within the Project Boundary were completed as part the Environmental Assessment in spring 2009 (during dry and warm weather) in accordance with best practise survey guidelines and understanding of the time for the species seasonal requirements in spring (Royal Botanic Gardens 2014). Observations also identified that majority of the specimens appeared to be dropping all vegetative material back to their root stock, following the occurrence of late winter frosts in July. It is unlikely many of the specimens observed would be present during spring.

1.1.3 Known habitat

This species has been recorded associated with dry scrub, open forest and woodlands. Most frequency recorded associated with over storey trees such as *Melaleuca uncinata, Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, Acacia lineata* and *Myoporum sp*. This species has been recorded in EPBC Act listed communities of Brigalow (*Acacia harpophylla* dominant and co-dominant) and White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (Threatened Species Scientific Committee 2008). The large population within the Piliga SF occurred within woodland dominated by *Eucalyptus pilligaensis* and *Callitris glaucophylla* with an understorey of *Acacia hakeoides* (Schodde & Mason 1999).

1.1.3.1 Habitat within Leard State Forest and the Boggabri project boundary

During the current targeted surveys (within Leard SF) the species was recorded within the following vegetation types:

- Grassy understoreys with shrubby patches (predominantly *Beyeria viscosa*) and *Callitris glaucophylla* mid-storey strata were present at the site with a good representation of *Glycine clandestina and G. tabacina* present; with which *Tylophora linearis* could be confused at a quick glance. The site was associated with gently sloping loamy substrates adjacent to an ephemeral drainage line, but not within its flood zone;
- Callitris sp. dominated stand on mid slope with little understorey cover in close proximity (<20 m) to open paddocks to the north. The surrounding area up slope was searched with no success, but these areas were somewhat dominated by *Desmodium brachypodum* and gravelly substrates; and
- Grassy White Box community with loamy substrates.

2. Methods

The random meander surveys were conducted across the Leard SF and Boggabri Coal mining lease on 22nd May 2014 and 29th May 2014. The targeted parallel transects were conducted between June and July 2014 within the proposed 2014 pre-clearing area (refer Figure 1). Given the size of the survey area two methods were used to sample potential habitat for this species, including;

- random meander surveys and;
- targeted parallel transect surveys.

2.1 Random meander surveys – Leard State Forest

Random meander surveys were completed within Leard State Forest and within the proposed disturbance limit boundary, but did not occur within the proposed 2014 tree clearing area (Figure 1). Random meander surveys were completed in accordance with the technique described by Cropper (1993). This technique can be used to locate threatened species but is generally not used to quantify the number of threatened species. This methodology involves walking in a random meander throughout the study area in a range of different habitat types and searching for threatened species. Records are made of common and any rare species observed.

The random meander surveys consisted of an initial random sample of sites across the Leard State Forest and Boggabri Coal ML associated with a range of topographic and floristic and attributes. At each site, a Random meander in accordance with Cropper (1993) was conducted in areas of potential habitat for approximately 100 m from each site (Figure 1).A total of nineteen sites were surveyed outside of the current mine operations area and the BCEP exploration lease.

These surveys were conducted on 22nd May 2014 and 29th May 2014. The entirety of the mine lease area was not covered due to time constraints. Emphasis was placed upon becoming conversant with the micro-habitat associations of the plant and its growth form characteristics. Due to the absence of known records to the south and east of the central Leard State Forest ridgeline identified in the original surveys conducted on 22nd May 2014. The surveys conducted on the 29th May 2014 were commenced in the northeast of the forest on relatively flat lower slopes within grassy White Box woodland. A plant species with similar form to *Tylophora linearis*, *Parsonsia eucalyptophylla* was observed and identified in addition to the *Tylophora linearis* that was recorded at the survey sites.

2.2 Targeted parallel transect surveys

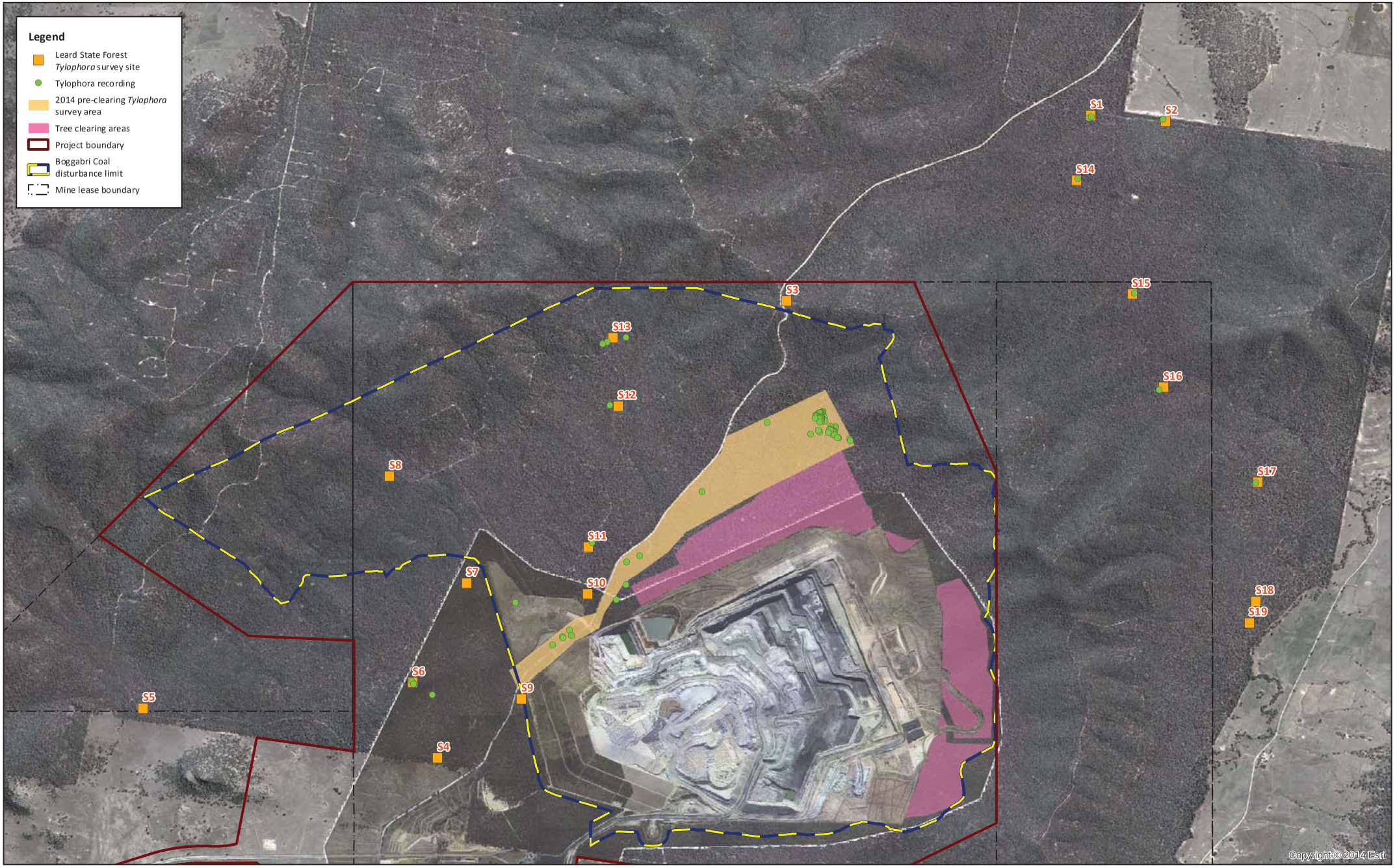
Two Parsons Brinckerhoff ecologists undertook targeted surveys for *Tylophora linearis* within the 2014 pre-clearing area (refer Figure 1). Parallel transects were completed in accordance with the methodology outlined in Cropper (1993). These surveys involved surveying across the 2014 pre-clearing area in parallel lines approximately 5 - 10 m apart and recording all *Tylophora linearis* observed. At times observations were made whilst bending down close to the ground to detect the species as whilst walking the species could not be detected due to the small size.

A point was recorded by a GPS and counts were undertaken within a 2 m radius of each point. Therefore one GPS point could indicate greater than one plant. This species has multiple aboveground stems within close proximity to each other; and as a precautionary measure each aboveground stem was counted as one plant, as it could not be determined if there were multiple plants or if the plants were connected by rhizomes.

Samples of potential *Tylophora linearis* collected during the survey periods outlined below were submitted to the Royal Botanic Gardens & Domain Trust – National Herbarium of New South Wales for confirmation of identifications made in the field. Confirmation of the identification of sample materials collected as *T. linearis* were received on 2 July 2014. A copy of this letter is provided in Attachment 2.

Limitations

The small size of the majority of plants recorded limited the speed at which the survey could be conducted, due to the difficulty of seeing individual plants (refer Attachment 1 Photo 1). Most plants were observed in fairly open ground-cover habitats, however this may not be a strong indicator of habitat preference, but a function of the difficulty of detecting plants where dense patches of *Desmodium brachypodum* occurred.



Data Source:
Imagery from Boggabri Coal (Lidar September 2013)
and Google Earth (acquired 09/12/2013)

Drawing No.: 2117317A_GIS_F096_A2
Date: 1/08/2014
Author: SuansriR
Reviewed:

0 125 250 500 750 1,000 M
Scale 1:30,000
Coordinate System: GCS GDA 1994
Scale correct when printed at A3 Landscape

Boggabri Mine

Figure 1
Targeted Survey Effort and *Tylophora linearis* locations

Idemitsu Boggabri Coal

\\APNTLFPS01\proj\I\Idemitsu_Aus_Resources\2117317A_ECO_Idemitsu_PM_secondment\10_GIS\Projects\Drawings_Figures_Sketches\2117317A_GIS_F096_A2.mxd

www.pb.com.au

PARSONS BRINCKERHOFF

3. Results

The following sections outline the results from both the random meander surveys and the targeted parallel transect surveys.

3.1 Random meander surveys

A total of 19 survey sites were searched for *Tylophora linearis.* Of these *Tylophora linearis* was recorded at ten of the surveys. These occurred both within the Boggabri Project Bound and within the wider Leard State Forest which will not be impacted upon by proposed future mining. Table 1 is a summary of the habitat type and which sites the species was recorded, whilst Figure 1 shows the locations of the *Tylophora linearis.*

Table 1 Summary of *Tylophora linearis* recorded during the random meander surveys

Site Reference	Habitat description	Records of *Tylophora linearis*
1	Grassy understoreys with shrubby patches (predominantly *Beyeria viscosa*) and *Callitris glaucophylla* mid-storey strata were present at the site with a good representation of *Glycine clandestina and G. tabacina* present; with which Tylophora linearis could be confused at a quick glance. The site was associated with gently sloping loamy substrates adjacent to an ephemeral drainage line, but not within its flood zone	Recorded at two locations
2	*Callitris* sp. dominated stand on mid slope with little understorey cover in close proximity (<20 m) to open paddocks to the north. The surrounding area up slope was searched with no success, but these areas were somewhat dominated by *Desmodium brachypodum* and gravelly substrates	Recorded at one location
3	Ridgeline habitat dominated by Narrow-leaved Ironbark and the ground-cover layer was dominated by *D. brachypodum*.	Not recorded
4	White Box dominated canopy within lowland toe slope associated with areas retained soil moisture, there were large patches of habitat containing ephemeral wetland inhabiting plants, such as Nardoo and *Juncus* spp.	Not recorded
5	White Box and Narrow-leaved Ironbark with grassy understories and patches of shrubs. Substrates were more loamy and elevated than Site 4.	Not recorded
6	Grassy White Box community with loamy substrates	Recorded at three locations.
7	Callitris sp. dominated stand on loamy soils and relatively open ground cover on a mid-slope	Not recorded
8	Upper slope located within a broad ridgeline setting with loamy substrates and Ironbark canopy.	Not recorded
9	Ironbark woodland dominated and occurred within a linear strip of vegetation between the mine spoil rehabilitation area and Leard Forest Road. The understorey had a high diversity of native species.	Not recorded
10	Site 10 occurs in a lower slope context with loamy soils, patches of shrubs and grassy ground-cover. The site looked suitable for Tylophora linearis apart from apparent dryness, but no plants were observed.	Not recorded

Site Reference	Habitat description	Records of *Tylophora linearis*
11	White Box Ironbark Grassy Woodland and occurred in a higher elevated position with gentle grades.	Recorded at one location
12	White Box Ironbark Grassy Woodland and occurred in an upslope location with mild grades and loamy substrates.	Recorded at one location
13	White Box Grassy Woodland and occurred on an upslope location with mild slopes, loamy substrates.	Recorded at three locations
14, 15, 16, 17	All sites occurred on relatively flat topography and dominated by White Box Grassy Woodland with loamy substrates	Recorded at all four sites
18, 19	Both sites were dominated by Grassy White Box Woodland habitat with loamy soils.	Not recorded

3.2 Results targeted parallel surveys

During the survey of the 2014 pre-clearing area some 845 individual plants were recorded across 71 separate plant patches (Figure 1). Densities and numbers of plants varied with the greatest patch number recorded being 110 plants within a 6 m x 6 m area. The lowest density within a patch was represented by single plants.

The highest densities of plants were associated with *Eucalyptus crebra* (Narrow-leaved Ironbark) on loamy soils with *Cassinia laevis* in the understorey and a generally sparse ground-cover layer strewn with leaf litter (refer Photo 3). The area of greatest density was on elevated slopes between 5 and 10 degrees with a westerly to southerly aspect. Plants were in varying condition with some patches exhibiting plants in green healthy condition, while others were reduced to leafless stems. A number of plant patches were showing red foliage and stems suggesting poor condition, possibly resulting from the effects of late winter frosts (refer Photo 2).

Plants were also found where *Eucalyptus albens* (White Box) dominated upper slope habitat and most habitat contained *Callitris glaucophylla* (White Cypress Pine) as a co-dominant species. *Acacia decora* was also regularly present in the understory and plants were also associated with understorey shrub layers dominated by *Beyeria viscosa* (refer Photo 5), and in one instance, *Dodonaea viscosa*.

No *Tylophora linearis* plants were observed in the south of the study area, where Narrow-leaved Ironbark communities were associated with gravelly substrates. However, where box occurred on loamy substrates in an adjacent flat land area *Tylophora linearis* was found to be present (refer Photo 4).

The survey appeared to support a general demarcation in habitat occupancy between south-western facing slopes and open grassy woodlands in flatter contexts.

4. Discussion

When results from this survey are compared with those conducted on 29 May 2014, it is considered possible that the relatively strong demarcation between high and low densities between south-western facing slopes and flatter grassy woodlands respectively, may not be as distinct as appears. *Tylophora linearis* was readily encountered in low slope open grassy woodland in May, although it was not easily encountered in July.

The high number of small plants (>70%) encountered during these surveys suggests that late summer rains in 2014 may have triggered a flush of regeneration. Due to a lack of follow up rain it may be that many small plants expired due to the drying influence of prevailing westerly winds. The significant numbers of small

plants exhibiting die-off during the July survey suggests that in more exposed habitats such processes may have taken out the majority of small plants. Persistent plants appeared to be in areas where moisture continued to be available, such as where upper and toe slopes are recharged by rainwater more efficiently. This appeared to be supported by a greater toe slope occurrence of plants throughout both surveys.

Plants were also very common under *Cassinia laevis*, in contrast to other shrubs. Key differences appeared to be the greater amount sunlight *Cassinia laevis* transmits to the ground, while still affording small plants protection from desiccating winds.

5. Conclusion and recommendations

Approximately 845 *Tylophora linearis* plants within 71 patches were observed during a within proposed 2014 clearing area. Together with surveys conducted across a broad area of Leard State Forest in late May 2014, it is likely that *Tylophora linearis* is widely distributed throughout the Leard SF, including areas of the Boggabri Coal Project Boundary. Due to the range of densities encountered during the survey periods it is likely however that *Tylophora linearis* distribution and densities are patchy, with the highest numbers in areas where moisture may be more reliable in contexts such as south-facing slopes, slope toes, upper slope verges and where shrubs provide cover from wind while still transmitting sunlight.

It is recommended that further systematic surveys for this species are required to provide more comprehensive understanding of the species population within the Leard SF and locality.

Future targeted surveys for *Tylophora linearis* in May are incorporated into the annual pre-clearing survey methodology for the Boggabri Coal Biodiversity Management Plan (BMP) and clearing protocol.

Yours sincerely

Alex Cockerill
Team Manager - Environment
Principal Ecologist
Attachment 1 Photos
Attachment 2 Letter for Royal Botanical Gardens

6. References

Eco logical Australia 2012, *North-east Pilliga Forest - Targeted threatened flora survey*, Newcastle.

NSW Scientific Committee 2008, *Tylophora linearis P.I.First (Apocynaceae) - Review of Current Information in NSW* Hurstville.

Office of Environment and Heritage 2014, *Tylophora linearis - profile*, viewed 2014 1/08/2014, <http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10815>.

Royal Botanic Gardens 2014, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, <http://plantnet.rbgsyd.nsw.gov.au/floraonline.htm>.

Schodde, R & Mason, IJ 1999, *Directory of Australian Birds: Passerines*, CSIRO, Melbourne.

Threatened Species Scientific Committee 2008, *Approved Conservation Advice for Tylophora linearis*, Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee 2008, *Approved Conservational Advice for Tylophora linearis* Canberra.

Attachment 1 - Photos

Photo 1 – Typical size of many of the small *Tylophora linearis* plants recorded.

Photo 2 – Old *Tylophora linearis* plant showing signs of wind or sun burning.

Photo 3 – Typical upper slope *Tylophora linearis* habitat with *Cassinia laevis* dominating the understorey.

Photo 4 – Typical flat land *Tylophora linearis* habitat dominated by *Eucalyptus albens* (White Box).

Photo 5 – Upper slope *Tylophora linearis* habitat dominated by *Beyeria viscosa* dominating the understorey.

PARSONS BRINCKERHOFF
A BALFOUR BEATTY COMPANY

Attachment 2 – Letter from Royal Botanical Gardens

The Royal
BOTANIC GARDENS
& Domain Trust

National Herbarium of New South Wales

Mr Allan RICHARDSON
Parsons Brinckerhoff
PO Box 1162
Newcastle, NSW 2300
AUSTRALIA

Enquiry No: 18545
Botanical.Is@rbgsyd.nsw.gov.au
Fax No: (02) 9251 1952
Ph No: (02) 9231 8111
Date: 27 June 2014

Dear Mr RICHARDSON,

Thank you for your enquiry of 05-Jun-14. We are happy to provide the following information:

Your ref: A905-RES-LTR-1 Rev1

Tylophora linearis conf. B.M. Wiecek 26 June 2016. Please record the colour of the sap (clear or milky) when collecting material from this family especially if there is no fertile material available.

There is no charge for this enquiry as we have very few collections of this taxon.

Thank you for your enquiry.

Yours sincerely

Barbara Wiecek
Identification Botanist
Botanical Information Service